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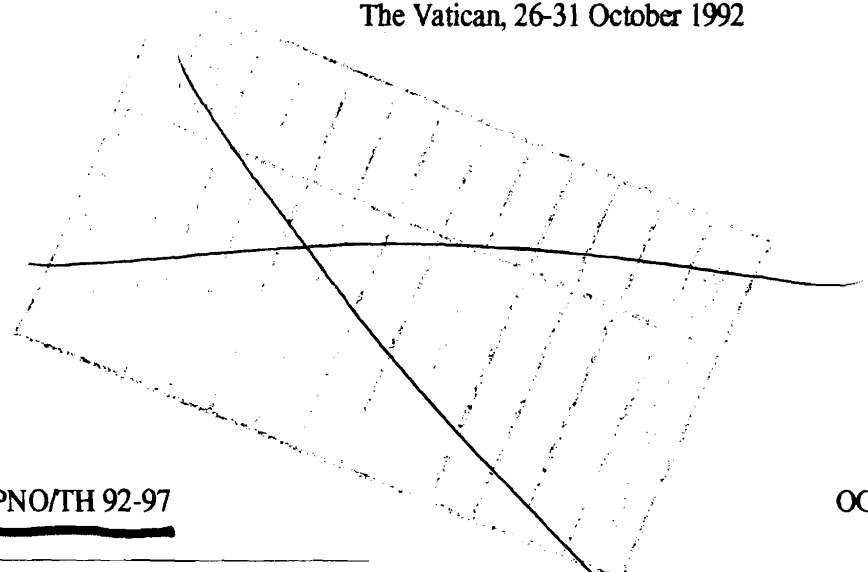
LEVELS OF COMPLEXITY AND LEVELS OF REALITY : NATURE AS TRANS-NATURE

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How can one study the emergence of complexity in hard sciences without a rigorous understanding of what we mean by "Nature" ? In fact, complexity and Nature are intimately interconnected. However, if complexity is widely recognized as a valuable notion, Nature finds itself in the paradoxical situation of being expelled from the realm of hard sciences.

Our century has invented all kinds of "deaths" and "ends" : the death of God, the death of man, the end of ideologies, the end of history. However, there is one death about which one speaks much less, probably from ignorance : the death of Nature. In my opinion, this death of Nature is in fact the origin of all the other deadly concepts we just invoked. In any case, the word Nature itself has disappeared from the scientific vocabulary. Of course, the layman and even the scientist (in his popular books or in his non-specialized talks) still uses this word, but with a confused and sentimental meaning, as reminiscence of magic. In our times, it is sufficient to pronounce the word "Nature" in order to be immediately qualified as "ecologist", which is, to say the least a huge oversimplification. How have we arrived at such a situation ?

Man constantly modifies his vision on Nature. The historians of science agree that in spite of what one might superficially believe, there is not just one Nature intersecting all historical periods (see, for example, Ref.1). What can there be in common between the Nature of so-called "primitive" man, the Nature of the Greeks, the Nature of the age of Galileo, of the Marquis de Sade, of Laplace or of Novalis ? Nothing besides the man himself. The vision of Nature in a given age depends on the leading imaginal at this age (for the meaning of the word "imaginal" see Ref. 2) which, in its turn, depends on many parameters : the degree of growth of sciences and techniques, social organization, art, religion etc.. The image of Nature once formed acts on all fields of knowledge. The passage from one vision to the other is not continuous : it occurs through sudden, radical, discontinuous breakdowns. Several contradictory visions can even coexist. The extraordinary diversity of visions of Nature clearly demonstrates why one cannot speak about *Nature*, but just about a certain nature in agreement with the imaginal of the given age.

It is important to underline that the privileged and even exclusive relation between Nature and science is just a recent prejudice, based on the scientific ideology of the XIXth century. The historic reality is much more complex. The image of Nature always had a multiple action : it influenced not only science but also art, religion, social life. This fact can explain a lot of strange

synchronisms. I just give two examples : the simultaneous occurrence, at the beginning of this century, of abstract art and of quantum mechanics and, at the end of this century, of the theory of the end of history and of unified theories in particle physics. The first example is relatively well-known while the second one has not been mentioned till now. The unified theories in physics have as their aim to formulate a complete approach, founded on a single interaction and which will predict everything we would like to know (hence the name "Theory of Everything" - TOE). It is obvious that if in future such a theory will be formulated, this would signify the end of physics, because there would be nothing else to look for. It is interesting to note that the ideas of the end of history and the end of physics arose simultaneously from our "end of century" imagination. Is that a simple and genuine coincidence ?

In spite of the abundant and fascinating diversity of images of Nature one can nevertheless distinguish three main stages : magic Nature, Nature as a machine and the death of Nature. Obviously I cannot enter into details of the description of these three stages. I can at most deal shortly with the question of the death of Nature, which is the starting point of my own research.

Magic thinking views Nature as a living organism, endowed with intelligence and consciousness. The fundamental postulate of magic thinking is that of universal relationship : Nature cannot be conceived without its relations with man. Everything is sign, trace, signature, symbol. Science, in the modern understanding of this word, is unnecessary.

At the other extremity, the mecanist thinking of the XVIIIth and especially of the XIXth century (which still dominates today) views Nature not as an organism but as a machine. It is sufficient to disassemble piece by piece this machine in order to completely possess it. The fundamental postulate of mecanist thinking is that Nature can be known and conquered by scientific methodology, defined in a completely independent way from what man really is. This triumphal vision of the "conquest of Nature" has its roots in the redoubtable technical and technological efficiency of this postulate. In spite of a persistent presumption, one can demonstrate that the origin of mecanist thinking is not the invention of the methodology of modern science by Galileo. The mecanist vision has in fact its origin in the thinking of Aristotle and Democritos. One can show that the new vision of Nature introduced by Aristotle - Nature constituted from elements

external to man - is intimately related to his binary logic (of identity, of non-contradiction and of the excluded middle). As to the atomist doctrine, it is well-known that, at that period of time, it had no scientific foundation. This doctrine arose from the visceral fear of a vacuum. The process of decomposing the substance had to stop somewhere in order that the universe and life should not vanish for ever into the vacuum. The "atoms", in the different meanings of this word, became later the fundamental building blocks of matter (quarks, leptons, etc.). One hoped that, starting from these building blocks, one could disentangle completely the code of the universe - machine of the contemporary neomecanist ideology. Hence, due to Aristotle, Democritos and their disciples everything was in place to engender the Nature-machine. However the vision of the founding fathers of modern science is, paradoxically, infinitely more complex, by a subtle mixture of magic, religious and scientific features (see, for example, Ref.3). Nevertheless it is the mecanist vision which was predominant, at least till the beginning of our century, for reasons which are too complicated to be made explicit here.

Some scientists, artists or philosophers felt fully the deadly danger of mecanist thinking. Thus appeared the antagonist current of the German *Naturphilosophie* (Ref.4). One can quote important names like Schelling, Schlegel, Novalis, Ritter, without forgetting Goethe. The *Naturphilosophie* has its roots in the visionary work of Jakob Boehme. From the point of view of our times the *Naturphilosophie* can be considered as a grotesque deformation and a crude manipulation of science, as a dead-end in a ridiculous attempt of a return to magic thinking and to living Nature. However, how can one hide the fact that this Philosophy of Nature generated at least two major scientific discoveries : the cellular theory and electromagnetism (Oersted, 1820) ? Perhaps the true fault of *Naturphilosophie* was to be born two centuries in advance, before the quantum, technological and informational revolution.

The logical outcome of the mecanist vision, which completely eliminated the *Naturphilosophie*, is the death of Nature, the vanishing of the concept of Nature from the scientific framework. The Nature - machine, with or without a watch-maker God, falls into a collection of attendant parts. From that moment, there is no more need of a coherent whole, of a living organism or even of a machine, which kept, after all, the musty smell of finalism. Nature is dead. The complexity remains. An astonishing complexity which penetrates all the domains of knowledge,

from the infinitely small to the infinitely large. This complexity is perceived as being accidental, man himself being considered as an accident of complexity. A joyful vision, which bring us to our own world today.

We arrive therefore at an etymological paradox. In fact "living Nature" is a pleonasm, because the word "Nature" is intimately related to that of "birth". I quote Robert Lenoble : "... the latin word *natura* is attached to the root *nasci* (to be born, to come into the world) and signifies first : the action of giving birth, growing ... ; ... *natura* signifies also the organs of engendering, and first of all the feminine organs. We can note that the form *natio-onis* has also, as primordial meaning, birth ; as a consequent meaning, by personification and deification, it signifies the nation or one's native land, one's fatheland" (see Ref. 1, pp. 229-230). In the light of this etymological considerations, what could be the fate of a civilization that accepts the death of Nature ?

This long introduction was necessary in order to situate my own approach.

First I have to make a methodological remark. I do not pretend to propose a unique and "scientific" model of Nature even if I will be continuously guided by quantum physics. In fact all visions of Nature in the past were many-sided or, in order to use a contemporary word, transdisciplinary (see Ref. 5). The equation hard science = Nature was just a phantasm - the scientific phantasm. My approach will be therefore resolutely transdisciplinary. Hence, as a specialist in a well-defined discipline (quantum physics), I take a non-negligible risk : to go out of my discipline by presenting to you a rough sketch of a long-term transdisciplinary research project which of course will involve in the future a large number of eminent specialists. However, I know that I can take this risk in this high place. The true risk is elsewhere, in the vertiginous jump towards the unknown, represented by the metamorphosis of the death of Nature into the rebirth of Nature.

My starting point is an experience I lived as a practician of quantum physics, namely noticing in my everyday life as a physicist the incompatibility between the results of quantum physics and cosmology and the neo-reductionistic attitude which concentrates exclusively upon the fundamental building blocks of matter and upon the four known physical interactions. According to this neo-reductionistic attitude every appeal to Nature is unnecessary and is even meaningless.

My aim is to formulate a definition of Nature in agreement with modern scientific knowledge. The two pillars of my definition of Nature are : the notion of *levels of Reality* and *the logic of the included middle*.

By the word *reality* I mean everything which *resists* to our representations, descriptions, images. I mean by the word *level* a group of systems which is invariant under the action of certain laws. Finally I say that two *levels of Reality* are different if the passage from one to the other involves a breakdown of laws and a breakdown of fundamental concepts (such as causality, for example). The obvious example is that of the couple microphysical level - macrophysical level (see Ref. 6). The breakdown between classical physics and quantum physics is really radical. This is why the interpretation of quantum phenomena in macrophysical language generates an endless series of paradoxes. Nobody has succeeded up to now to find a mathematical formalism allowing the rigorous passage from the quantum world to our macroscopic world. Nevertheless these two worlds coexist. The proof : our own existence.

The second aspect concerns logic. Modern science was born by a methodological breakdown, but not necessarily by a breakdown of logic, as compared with the previous science. This explains why it generated both classical and quantum physics. However, the quantum revolution concerns first of all the problem of logic to be used. More precisely, the quantum revolution consists in the possible emergence of the included middle thanks to the scientific methodology.

Quantum mechanics and, later, quantum physics caused to suddenly appear couples of mutually exclusive contradictories (A and \bar{A} , where \bar{A} denotes not- A). I give just few examples : wave *and* particle, continuity *and* discontinuity, separability *and* non-separability, local causality *and* global causality, autonomy *and* constraint, visible *and* invisible, manifested *and* non-manifested, symmetry *and* symmetry breaking, reversibility *and* irreversibility of time. I discussed several of these couples in Ref. 6.

There are two possible solutions to this astonishing situation : either one refuses to allow a status of reality to the quantum scale (which is equivalent to asserting, once again, the death of Nature) or one has to change the kind of logic which is used (as was proposed towards 1930-1940 by Alfred Korzybski and Stéphane Lupasco). It is this second solution that I adopt here.

The fundamental logical change concerns the third axiom of the binary aristotelian logic - the axiom of the excluded middle : there is not a third term T (T from "third" included) which is at the same time A and \bar{A} . One has to replace this axiom by the axiom of the included middle - "there is a third term T which is at the same time A and \bar{A} " - formulation which might seem paradoxical but which becomes completely transparent if one takes into account the first notion I discussed - levels of Reality. The three terms of the new logic - A , \bar{A} , T - and their associated dynamics could be represented by a triangle, one of the vertices being located on one given level of Reality and the other two vertices - at another level of Reality (see Fig. 1). If one considers just one level of Reality everything appears as a fight between two contradictory elements (say, wave and particle). The third dynamism, that of the T -state, occurs on a different level of Reality, from where that which seems separated (wave and particle) is in fact unified (quanton) and that which seems to be contradictory is perceived as non-contradictory.

In spite of the distrust motivated by the fear of a return to magic thinking, the logic of the included middle was seriously studied, at least in France, by thinkers like Stéphane Lupasco, who proposed a possible formalization of this logic (Ref. 7), Edgar Morin (Ref. 8), Jean-Jacques Wunenburger (Ref. 9), Gilbert Durand (Ref. 10) and Antoine Faivre (Ref. 11). I, myself, in collaboration with Thierry Magnin, tried recently to show that the method of analysis of complexity used by modern scientists, in relation to the logic of the included middle, turns out to be fruitful also for the theologians, without any confusion or concordism (Ref. 12). Interesting research on this approach has been carried out by Xavier Sallantin (Ref. 13).

In any case, the logic of the included middle has revealed itself as the ideal tool for the analysis of complexity. I would like to quote in this context the epistemology of complexity elaborated over the years by Edgar Morin, which gives us a framework for the study of a large variety of phenomena. Edgar Morin rightly underlines that there is no question about abolishing the logic of the excluded middle but just about recognizing it as valid only in simple cases : "The field of the excluded middle is valid for simple cases... One cannot abolish the excluded middle ; one has to inflect it in terms of complexity... The dialogics is precisely the included middle, two contrary propositions which are necessarily linked and opposed in the same time" (Ref. 8, pp. 200-201). We can also note that the logic of the included middle is implicit in systems theory

thinking (Refs. 14-15). In my opinion, the notion of "levels of Reality" formulated by us several years ago (Ref. 6) will strengthen in the future the empirical scientific foundation of the logic of the included middle.

There are many other landmarks for a new Philosophy of Nature (which is radically different from, but complementary to natural philosophy) : quantum discontinuity, indeterminism, constructive random processes, chaos creating order, quantum non-separability, bootstrap dynamics, the unification of all physical interactions, supplementary space dimensions, big-bang dynamics, the anthropic principle, the quantum vacuum. To study the implications of all these ideas and phenomena I would need not a conference but a book. I can at most shortly formulate several questions. From where comes the non-separability, when everything in our macrophysical world seems to be separated ? From where comes the bewildering coherence between the infinitely small and the infinitely large ? Why does the evolution of the universe seem to require, for its own existence and for the engendering of life, extremely narrow windows for the fundamental physical parameters ? What is the "reality" of the supplementary space dimensions ? What is the meaning of a single and unique physical interaction, unified at an energy which will never be reached in our accelerators ? Such questions, solidly rooted in scientific ground, can guide our steps in our search for a new definition of Nature.

I take as a starting point *two axioms : the existence of several levels of Reality (their number being finite or infinite) and the universal action of the logic of the included middle* . These two axioms have, as we have seen, a certain experimental scientific basis.

These axioms lead me to introduce first a ternary which depends on a certain level of Reality (NR), considered as a reference frame :

(creaturely Nature, intermediate Nature, Supernature).

The obvious reference frame to be chosen is of course the level of Reality to which we belong - the macrophysical level (NR₀).

The *creaturely Nature* is defined by the cosmic processes taken in their entirety, as they appear to us without the intervention of human activity : man, animals, plants, earth, planets, galaxies etc. This aspect of Nature reveals itself at the macrophysical level NR₀.

The *intermediate Nature* can be also explored by experiments, but the laws governing the corresponding levels of Reality (NR_1, NR_2, \dots ; NR_{-1}, NR_{-2}, \dots - see Fig. 2) are radically different from those governing the macrophysical level NR_0 . One can give as examples the quantum level (NR_{-1}) and techno-Nature (NR_1). I have already described elsewhere the quantum level (Ref. 6). Here I would like to explain why I consider techno-Nature as a different level of Reality, belonging to the intermediate Nature.

I mean by *techno-Nature* the material external projection of the mind, generating results which are not produced by the so-called "natural" cosmic processes. These results have nevertheless their own self-movement, beginning with the system of highways in the United States and finishing with the troubling virtual Reality. The techno-Nature seems to obey a maximality principle : everything which can be made will be made. This principle is a particular case of a general maximality principle which seems to govern Nature : *everything which can happen, according to the existing laws, will happen*. The virtual Reality (which, for philosophical terminological reasons I would like to call "potential Reality") has a central place in techno-Nature, because it shows that abstraction is a component of Reality, a phenomenon already present in the quantum world.

Finally, *Supernature* concerns all levels of Reality inaccessible to scientific experiments. Therefore, Supernature is not really "supernatural", because it simply translates a double limitation: the limitation of our sense organs and of their extensions and the limitation of the galilean scientific methodology.

In Fig. 2, I represented a closed and oriented loop intersecting all levels of Reality. It signifies the existence of an informational flux crossing these levels. The closing of the loop is the symbol of a self-consistent bootstrap-type dynamics : *each level of Reality is what it is because all other levels of Reality exist at the same time*. The orientation of the loop signifies that the passage of the informational flux is operating in a coherent manner, either by loss or by gain of information. This orientation could be an interesting way of understanding and even of leading to a mathematical formulation of an outstanding scientific contemporary puzzle : that of time irreversibility. In our representation the irreversibility is the result of a loss of information, the passage from one level of Reality to another being necessarily associated with a modification of

information. For example, the passage from the microphysical level NR_{-1} to the macrophysical level NR_0 occurs by a loss of information. The reversibility is present at the level NR_{-1} (it is governed by the theorem of CPT invariance), while the irreversibility occurs at the level NR_0 .

In our representation, the levels of Reality are considered as energy levels, the passage from one level to another being, by definition, discontinuous. The energy is a unification concept : it appears in a coded form as information or in a concrete form as substance.

One can say that our representation of Nature corresponds to a *fibering* (Ref. 16), leading to a *Gödel-like* structure of our knowledge.

We can define a local causality, concerning a well-defined NR and a global causality, concerning two, several or all levels of Reality. The global causality must not be confused with ordinary finality. The movement springs from the interaction between the local causality and the global causality. The "objectivity" depends on the considered NR. In the presence of several NR the binary partition (subject, object) has to be replaced by the ternary (subject, object, included middle). We are therefore able to describe the notion of *contradiction* : it signifies the ceaseless change from one quality of energy to another. The definition of *meaning* , as proposed by the philosopher Raymond Ledrut - the contradictory relationship between a presence and an absence - is integrated into our approach (Ref. 17).

These few considerations allow us to introduce another ternary of *the living Nature* :
(Nature, anti-Nature, trans-Nature).

This ternary does not depend on a particular level of Reality, i.e. is *invariant* as regards all levels of Reality.

Nature is the entirety of phenomena which appear to us as results of cosmic processes or of the mind. One can characterize it by increasing entropy, by a tendency to fragmentation, by a depletion of energy (see Fig. 3). *For us* , this Nature is the place of involution and death. Going against this movement signifies to go "against Nature", which does not yet mean the conversion to anti-Nature. Using the terminology of Lupasco, Nature can be defined as *the actualization of all the actualizations* .

It is therefore clear what *anti-Nature* means : the decreasing of entropy, the tendency towards unity in diversity, the growing in density of energy. Anti-Nature is therefore the place of

evolution and life. Using the terminology of Lupasco, one can assert that anti-Nature is *the actualization of all the potentializations* .

Going from Nature to anti-Nature involves a discontinuity. This discontinuity forces us to introduce a third term - trans-Nature.

Trans-Nature is both what crosses and what is beyond Nature and anti-Nature. Trans-Nature is *the actualization of all T-states and of affectivity*. In particular, trans-Nature engenders *transculture* . Transculture appears as the incarnation of trans-Nature, as the experience of life and of imaginal of all nations of the world. Trans-Nature induces a true *trans-presence* at all levels of Reality.

Living Nature is therefore defined by the two ternaries discussed above. These two ternaries allow me to consider, as concrete application to our life a multitude of ternaries such as :

- (energy, movement, relation)
- (unification, unity, uniqueness)
- (levels of Reality, levels of knowing, levels of understanding)
- (meaning, anti-meaning, nonsense)
- (hard sciences, soft sciences, sciences of the included middle)
- (Science, Art, Religion)
- (techno-Nature, technoculture, technoscience)
- (humanism, technohumanism, transhumanism)
- (subject, object, included middle).

The last ternary (subject, object, included middle) is the generator not of post-modernity but of what one can call *cosmodernity* . I have no time to comment on all these ternaries. I am convinced that they represent tracks full of promise for transdisciplinary research. I would like to add that the confrontation of the new definition of Nature with the vision of Nature of other thinkers of threefoldness will turn out to be extremely rich. I think especially of Charles Sanders Peirce (Ref. 18), of his theory of three universes and of his ternary of fundamental categories (Firstness, Secondness, Thirdness).

It is also important to note that our definition of Nature is perfectly compatible with the three theses concerning the laws of Nature as formulated by Walter Thirring (Ref. 19) : "(i) The

laws of any lower level in the pyramid mentioned above are not completely determined by the laws of the upper level though they do not contradict them. However, what looks like fundamental fact at some level may seem purely accidental when looked at from the upper level; (ii) The laws of a lower level depend more on the circumstances they refer to, than on the laws above. However, they may need the latter to resolve some internal ambiguities ; (iii) The hierarchy of laws has evolved together with the evolution of the universe. The newly created laws did not exist at the beginning as laws but only as possibilities." In my opinion, the logic of the included middle offers a rational foundation for these three theses.

Before concluding, I would like to say few words precisely on the logic which governs the interaction of the levels of Reality.

At a well-defined level of Reality (say, NR_0) aristotelian logic is valid. In particular the *identity principle* (A is A) is true at this level (see Fig. 4). The influence of another level of Reality, revealed by scientific theory and experiment, manifests itself, at the considered level, by contradictory, mutually exclusive phenomena. Taking into account the quantum paradoxes, Alfred Korzybski introduced in 1933 (Ref. 20) a *contradiction principle* (A is \bar{A}). The abrupt formulation of this principle explains why it inspired science-fiction authors. However, as we have seen, there is a rational solution of quantum paradoxes : the adoption of the logic of the included middle and the introduction of the notion of levels of Reality. The principle of contradiction appears as the projection of a threefold dynamics on a given level of Reality.

Two contiguous levels are connected by the logic of the included middle, namely the T-state present at a certain level is linked into a couple of contradictories (A, \bar{A}) of the immediately contiguous level. The iterative action of the logic of the included middle, represented by the triangulation shown in Fig. 4, implies the imbrication of levels and the coherence of Nature as a whole. A particular role is played by the topological envelope of all T-states, represented by the closed loop in Fig. 4. This envelope represents the action of a new principle, having its root in trans-Nature. I call it *the principle of infinite identity*, because there is a perpetual, iterative and cyclical transmutation of a T-state into a couple of contradictories (A, \bar{A}). The principle of infinite identity embodies both the aristotelian identity principle and the principle of contradiction. This new principle brings an interesting light to the problem of complexity : the terrifying complexity of

a single level of Reality can mean the harmonious simplicity of another level of Reality. *The complexity appears therefore as a measure of the distance between man and Nature* . It is interesting to note that "level" and "complexity" are etymologically interconnected : the word "complex" comes from the latin word "complecti", which means "to embrace, to contain, to grasp an entirety of things."

For example, according to superstring theory in particle physics, physical interactions appear to be very simple and unified as a result of a few general principles, if they are depicted in a multidimensional space-time and at an ultra-high energy. Complexity arises at the moment of the passage to our world, which is inevitably characterized by only four dimensions and by the fact that considerably lower energies are available. Unified theories are very powerful on the level of general principles but they are rather poor in describing the complexity of our own level (see also Ref. 19). This seems to be one of the aspects of the Gödel-like structure of Nature and knowledge.

Let me stress the probable role of the nature of space-time in the definition of a level of Reality and thus in the understanding of the nature of complexity.

Our space-time continuum of four dimensions is not the only one conceivable. In certain physical theories, it seems more like an approximation, like a "section" of a space-time a good deal richer in terms of possible phenomena. The supplementary dimensions are not the result of simple intellectual speculation. On one hand, these dimensions are necessary to assure the self-consistency of the theory and the elimination of certain undesirable aspects. On the other hand, they do not have a purely formal character - they have physical consequences on our own scale. For example, according to certain cosmological theories, if the universe was associated with a multidimensional space-time at the "beginning" of the Big Bang, the supplementary dimensions will remain hidden and unobservable forever, but their vestiges would be precisely the known physical interactions. In generalizing the example given by particle physics, it is not absurd to think that certain levels of Reality correspond to a specific space-time distinct from that of our own level. Complexity itself will depend on the nature of the space-time. The metaphysical relevance of the supplementary space-time dimensions was already stressed by Abdus Salam (Ref. 21).

The principle of the infinite identity allows us to approach the difficult problem of *Reason*. Every level of Reality corresponds to a certain *degree of Reason* . The Reason is the

entirety of the degrees of Reason. The imbrication and the coherence of the degrees of Reason translates the imbrication and the coherence of the levels of Reality. One can distinguish "degree of Reason" from "the small reason". The small reason results from the contraction of all levels of Reality to just one single level of Reality. The small reason is therefore, at least in the framework of our model, a delirious, irrational and even dangerous reason. Many historical events could be explained as results of the action of the small reason.

Our notion of *degrees of Reason* has to be confronted with the notion of *degrés du savoir* introduced by Jacques Maritain (Ref. 22). In any case we can distinguish *reason of knowing* from *reason of understanding* : the reason of knowing settles in us merely as information, whereas the reason of understanding fuses organically with a man's being. It is the reason of understanding in one form or another which could help in developing the dialogue between science and meaning (see, for example, Ref. 23).

The definition of Nature I propose does not signify a return to magic thinking or mecanist thinking, because it is founded on the double contradictory assertion : 1) man can study Nature via science ; 2) Nature cannot be conceived as independent of man.

I am fully conscious that my model can be criticized, ameliorated and even disputed. However I think that the time has come for beginning a true transdisciplinary research, which requires a new definition of Nature. As René Berger says "... nothing is more urgent than to save our imagination from a total surrender, by breathing into it the meaning of respect and wonder" (Ref. 24).

In conclusion, I have tried, by my definition of Nature, to bring a contribution to the methodological foundations of transdisciplinarity. Transdisciplinarity, without being a new discipline, appears as *the science of living Nature* . I tried to show how the foundation of a world without foundations is precisely the absence of foundations. Knowledge appears as a common birth of man and Nature. The famous "conquest of Nature" leads to the vanishing of our own nature. A true cooperation between man and Nature has to replace the murderous folly of "conquest of Nature". An evolutive future seems to be intimately linked to the formulation of a new Philosophy of Nature, founded on Nature as trans-Nature.

Galileo had the vision of Nature as a text in mathematical language : it is sufficient to puzzle out and read it. This vision, which traversed several centuries, turned out to be of a redoubtable efficiency. However we know today that the situation is much more complex. Nature appears to be more as a pre-text : the book of Nature has not to be read but written.

A great physicist like Steven Weinberg does not hesitate to pose the problem of the *absurdity* of the universe : "... It is even harder to realize that this present universe has evolved from an unspeakably unfamiliar early condition, and faces a future extinction of endless cold or intolerable heat. The more the universe seems comprehensible, the more it also seems pointless" (Ref. 25). For his part, Edgar Morin raises the question of the tragic character of the universe : "Isn't the growing complexity only a detour in the generalized disaster of a universe that is intrinsically and definitively tragic ?" (Ref. 26).

Is the universe absurd ? Tragic ? Maybe, if one ignores the role of life, of man and his consciousness, of living Nature.

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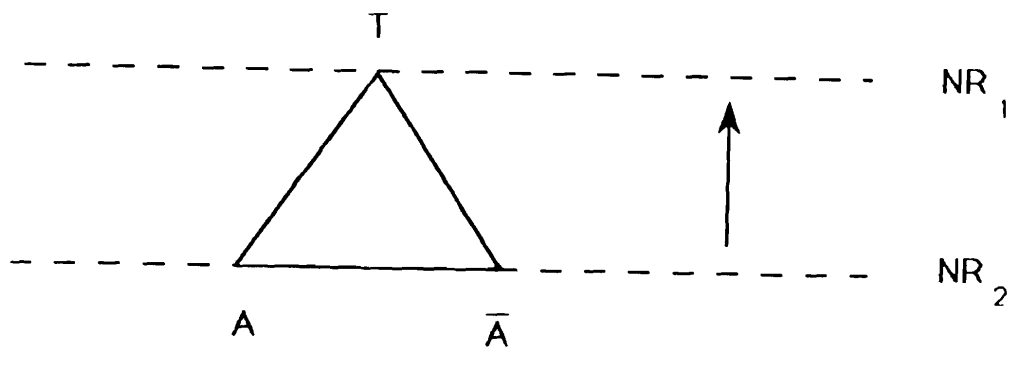


Fig. 1: Schematic representation of the action of the logic of the included middle. NR_1 and NR_2 denote two different levels of Reality.

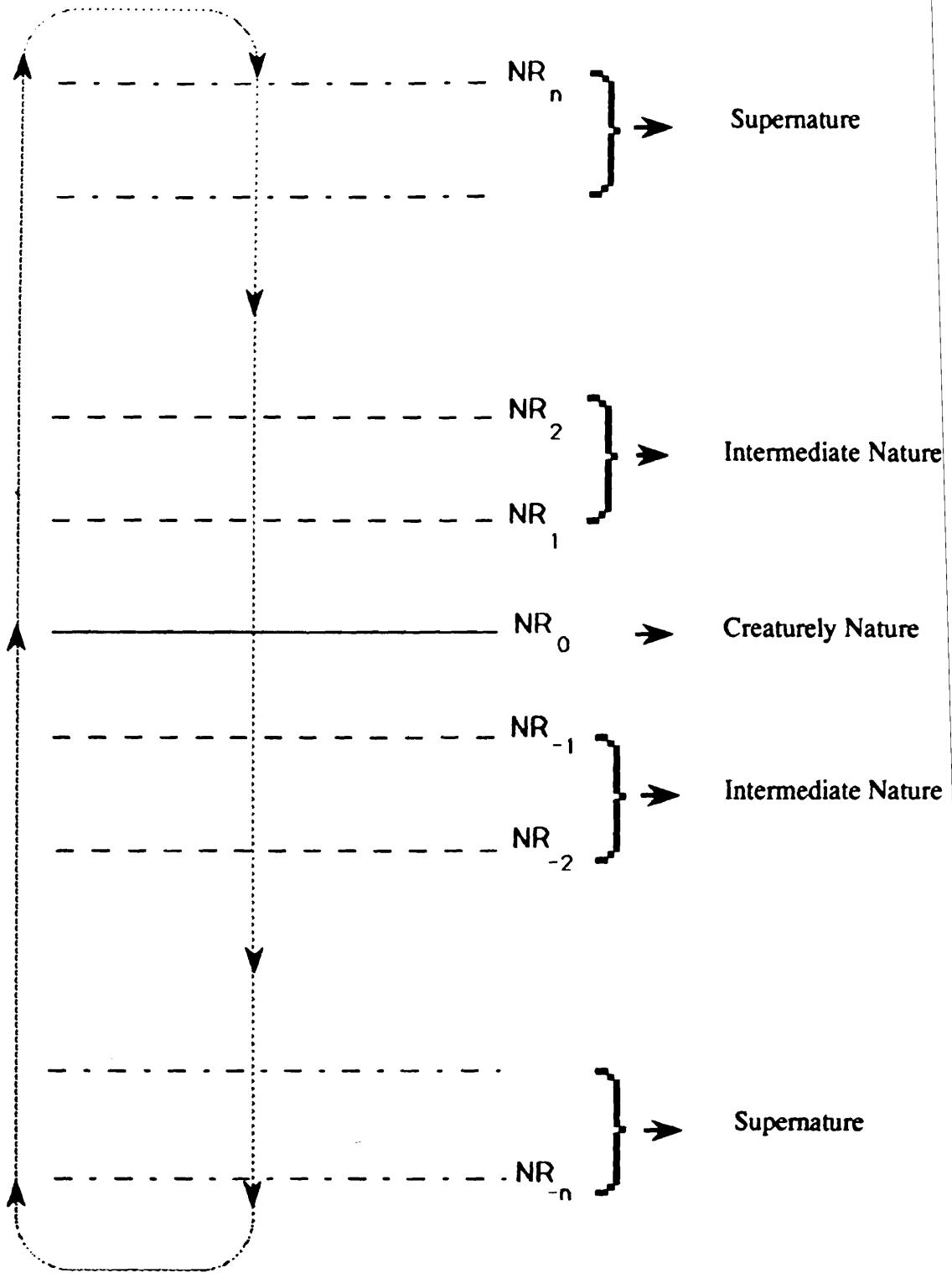


Fig. 2: Schematic representation of the ternary (creaturely Nature, intermediate Nature, Supernature).

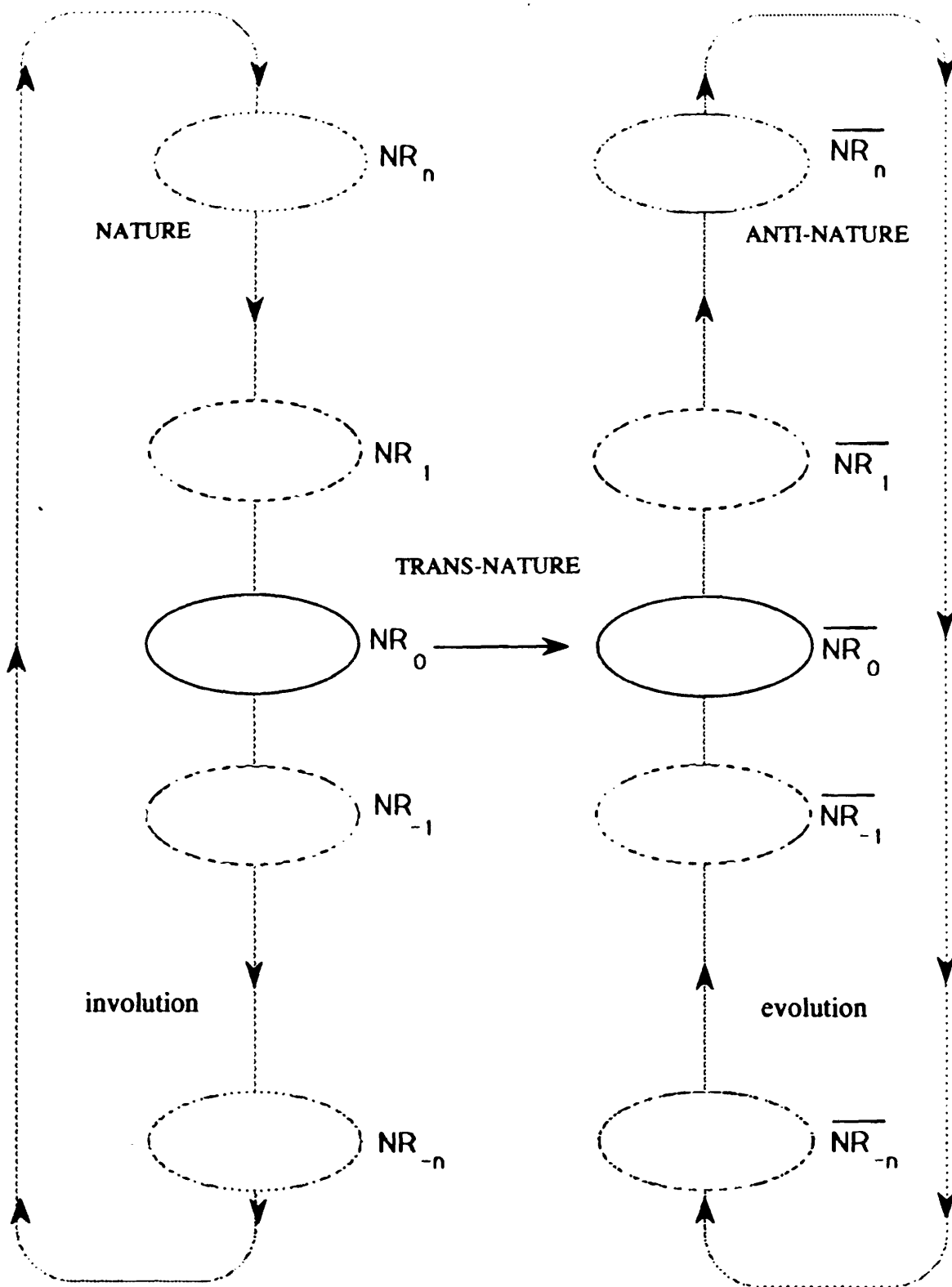


Fig. 3: The ternary of the living Nature : (Nature, anti-Nature, trans-Nature).

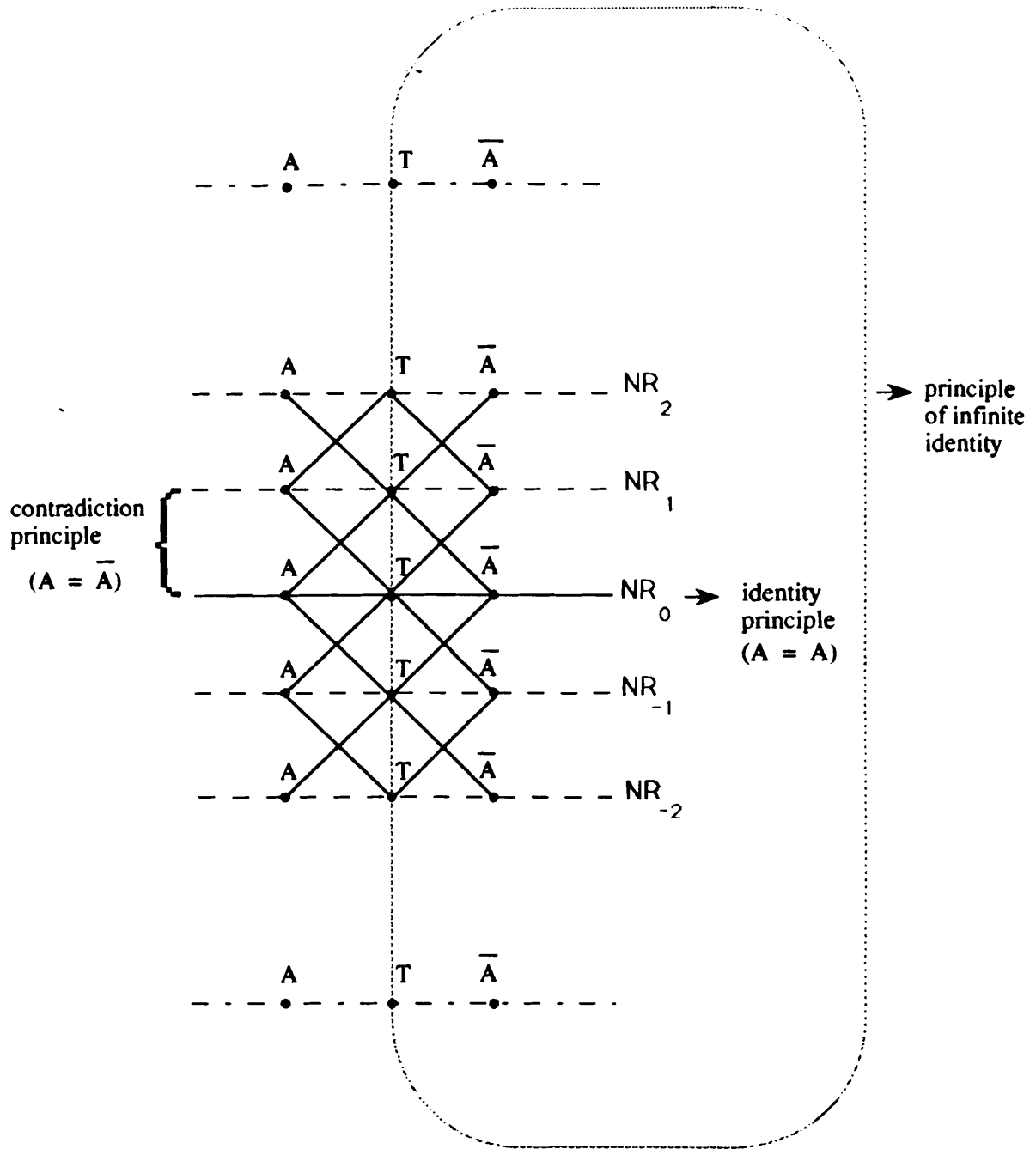


Fig. 4: Schematic representation of the action of the principle of infinite identity.