ON MIDDLES AND THIRDS

***Keywords*:** actualization; contradiction; difference; dynamic; inclusion; information; lemma; logic; middle; morality; non-contradiction; potentialization; society; third

1. Introduction. The Excluded Middle

The Third Axiom of Aristotle has served logic, science and common sense for over two millennia: there is no term C that is at the same time A and B, its contraries or opposites. The advent of quantum mechanics changed the picture, giving scientific weight to the concept of intermediate or included states, physically or conceptually "between" two others, partially or completely. Wave-particle duality is now an accepted principle in physics, and echoes of the principle can be found in, above all, Asian cosmogonies. Notwithstanding, the default logics in both Eastern and Western standard thought has been bivalent or binary, propositional logics of their mathematical equivalents. So-called fuzzy logics, like most others still are dependent on fulfilling binary criteria of truth and falsity. These logics underlie and are essentially equivalent to standard set and category theory: 1) sets and members of sets are independent of one another and 2) categories are defined as instantiating the properties of exclusivity and exhaustivity.

The purpose of this paper is to revisit the concepts of a third in logic and philosophy that have existed since antiquity, widely separated in time and space, but expressing what I consider a higher level of understanding, without going outside the boundaries of science.

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2. Contents of Paper

The subjects I will cover and the major sources I will draw on are following:

- **The Law of the Middle**
  - The South-Indian Nagarjuna, ca. 300 C.E. [1]
  - The Japanese Yamauchi Tokuryu (1890 -1982)
    Logos et Lemme, 2020 [2]
- **The Logic of the Included Middle**
  - The Franco-Romanian Stéphane Lupasco (1900 – 1988) [3]
    The Logic of Energy, 1951 [4]
- **True Contradictions**
  - The English Graham Priest, (1948 -
    Beyond the Limits of Thought, 2002 (1995) [5]
- **The Logic of the Third**
  - The Austrian Wolfgang Hofkirchner (1953 -)
    Emergent Information, 2013 [6]
    The Logic of the Third, 2022 [7]

Since 1998, I have worked with the theoretical physicist Basarab Nicolescu, a friend and continuator of Lupasco in the field of Transdisciplinarity. Lupasco and Nicolescu, and others founded the International Center for Transdisciplinary Studies in Paris in 1984 [8, 9]. My task has been to make the work of Lupasco accessible in English. I have designated my update and extension of Lupasco's work as "Logic in Reality" (LIR) [3]. I start with some general comments and overview of LIR since it will be the least familiar to most readers.

2. LOGIC IN REALITY (LIR)

2.1 The Fundamental Principle of Dynamic Opposition:

The major components of LIR are its fundamental Principle of Dynamic Opposition (PDO) and its axioms based on it. The principle states that complex phenomena continually but non-cyclically (that is, without perfect circularity – returning to their starting point) move between states of primarily actualization to primarily potentialization of themselves and their opposites or 'contradictions', and *vice versa* alternately and reciprocally, without going to the ideal limits of 0 and 1. The Principle of Dynamic Opposition (PDO) implies a real physical as well as cognitive linguistic antagonism, including of two theories or ideas. The PDO is a principle of change and movement. [3]

2.2 Classical Axioms

For comparison, I give one version of the classical axioms:

CL1: *Identity*: A is (is identical with) A (or B): A = A or A = B.
CL2: *Non-Contradiction*: A is not non-A (not (A and non-A)). Arguments that lead to contradiction are *prima facie* false (LNC).
CL3: *Excluded Middle*: there exists no third term T that is at the same time A and non-A (A or non-A) (LEM).

The corresponding Lupascian formulations, in part restatements of the PDO, are the following:

LIR1: *(Physical) Non-Identity*: There is no A at a given time that is identical to A at another time. This formulation is essentially that of Leibniz.
LIR2: *Conditional Contradiction*: A and non-A both exist at the same time, but only in the sense that when A is primarily actual, non-A is primarily potential, and *vice versa*, alternately and reciprocally.
LIR3: *Included (Emergent) Middle*: An included or additional third element or T-state emerges from the point of maximum contradiction at which A and non-A are equally actualized and potentialized, but at a higher level of reality or complexity. This axiom has a clear relation to classic Chinese and Indian logics.

I then add three axioms required for application to real-world elements, rather than only to linguistic terms.

LIR4: *Logical Elements*: The elements of the logic are all representations of real physical and non-physical entities, none of which can be totally identical to another.

LIR5: *Functional Association*: Every real logical element **e** – objects, processes, events – always exists in association, structurally and functionally, with its anti-element or contradiction, non-**e;** in physics terms, they are conjugate variables. This Axiom applies to the classical pairs of dualities, *e.g.*, identity and diversity, presence and absence referring to real changes, in movement as described by the Fundamental Postulate.

LIR6: *Asymptoticity*: No process of actualization or potentialization of any complex element goes to 100% completeness. This is a restatement of the fundamental postulate, including the essential concept that no real process goes to the idealized, abstract limits of classical logic of 0 or 1.

In LIR, the key logical operator is implication. In standard logic, implication is a linguistic, binary operator resulting in logical consequence. In LIR it is an ontological operator, which can result in real physical change.

2.3 Science and the PDO

The operation of the PDO in science justifies its place in logic. In the areas listed in Table 1, one or both of the key concepts of Logic in Reality are instantiated. These are 1) the movement from potentiality to actuality and *vice versa* and 2) the presence of an included middle state (Axiom LIR3) through which a process passes in an asymmetric, sinusoidal movement. Entropy and global irreversibility characterize the world as a whole, but negentropy and reversibility emerge locally at higher physical levels and in cognition in human beings. Higher levels of order are possible in physics due to the operation of the Pauli Exclusion Principle for electrons, which is a principle of difference.

Table 1
Areas of Application of the Included Middle

Physics	Pendulum: actual <> potential energy
Chemistry	Transition States
	Oxidation/Reduction Potential
Biology	Activation/Passivation of Nerves
	Mitosis
Psychology	Doubt
	Memory
	Consciousness
	Creativity
	Ambivalence
	Anticipation
Sociology	Altruism
	Common Good
	Democracy

2.4 Other Logics

Starting in the 20th Century, new groups of logics were developed, as it became apparent that the strict limits of the Aristotelian system were inapplicable, especially in quantum physics: paraconsistent; paracomplete; quantum; probabilistic

Of these only quantum logics, in principle limited to quantum phenomena discuss real physical change. Nicolescu has suggested, however, that some aspects of quantum mechanics apply in the macroscopic world as well, especially to cognitive phenomena, as in the previous list.

Other Buddhist and Western logics can be interpreted as linguistic systems of predicates or propositions. The terms "gaps" and "gluts" apply to the lack of or excess of true statements possible according to the Aristotelian laws of the Excluded Middle (LEM) and Non-Contradiction (LNC) respectively. The corresponding logical systems are referred to as paracomplete and paraconsistent. Paraconsistent logic includes what Graham Priest has called "true contradictions" [5], which from the strict classical perspective is an oxymoron. I will return to this later.

To my knowledge, LIR is the only theory in which the three major axioms of classical logic are modified at once. Standard propositional or predicate logics, (classical or non-classical) involve rules of inference for determining the truth of propositions and linguistic formulations of beliefs, etc. LIR involves rules for inferring the actual/potential state of the changing real-world elements involved in a phenomenon.

In some cases, an algorithm exists which such a logic can follow; however, this is not a necessary property. There is a great deal of existence, real within science, for which algorithms cannot be written. One example is the equations for quantum systems which do not commute or distribute.

LIR is concerned with reality as directly as possible and not with statements or propositions about reality. LIR follows the laws of theoretical physics, but does not have the same underlying mathematical structure. The emphasis is on real change as it is and could be experienced by human beings. It is thus an "ontology with a human face" [10], without the features of exclusivity and exhaustivity of category theory.

3. Information and the Philosophy of Information

Major recent developments first in science and technology and later in philosophy have been made in the field of information. Information is unique, appearing to "combine" both epistemic elements and ontological processes. I introduce it here to justify the need for some new paradigm for logic. The features of information have made this key concept extremely difficult to characterize in standard logical terms. Logic in Reality accepts that both features co-exist and change, and I consider that it these features of reality that require a corresponding logic. For example, Terrence Deacon [11] has suggested absence as a significant feature of information, a rare recognition of the ontological importance of a "negative", always in a dynamic relation with its positive – here presence.

4. LIR and Information

In relating logic to information, I emphasize that LIR and the Lupasco theory on which it is based is a Logic of Energy, better of Energetic Change. The scientific ground is in the movement of energy from higher to lower levels, from greater to lesser complexity, following the 2nd Law of Thermodynamics which applies globally. Local reversal to more complex ordered states can take place but require an input of energy in some form.

The cybernetician Norbert Wiener stated that information is neither matter nor energy but "information". Recent interpretations support rather the physical nature of information *via* the concept of an energy-information equivalence principle. The concept that information is a physical system obeying physical laws is at the core of Logic in Reality. My own best definition of information is as a bundle or sheaf of processes and meanings, all of which are operators in the real world. These process elements follow the principles of logical movement from actuality to potentiality. In some cases, an algorithm exists which such a logic can follow; however, this is not a necessary property. There is a great deal of existence, real within science, for which algorithms cannot be written. One example is the equations for quantum systems which do not commute or distribute. However, it is important to recognize and value to Wiener's underlying insight that there is "something else going on", something like a middle (?) between energy-as-physics and energy-as-information that is also a carrier of meaning.

The Catalan sociologist Manuel Castells [12] suggested in 2000 that unique relationships are developing between theclassical disciplines of science and philosophy as a consequence of new understandings of the science and philosophy of information. As stated by the contemporary Chinese philosopher Wu Kun [13,14], the overall movement is that of a philosophization of science and a scientification of philosophy leading to their convergence - a Unified Science-Philosophy of Information (USPI). What is essential is the clear joint operation of scientific and philosophical aspects of information in communication and human social interactions.

3. Eastern Logic

The principles of Logic in Reality can be related to the most fundamental concepts of logic as they appeared first as part of Buddhism in China, perhaps as early as 400 BCE, later in India and Japan. I draw on the authoritative *Buddhist Logic* of the Russian Stcherbatsky of 1930 [15] and the late 20th Century Japanese philosopher Yamauchi Tokuryu [2], whose work and commentaries on it have recently become available in French translation. I will show that these "Eastern" logics are ones for which LIR can give a grounding in science, potentially furthering its application in knowledge and the society. The following interpretation and discussion is basically mine and does not appear in Lupasco's work.

3.1 Eastern Concepts of "Middle"

The central thesis of these "Stances of the Middle", *Logiques du Milieu*, is the inversion of the principle of the *excluded Third*, as it appears in standard logic. They point to a unity underlying Eastern and Western thought that is often neglected in favor of alleged incompatibility.

An Eastern logic of the real can be distinguished from phenomenology by its concept of a "space" between two opposing elements not as empty, by the principle of the excluded middle, but containing a median. In contrast, the opposition of Sartre of being and nothingness or void still depends on a principle of bivalence. The terms of contradictions are mutually incompatible, and a term subsists by annulling its opposite.

3.2 The Logic of the Middle

My thesis is that Logic in Reality is supported by Yamauchi. His approach starts with a critique of the dialectics of both Hegel and Husserl in Europe and Nishida in Japan. Yamauchi refers to the Chinese logic of the middle as a logic of analogy, developed further in the India of the 3rd Century CE by Nagarjuna as a median way between Eastern and Western logics, subsuming both. The logic of Lupasco is close to that of Nagarjuna. Opposites subsist in reality because neither is totally present nor absent: the term of opposition might be replaced by that of *difference.* However, I claim that the Lupasco principle is one that has not been taken into account in either Eastern or Western thought. One exception is Jacques Derrida's concept of *différance* [16], with an 'a' in the third syllable, differs from the word for difference in French, which is spelled *différence*, as in English with an accent. *Différance*, in Derrida's words, "invites us to undo the need for balanced equations, to see if each term in an opposition is not after all an accomplice of the other. At the point where the concept of *différance* intervenes, all of the conceptual oppositions of metaphysics, signifier/signified; diachrony/synchrony; space/time; passivity/activity, *etc*. become non-pertinent. We may compare the recent statement by Bateson that "information is a difference that makes a difference" – in reality.

4. The Tetralemma of Nagarjuna. Logos and Lemma

Nagarjuna developed the concept of a lemma in opposition to a logical axiom as better reflecting non-linguistic reality. One of many existing versions is as follows [1]:

1. There is
2. There is not
3. There neither is nor is not
4. There both is and is not

4.1 Lemmas 1 and 2

The first two lemmas, taken together are equivalent to or define the basic principles of Western binary, bivalent logic. As shown by Yamauchi they encode (as one says today) the three key Aristotelian *logical - epistemological* principles of identity, non-contradiction, and the excluded middle. These principles found separability - categorial exclusion and exhaustivity, in standard category theory.

4.2 Lemmas 3 and 4. Lemmic Logic

The 3rd Lemma of double negation and the 4th Lemma of double affirmation are qualitatively quite different: they state that duality exists but does not imply exclusivity. The 4th lemma, which should be read as both the precondition and the consequence of the 3rd, together with it, define a new set of conditions for existence. In the lemmic logic of Nagarjuna, nothingness is not in a relation of relativity between affirmation and negation, as noted above but a double negation, negating negation itself, without return to the *status quo ante*. The application of the 3rd Lemma, in particular, represents a fundamental shift in thought regarding the domain of real phenomena and their changes. The 3rd Lemma is an "absolute" negation, transcending the distinction between affirmation and negation.

As a perhaps more familiar definition of the domain of application of the Lemmas, we can say that the logics of the 1st and 2nd are Boolean logics and of the 3rd and 4th non-Boolean.

4.3 The Yamauchi Middle. Co-suscitation

The shift in thought was formulated by Yamauchi as follows: being a middle is not only being between two terms, but also being neither one nor the other, and accordingly being one *and* the other. Classic bivalent logic is a logic of exclusion, of either/or, a "worldly" logic; lemmic logic resembles concepts in Buddhism such as the Great Vehicle and Supreme Truth. For Yamauchi, we have arrived at logic, not as a synthesis derived from the relation between affirmation and negation, but via an immediate direct experience, an intuitive reality. To repeat, the joint operation of double negation and double affirmation is antithetic to standard logic but results in the compatibility of opposing terms such as being and non-being and grounds them. I give one Western example of structural negation: Stafford Beer [18], the inventor with Buckminster Fuller of synergetics, stated:

"To Be and Not To Be; that is the System"

This statement recognizes that a system is characterized by a fundamental duality, implying that a way must exist for the system to express this duality. *How* can a statement and its negation can exist at the same time in the same place? In Logic in Reality the aporia is resolved by assuming that one applicable ontological property – being - is predominantly actualized or present and the other - non-being – is predominantly potentialized or absent. But this absence and this presence, which are by the basic principle of dynamic opposition never 100%, actualized or potentialized, characterize a system, carry information and are causally efficient.

To say that non-being is the foundation of non-being is not a logical statement, like the relation between things. Although at a higher level, it is still an epistemic statement. In the lemmic system, the foundation of being is a lemmic void, expressed in terms of co-suscitation or co-dependence. What makes a thing a thing – a part of real existence – is not another thing but a fact. But this kind of identity of being and a ground in non-being is given only by intuition, by an intuitive identification, not a dialectic mediation between opposing terms.

According to Yamauchi, co-suscitation is the most global cognitive process, providing the basis for the perception of cause and effect of the usual kind, as two independent terms in a semantic logic (logic of the logos). In contrast, in the relation of co-suscitation, each term depends on the other, is "there" only by virtue of the existence of the other. It is part of the basis for saying that two terms can be both the same and different, as discussed in the next Section.

5. Lemmic Logic. Grounding the Tetralemma

However, Yamauchi and his followers have admitted that they have not found an epistemic or ontic ground for their logic *except* in human intuition [18]. This could disqualify Lemmic Logic for serious consideration, let alone scientific validity. The Lemmas cannot be "proved" in any classical, semantic sense. Taken by itself, any statement of belief that their grounding is intuitive is inadequate as a basis for science and natural philosophy.

From my standpoint of mental processes as following physical laws, I suggest that the complex mental processes corresponding to knowledge –in Lupasco's terminology Knowledge-as-Such and Intuition - are not separated or separable, constituting another real duality, and I conclude that the missing grounding for the "middle way" of Nagarjuna and Yamauchi can be found in the Principle of Dynamic Opposition (PDO).

This means that the conscious mind moves between a state in which it is occupied by and dealing with hard knowledge, 1) knowledge-as-such and intuition is in an ill-defined background and 2) the reverse, where a strong intuition, perhaps as strong as knowledge, is suddenly available to consciousness. There is never one without the other, more or less actualized and potentialized, as for all complex phenomena.

Yamauchi asked himself if we must go to principles such as physical, dynamic opposition for explanations, as in Logic in Reality, is such a doctrine still a logic and not a physics? Very seriously, the answer, like that to many other questions at this level of synthesis is "yes and no". This answer is not trivial but can only be appreciated in dynamic terms, those of a mental movement between two terms or positions, apparently opposed, contradictory or counteracting. Some people may find such a "ground" too unstable for comfort. I see it as helping to remove the barriers between our minds and the world.

6. Logic and the Limits of Thought

The English philosopher Graham Priest [5], one of the founders of paraconsistent logic, has presented a cogent integration of Western and Eastern logic as defined here. His approach shows the central nature and role of contradictions in human thought. Contradictions invalidate standard logical arguments, and hence are to be avoided "at all costs". According to Priest, they are rather to be understood, lived, and mined for the insights they provide into the way the world works. For Priest, as for Lupasco, the world is contradictory. The next step, which I have proposed, is to see the operation of contradictions in terms of real physical processes, oppositions, or counteractions.

In his 1995 book, *Beyond the Limits of Thought*, Priest defined the "limits" he finds in aspects of both classic and modern views of language and philosophy. Examples are expression, iteration, cognition, and conception. Each of these would need a separate talk, but they have the general property that if steps are taken to avoid a contradiction in one aspect, it appears in another. Iteration is often considered to result in an "infinite" regress, linguistic or visual. As Lupasco showed, in reality, a regress stops after two or three stages because no new information is added by subsequent ones. In Nagarjuna, and in Lupasco, contradictions are not true in the standard semantic realm. They are contradictions which do not concern a conventional view of reality. Both placed the emphasis on the primacy of a non-semantic reality, of the lemma over the logos.

There are here echoes of George Boole's *Laws of Thought*, often considered a modern refoundation of bivalent logic. Close reading of Boole, in particular his Appendix, shows that he left the door open for a more dynamic, ternary *non*-Boolean logic.

Priest shows clearly that Nagarjuna had demonstrated the untenability of any single position: "Anything that comes into being that depends on something else is neither identical to it nor different from it. It is neither non-existent in time nor permanent". In the expression of the contemporary chemist Roald Hoffmann [19], it is the "same *and* different". That Nagarjuna was inconsistent was refuted by Priest and can also be refuted by the Principle of Dynamic Opposition, when applied to *reality*, not to statements about reality: here from Priest is another form of the Tetralemma:

Everything is real
Everything is not real
Everything is both real and not real
Everything is neither real nor not real

This can be seen in art. Lupasco said that the best art expresses both reality and non-reality. Logic should avoid a conventional collapse into standard, inactive dualities like appearance/reality or phenomenon/noumenon in which there is no opposition or "partialness" between the terms. Of several conclusions provided by Priest, I found one particularly relevant: "When I say that reality is contradictory, I mean that it is such as to render some contradictory statements true. The "it is such", the contradictoriness of nature, is described by Logic in Reality as a reflection of its dynamics.

Nagarjuna's conclusion, emphasized by Priest, is that the acceptance of the identity/non-identity of the two realities permits the recovery of "ordinary" logic, but at a higher cognitive level due to the recursion that has taken place. A Lupascian interpretation of Priest's thesis is possible, in that the units of his argument may be seen as non-semantic. As lemmas rather than logic they are directly in the line of Yamauchi.

I feel the Lupasco principle can be applied to the status of reality and non-reality. This too is not fixed but changes from predominantly one to predominantly the other in our minds and in some actions. The same recursive movement that takes place involving the entities of physics and chemistry listed above. As the sociologist Roberto Poli put it, it is an "ontology of what is not there", or not there yet - *partly*.

The Eastern world view as represented by Nagarjuna and Yamauchi can define an inclusive logic for society. In all societies, contradictions are present between individual and collective wants and needs. In one individual, they are between genetically and non-genetically determined predominance of altruism or selfishness.

7. The Logic of the Third (LOT)

The Logic of the Third (LOT) proposed by the systems and information scientist Wolfgang Hofkirchner [7] is also not a logic in LIR or in the standard propositional sense. It has a moral dimension and rather points toward a paradigm shift for a shared future for humanity.

LOT is an epistemological system – Hofkirchner calls it a Praxio-Onto-Epistemology, POE - that structures the corresponding three domains of knowledge into a cross- or trans-disciplinary Evolutionary Systems Theory. The POE is proposed as "a response to the current developmental requirements of humanity". While traditional approaches seem stuck in the three disciplines as alternatives, POE offers a transdisciplinary response for going beyond them, resembling LIR in this respect.

I list here all the major building blocks of Hofkirchner's system. LOT has the capability of categorizing complex sociological structures and trends and above all the needs of the society for sustainabilization and stabilization.

Previous Work

1) Praxio-Onto-Epistemology (POE) as a philosophy
2) Evolutionary Systems Theory (EST) based on POE
3) Unified Theory of Information (UTI) based on EST

Current Work

1) Critical Social Systems Theory (CSST) based on EST
2) Critical Information Society Theory (CIST) based on CSST and UTI
3) Critical Techno-social systems Design Theory (CTDT), based on CIST

7.1 Being and Non-Being

One fundamental philosophical concept that appears in *The Logic of the Third* is that of **Being and Non-Being**. Hofkirchner analyzed it in terms of seven ontologies, in the classificatory sense, covering a wide range of social perspectives:

- **Emergentist; informationist; sociogenetic; noogenetic; bifurcationist; transformationist; techno-social systemist**

In these ontologies, being and non-being are existence conditions for different kinds of social relations, the basis in turn for more complex socio-epistemological structures.

As one example, I give the author's description of an existentialist fallacy: viewing "non-being and being as nothing and something, respectively, in particular as nothing causative and something else." In Hofkirchner's view, in contrast, only an emergentist perspective can provide a rational account: rather than being nothing, non-being is a present potential as a necessary condition for a future integral, and the actual integral is an emergent from the past potential. The causative is anchored in the potential, and the caused emerges as actuality.

7.2 Social Processes

Hofkirchner's Evolutionary Systems Theory (EST) treats both entities and events as processes, the consequences of other processes that support the emergence of systemic interconnectedness. LIR provides the essential grounding in science for this epistemological concept. In my view, Hofkirchner's emergent effects are the result of causality in operation recursively between techno-social and social systems and best described as 'spiral' rather than circular; no process returns to the same point from which it started.

For understanding the dynamics of social, economic, and political processes, the major work of Castells referred to above [12] has proven extremely prescient. Society is a complex system of networks that are a consequence of the new information and communication technologies. The LIR logical approach, applied to an analysis of the dialectic properties of the networks and their nodes complements Castells' informal reference to a "logic" of the network society and its dynamics.

The concept of the sociotype has been introduced recently by the information scientist and neurologist Pedro Marijuán and others [20]. A social system is constituted by reflexive, *i.e.*, communicating, interacting individuals. In the social 'organism', the phenotype and genotype correspond to the biological realm, while the sociotype appears as the constituent imposed by the social structure. A sociotype is an ontolon, a complex dynamic but relatively stable cognitive entity identifiable in the social world. It includes the bonding structures of the social environment, the dynamics of social interactions to which the individuals of our species are adapted by evolution. The sociotype can be considered as a pattern in the sense of Ladyman and Ross – human subjects form social entities through their recursive mutual processing of information from the environment and themselves. This for me is another reflection of the Lupasco principles.

8. The Moral Dimension

Logic in Reality supports a non-transcendental, ontological basis for individual and collective moral behavior. Its scientific dualism can be applied to the pair self and other. Lupasco wrote that if we as knowers are not totally external to what is known by us, nor completely different from it, then we must conclude that there are other knowers that are part of our known and *vice versa*. The source of human dignity *is* then in ourselves as knowers. If we avoid solipsism, the origin of moral responsibility can only come from our relation to other knowers, in other words, to all human beings, and by extension, to other beings. *A contrario*, one cannot find responsibility in oneself as an isolated agent. Since we are both 'not-other' *and* 'other' a self-interest argument for morality holds. In another form, this is the "I am Thou" of Martin Buber.

Concern for the human "other" extends naturally to concern for and the preservation and sustainable improvement of the environment and other non-human entities. Lorenzo Magnani has explored the human/non-human relation in an important 2007 book, *Morality in a Technological World. Knowledge as Duty* [21]. One original thought in this book is the respect one should have for *things*. Things and humans share one essential feature: existence. Logic enters in in the way we should –it is our duty to - use knowledge to further moral reasoning, making moral inferences systematically to solve practical problems. The LIR approach to logic emphasizes the scientific core and dynamics of moral positions.

9. Summary

There is no hard conclusion that I can or wish to make. My objective has been to expand the debate about what logic is and how it operates. I have tried to capture my theses in the following points::

1, Reality – human life and society – follows **a logic of energy**, not a logic of propositions and their truth or falsehood, or their mathematical equivalents

2. This logic - **Logic in Reality; LIR-** relates to the dualisms such as actuality and potentiality, presence and absence, knowledge and intuition, altruism and selfishness fundamental to our understanding.

3. Although of necessity expressed in language, LIR can describe the dynamic, changing, non-linguistic structures of **existence, reality and non-reality.**

4. Any logic or logical approach to existence must include one to its dual which is **non-existence**. The relation of existence and non-existence is the little discussed ground of all thought, expressible in the **Lemmas of Nagarjuna**, as reformulated by **Yamauchi**. LIR suggests the same dynamics for them as those that ground science, providing a more rigorous foundation for them.

5. The concept of **Priest** of **real contradictions** at the **limits of thought** can be read in energetic terms as in LIR and extended to non-linguistic phenomena.

6. As stated by **Hofkirchner**, society operates according to a **Logic of the Third (LOT)** that is practical, ontological, and epistemological. The nature and properties of information, and their physics, provide a scientifically necessary and sufficient base to ground both LIR and LOT. The joint application of the insights of Yamauchi and Lupasco should help to eliminate the traces of logical positivism still contaminating logic and philosophy.

7. LIR sees the **Principle of Dynamic Opposition**, the alternance of actuality and potentiality for two opposing phenomena as applicable to the self-other dualism. Since I am partly the Other, I have a self-interest in **morality** and moral behavior, also to the environment.

It is the overlapping set of these logical systems and principles that I propose as the appropriate logic for society, in particular, for a Globally Sustainable Information Society.

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