

the forms of in-itself and for-itself and there is regeneration of information. For-itself and regeneration information both have the same form of existence: they are not nothingness, or an impossible emptiness. In the terms of Logic in Reality, they are both real *and* unreal, with reality and unreality linked dynamically, more or less potentialized or actualized, as the case may be. Also in the objective world, there is also not real there, in-itself information is not *completely* real existence, following the same dialectics. As the subjective world is not totally real existence, and because the two large areas of real existence and not real existence are present in the objective world, these two areas are nested (in a relation of dynamic opposition), establishing a world with a dual existence of the matter and information.

Regenerated information. Regenerated information is a form of subjective indirect existence, information created by a subject. Its basic content is concept-phenomenon information and symbol information. Concept-phenomenon information is thinking in terms of images to create a new image; symbol information is a kind of for-itself information and a sign of concept-phenomenon information. Human abstract thinking is a kind of logical deduction for symbolic information, a high-level integrated process of analysis and transformation. At some point, as also recognized by Lupasco in his book *The Psychic Universe* [Lup79] information activities must lead to the establishment of a cognitive control system. The essence of thinking is precisely that it is within the thinking subject through the operation of information processing, the information processing steps performed to achieve the subjective creative activities. This subjective creative activities of information are thus based upon an advanced form of information activities involving for-itself information processing and transformation. We common reference to “mind” (spirit) is in fact to for-itself and regenerated, processed information, equivalent to subjective indirect existence.

Social information. Social information is not a form of independent information; it embodies the three above types of in-itself, for-itself and regenerated information and their relationships showing a comprehensive, three-fold form of organization of information. There are three social worlds of information: first, human understanding and transformation of the part of in-itself information (in the form of in-itself informosome exists) of the objective world; second, human knowledge of for-itself and

regeneration activities within the information field itself; third, the external storage of regenerated information (which constitutes the created culture of the world).

“Information society” is a term for the part of the information world that it necessary for people to understand and master. The social information required to understand and transform the human subject combines in-itself, for-itself and regenerated information. (In Figure 2, the dotted lines indicated that only part of in-itself, for-itself and regenerated information have the organic unity to enter the range of social information.)

Just as matter has gone through different stages of evolution of its form, the corresponding information has also gone through different stages of evolution of its form. Natural information, from the standpoint of its aspects of in-itself and for-itself information has undergone a long evolutionary process of regeneration resulting in a coherent body of social information, having a unity of essence (that has been largely ignored by philosophers). This is what we call the dialectics of the movement of the *form* of information.

3.3. The informational field. Additional aspects

Wu Kun’s concept of an informational field further defines the essence of information. The informational field is a multidimensional conceptual construction, including the various functions, roles, structures and relationships involved in the production, transmission and reception of information. From the standpoint of LIR, all of these entities, especially structures, must be looked at as causally effective processes. Lupasco used the term structuration, “*structuration*” in French, to emphasize the dynamic *process* aspects of complex structures, biological, cognitive or social. The answer he gave to his own question “*What is a structure?*” [Lup67] was that structures are also dynamisms, not to be objectified and reified. In the LIR perspective, structuration is a real operation on the relations between two individuals. Any individual structure is never rigorously actual, that is, absolute in any sense, given the nature and logic of energy. It is a dynamic “structuring” that is always functionally associated with an antagonistic and contradictory potential structuring. Another way of saying this is that a structuring seen externally is a kind of form; looked at internally, it consists of the processes themselves.

The term of structuration was used later by Giddens [Ley09] who related it to his view of the double hermeneutics operating in intentional interactions among human beings, instantiated in observable networks of communicative relations, hence of information.

3.3.1. Toward a unified theory of information

We note first that the scheme of principled distinctions proposed by Wu has a relationship to and a place in the conceptual approaches that Hofkirchner has recently listed to a Unified Theory of Information (UTI). Hofkirchner [Hof09] among others has argued for the desirability of a UTI that would encompass the different manifestations of information processes. Such a UTI should be capable of balancing the apparently contradictory properties of information — physical and non-physical, universal and particular — without reduction. Its underlying principle should be “as abstract as necessary but as concrete as possible at the same time”. Hofkirchner considers information as a “superconcept”, which includes a group of overlapping concepts such as message, signal, *etc.* as they apply to communication, cognition and cooperation between human and non-human organisms. Hofkirchner asks how matter and idea, mind, information, *etc.* can be grasped as complements and with them information as a thing (a structure, a flow) or as a human construction. Hofkirchner gives a dialectical answer to the implied division between subject and object, suggesting that mind, and with it information, is of a different ‘materiality’ than ‘non-emergent’ states of matter.

His own approach to a Unified Theory of Information (UTI) is to eliminate the absolute and in our view artificial separation between critical concepts of information in favor of a dialectical relationship similar to the ancient intuition of ‘unity-in-diversity’. Specifically, his “UTI seeks a concrete-universal concept of information rather than an abstract one”. Hofkirchner wishes to avoid reliance on a “formal-logical figure of necessary and sufficient conditions” and use a way of thinking that integrates as well as differentiates the particular and universal”, with which LIR agrees.

From the LIR standpoint, mind and information can be seen as “complements” if ones sees them as processes. Structure, flow and “human processing activity” all follow the same real, physical dialectics. If matter and information are differentiated in a “common genus”, for LIR, *that genus is simply energy, and both follow its logical patterns of evolution*, avoiding the problems of the term “different materiality”. Logic in Real-

ity is, also, a logic of emergence or “emergent materialism”. In this view, information is, *pace* Wiener, an energetic phenomenon that instantiates real contradictions.

Wu and Brenner consider that the “opposites” in information are not captured by the classical concept of a classical, static “unity of opposites”, but by the dialectical interaction of the opposites as classified above. The Wu classification is the critical *first step* in the characterization of the complex phenomenon of information. Further, however, Wu’s classification is based on his general philosophy of natural ontological levels that captures the essence of the properties of information. The resulting doctrine of objective information, subjective information and human information in society that constitutes Wu’s information theory establishes a unified philosophical foundation of information science as a basis for further research.

3.4. The general model of information systems

In his General Systems Theory, GST, based on his fundamental research in biology and embryology, von Bertalanffy proposed [Ber69] that the only meaningful way to study organization was to study it as a system, defined simply as “complexes of elements standing in interaction”. The necessity and potential feasibility of the systems approach was recognized only after the developments in theoretical physics and mathematics of the mid-20th Century, despite the fact that they cannot be fully formulated mathematically. Von Bertalanffy saw both the physical and biological world as a play of energies and a flow of processes. There are clearly models, principles and laws that apply to generalized systems and sub-systems, irrespective of their particular kind, the nature of their component elements or the relations or forces between them. As Brenner has shown elsewhere, however [Bre08], since the formulation of GST systems science developed along lines similar to those of standard logic. Systems are often models that operate to exclude the most dynamic aspects of natural processes, simply because the latter tend to be mathematically intractable.

Wu also analyzed the problem of information systems from the point of view, now shared by Deacon [Dea07], that Shannon’s model of communication and information systems, as just a non-feedback, deterministic model of an information transmission and reception system model cannot function as a general system model of information processes. To

establish a general model of a system of information activities one must consider the following aspects: first, the feedback mechanism of information; and second, the simultaneous deterministic aspect of information activities and the non-deterministic nature of their conjunction; third, the dynamic mechanism of the generation of new information; fourth the operation of the dynamic mechanism in the creation of new information by interactive processed converting it to an objective reality.

A satisfactory model, therefore, must include the second-order characteristics of human information activities involved in the establishment and implementation of information systems created to achieve human goals and purposes — frankly teleological in nature.

In Wu's view, the human cognitive activities inside and outside this multi-information model are involved in processes of the mutual selection and matching, reorganization and reconstruction, create, according to the non-deterministic model, new subjective information processes. We designate also as teleological (in the Deacon sense) or purposeful information that created by human beings to achieve or insure the success of practical activities. The human activities of material production, from our informational standpoint, imply the process of planning to implement purposeful, structural information to create material objects (cf. Section 3.5).

Here, we are particularly concerned about the way in which, as stated by Wu, new information is created in the recombination of available modes. In the process of transmission of information from sender (subject) to receiver (object), the teleonomy of the subject implies that its information will be realized in the object. Meaning emerges in this process that we now propose follows the dialectic principles of LIR. The categorial feature of non-separability relates the dynamic categories of subject, object and subject-object.

3.5. Levels (grades) of information. Teleonomy

The four kinds of information noted above correspond to the phenomenological characteristics of peoples' processing and understanding of that information, their interactions with the environment, and the social processes in which information is transformed. Wu casts these characteristics into a system of five basic levels of informational activities, as follows:

- activities related to in-itself information,
- intuitive identification or self-awareness of perception,

- memory (storage) of information,
- individual creation of subjective information,
- social “processing” (transmittal and reception) of subjective information.

Wu then analyzes the complex bottom-to-top and top-to-bottom relations between these levels, in which he discerns a dual control process of higher levels on lower levels that are both opposite and complementary that he calls “guidance” and “restraint”. Summarizing rapidly, this picture emphasizes that both high- and low-level processes are mutually conditioned and transformed, constituting the entire, organically-linked whole of the qualitative informational structure of the individual.

Throughout this section of the BTPI, Wu repeatedly calls attention to the process aspects of the complementary *non-separable* interactional relations between the different levels of informational activities, a set of complementary interrelations. As discussed above in Section 3.2 and again in more detail below in Section ??, it is exactly this type of complex interactive processes which LIR designates as logical and for which it suggests the patterns of evolution. Wu uses the four corresponding complementarity laws to show the unity of the complex interactive relationships in which the subject is involved (informational activities):

- an initial *construction* by the subject of information,
- the *movement* from higher to lower levels in a holographic control structure (see the next section),
- the comprehensive *participation* in this process by the subject,
- the *transformation* between levels of information activity.

Wu sees the origin of higher levels or grades of information in the property of a subjective *teleonomy* in human beings. In 1970 [Mon70], Monod introduced *teleonomy* as one of the three fundamental properties of biological objects, together with autonomic morphogenesis and reproductive invariance. Teleonomy was defined as the *apparent* purpose or possession of a project in the organization of a living system. Subsequently, despite some weaknesses of explanation (reference to pure chance), teleonomy became quite popular as a theoretical basis for discussions of mental and other phenomena by Edelman and others. LIR supports the descriptive elements of teleonomy by proposing a modified conception of teleonomy as *both* reality and appearance. We recall that reality and appearance are both real, as are the dynamics of their alternating actualization and potentialization; chance and necessity, determinism and indeterminism have their role to play.

Combining the Wu and Brenner approaches, we re-evaluate the concept of levels of reality in logical and informational terms, such that the higher informational grades or strata also possess in part the nature of the lower ones. In *Logic in Reality*, two important considerations were mentioned: 1) that every phenomenon embodied aspects of the properties of its constituents from a lower level of reality and 2) a real energetic interaction — the Principle of Dynamic Opposition — between subject and object and/or subjective and objective aspects of phenomena was postulated as existing in all complex phenomena. We thus see that the informational picture of Wu is consistent with LIR in its primary description of the functional structure of reality across its different levels.

3.6. The relation to Logic in Reality. Process

The reader will have grasped that the Logic in Reality described in Section 2 and applied to earlier topics in this section is fundamentally different from standard logics in the sense that the contradictorial, dialectic formulations, for example, of objective and subjective, or real and unreal (as in art) that are permitted involve real interactions between the two terms. Our preliminary conclusion from the juxtaposition of the two approaches is that the use of standard logic and process logic by Wu Kun is sufficiently comprehensive and adequate for the *classification* of the information field.

Simple classical logics cannot reveal the profound essence of the phenomenon of information, because information is generated in the process of interaction of things, and classical two- or multi-valued propositional logics cannot describe process interactions as Brenner has shown. The logic used by Wu for the re-partitioning of the existence field involved two pairs of contradictory terms: subject and object, reality and unreality. The simple subjective and objective classification method assumes that there are no real contradictions in nature (*dialetheias*). If one use the contradiction rules of classical two-valued logic purely for the analysis of reality and unreality, (which can only express a binary relation), it is impossible to reveal the process of transformation from reality to unreality, making impossible the deep understanding of the information phenomenon, since it ignores the process of contradictory movement and the dynamic relationships between these areas.

Wu Kun uses both subjective and objective, reality and unreality as two coupled categories, and carries out a cross-combination of logical

deductions, which not only shows that the objective world has a real and unreal nature in a doubly contradictory or oppositional movement, but also shows the unreal nature of the information as part of the subjective world. This was originally just a mechanical division of the subjective and objective classification. In fact, the complementarity of reality and unreality, their “cross-classification” yields a new transformational process from the objective to subjective that has a logical intermediary — the “T-state” in Brenner’s LIR.

For Wu Kun, the effect of complex interaction relation between multi-level human informational activities lays the ontological foundation for a holographic theory of process interactions. We repeat that the logic of such processes cannot be a two-valued logic, because they require an intermediary or intermediate state. Also, a simple polarization of opposites does not constitute a process, while the mediated contradictory movement can be described as a real process [Bre05]. In addition, intermediaries also often are multi-level, involving levels of existence and the relationship between levels. Logic in Reality provides the principles for describing the evolution of these mediated interactions, and the complexity of the transformation processes involved. The Wu split level theory of the existential field, and his multi-level hierarchy of information activities, and the complex interaction between the hierarchy is precisely with this multi-level classification, a process of mediated interactions consistent with the principles of Logic in Reality.

The use of the term “holographic” in this paper to describe informational interactions requires some further comment: in Wu Kun’s interpretation, a holographic informational phenomenon is its own structure map, a self-organizing condensation of its internal and external complex multiple information components, their historical and evolving relationships and the results of that evolution, including their loss, distortion or dissipation. The concept of the “informosome” outlined above embodies this holographic principle. A “holographic rule” is a rule that defines the (more or less) coherent mutual dependence of the different types of variables involved. One should consider Wu’s emphasis on, for example, the nature of human information activities as holographic not as metaphorical, but as describing real three- or higher-dimensional dynamic structures. The concept, including a categorial classification of holographic phenomena is discussed in detail in [Wu94-05]. It might be objected that holograms are static objects, only susceptible of being viewed in three dimensions. While this was true of the original holograms

of Gabor and others, technology is now “catching up” to information and moving holograms have begun to be produced (2012).

In the remainder of this paper, we will continue on the basis that the principles of LIR in fact support to the descriptive resegmentation of the existential field (the extant domain) by Wu. LIR makes it “logical” to talk about interactive relations between objective and subjective, reality and unreality, internal and external, direct and indirect and so on, and it does not exclude *a priori* the existence of real contradictions. LIR formalizes and explicates the absence of separation noted by Wu, retaining the consequences for information. For LIR, its “unreality” is only apparent since all information — as sent or received — is the effect of some real causal process. When applied to informational processes or ‘activities’, it aids in the explication of their active non-quantitative and normative properties and the evolution of the latter in their transmission, reception and interpretation.

As indicated in Section 2.1.3, LIR basically defines information as a process as the reality in a physical space of a dialectical relation between sender and receiver, in which meaning and value emerge due to the constraints on the evolving interactions [Bre09]. The conception of information-as-process is central to both the BTPI and LIR views. As stated by Queiroz *et al.* [Que08], the processual approach to information departs from the treatment of information as contained in some (static) structure, but moves in Brenner’s view toward an understanding of information as a dynamic semiotic process, a *non*-Peircean semiosis [Bre11].

According to Wu, information is not only included in the dynamic process of the content presented, but also in the corresponding dynamic of the process that in effect produced that content. The content of the process is reflected in the information field generation and its structure; it is the main form of transmission of information space. The main form of temporal transmission of information is as an *effect* of the process, mainly reflected in the structure of informational reception and transmission.

If the former is mainly reflected as a dynamic process, then, the latter is mainly reflected as a static structure. Of course, the space transmission and time transmission of information are not separated, and the two imply each other, so that the process of dynamic information activities and static structure always complement each other. It is because of this that evolutionary relative variability of information content can be stored, that one can transfer and share relatively stable information content, and distortion can be dissipated.

To understand and grasp the essence of information and its mode of existence one must operate on two complementary static and dynamic levels. Perhaps one should use the two concepts of “structure” and “structuration”, where “structure” expresses that specific information content that corresponds to the coding form of a specific “structure”, while “structuration” means a production of specific content of information that depends on the original “structure” of the instability of the process involved, and becomes a new “structure” encoded form. It seems that these two concepts is the information corresponding to the static and dynamic, combining these two concepts will be good indication united characteristics each other between static and dynamic of information activities. It is also consistent with principle of dynamic opposition proposed in Logic in Reality.

4. The role of “self”-organization in information

As a first example of the application of Logic in Reality to the Basic Theory of the Philosophy of Information, we will analyze the concept of self-organization. Since the work of Maturana and Varela and their followers, it has become customary to refer self-organization and autopoiesis as necessary to characterize the unique properties, including informational properties, of complex systems at biological, cognitive and social levels of reality. However, even if the concept of self-organization is correct in some sense, it can be criticized as being insufficiently rigorous [Col03]. Two concepts adduced in the past as attempts to ground these phenomena recur frequently: the concept of “spontaneity”; the related concept of ontologically random behavior, with some form of combinatorial selection to insure a minimum incidence of emergence. This displaces the problem: it requires both random and deterministic processes, without explanation of why two should exist. To define, as Morin did, that a self-organizing process is one in which each system creates its own determinations and its own finalities raises the further question of the minimum system, which is viciously circular. Stuart Kauffman has proposed that it is the smallest system capable of executing one thermodynamic work cycle, but the origin of this capability remains unclear. The most recent pertinent discussions of chance and spontaneity, such as those of Deacon [Dea11] and Ulanowicz [09] eliminate their

absolute characteristics and allow for a dialectic between determinism and indeterminism, as foreseen by Lupasco.

In standard discussions of self-organization, the encounters are, at least, between elements that are really, as opposed to analytically, distinct. The consequence of any self-organizational process is the constitution of emergence of a new form, or of a restructuring, by complexification, of an existing form. The problem is how this comes about in the absence, by definition, of any organizing entity. In LIR, a “logic of emergence”, the causes of emergence can be seen to be the residual potentialities in and of the elements that are the effects of their constitution by prior processes. There are, in addition, mathematical theories of self-organization, but these show only how ideal objects can organize themselves into more complex states or structures. These will not be discussed further as they do not apply to this critique of a principle of self-organization that is said to apply to physical, spatio-temporal entities.

4.1. The Wu concept of self-organization

One of the most important and novel aspects of the Wu approach to self-organization is that corresponding to self-organized activities, there is a process of the structure and the building of non-self-organizing nature, and he proposes the term of hetero-organization to better indicate this process. In further discussion, Wu Kun shows the difference between self-organization and hetero-organization, and the interactive relationships of cooperation and transformation between the two.

For Wu, an ordered structure capable of self-organization is nevertheless dependent on the input of external energy and information for it to form and persist. It is not “spontaneously” generated within the system, even if it “spontaneously” forms. Here, the self-organized “spontaneity” applies only to the model of the ordered structure, rather than to the reasons for the formation of this structure, that is to say, this orderly pattern is primarily generated internally, rather than externally, but the internal generation of ordered patterns is not independent of external factors. Once initiated, the process of self-organization does result in the creation of new entities. However, both self-organization and hetero-organization require new (externally) available energy and information for their further evolution. Self-organization relative to hetero-organizational concept refers to the introduction in the system of a

model of the external information, and the process of organization of the system takes place according to this model.

The rigorous logical approach of LIR can be applied to the concept of self-organization. If one assumes a standard definition of a system, a self-organizing system is defined as distinguished by the formation of some states or entities arising from the reciprocal or collective interactions (encounters) between its components, *quite independently of outside inputs*. LIR theory, however, states that the critical terms of ‘self’ and ‘independent’ involve question-begging assumptions, given its critical categorial feature of Non-Separability (Section 2.1).

4.2. The Brenner critique

Brenner suggested that the critical step in the organization process is not spontaneous, in the sense of uncaused by outside agents, which the use of the particle “self-” without qualification implies. New organizational structures are the effective consequences of the potentialities residing in the components and/or introduced during the original constitution of the natural system or artificial experiment. This view supplements the discussion of self-organization in society proposed by Fuchs, in which the emphasis is on a dialectical, emergent transition from simple elements defined by one or two parameters to more complex process-like entities instantiating quality or meaning. Fuchs [Fuc06] also suggested the need for a new functional “logic of self-organization”. The advantage of LIR for a theory of organized systems is thus that it provides at least a partial answer to the question of why some systems self-organize, or display autopoïesis, and others do not. LIR simply takes the theory of self-organization and grounds it in (at least) one lower level of reality, without the need for invoking any non-causal spontaneous processes.

Wu and Brenner thus agree that the most reasonable view is that self-organization is not, in and of itself, a ‘self’-evident mode of system formation and change. All systems, including the so-called self-organizing systems, in their structure, formation and evolutionary processes, are to some extent dependent on intermediary of external factors. Here we once again encounter the the contradictorial terms of internal and external, conditions based on interaction, following a unified dialectical logic of mutual complementarity.

Varela refers to something like this view of self-organization [Var99] when he states that coupled non-linear oscillators can give rise to kinds

of self-organization that result in the emergence of neural structures from the component level. A local-global interdependence is necessary to understand the emergence. The components “attain relevance” through their relation with their global correlates. At the same time, due to constraints related to the overall relationships, emergence occurs not only occur at the overall level, but also at lower levels, because the overall relationship will in turn effects changes in part in their nature and function. Morin has called this is “double emergence”; Deacon provides a careful, scientific picture of the interactions of the dynamics that are required as one moves up from the thermodynamic, morphodynamic to the teleodynamic levels of reality.

The somewhat reduced role for self-organization as a secondary or derivative phenomenon can nevertheless be combined with the other characteristics of systems, such as internal and external feedback, to give a comprehensive description of the complexity of information science. Wu includes a fundamental principle of internal and external randomness in this picture, however, that implies a role for randomness in the universe at the foundations of a theory of information. We therefore now need to review the basic cosmological concepts and grounding in energy of both the BTPI and LIR theories that will support the claims made above and constrain, from both authors’ point of view, the origins and characteristics of information.

In part II which follows, we will explore both the implications and applications of the logics involved.

References

- [All98] Allaby, M., *A Dictionary of Plant Sciences*, Oxford University Press, Oxford, 1998.
- [Béz00] Béziau, J.-Y. (ed.), *Logica Universalis. Towards a General Theory of Logic*, Birkhäuser Verlag, Basel, Boston, Berlin, 2000.
- [Béz07] Béziau, J.-Y., and A. Costa-Leite (eds.), *Perspectives on Universal Logic*, Polimetrica, 2007.
- [Bre05] Brenner, J. E., “Process in reality: A logical offering”, *Logic and Logical Philosophy*, 14 (2005): 165–202.
[DOI: 10.12775/LLP.2005.012](https://doi.org/10.12775/LLP.2005.012)
- [Bre08] Brenner, J. E., *Logic in Reality*, Springer, Dordrecht, 2008.
- [Bre09] Brenner, J. E., “Prolegomenon to a logic for the information society”, *triple7-c*, 7 (2009), 1: 38–73. <http://www.triple-c.at>

- [Bre10] Brenner, J. E., “The logic of ttchical information”, *Knowledge, Technology, Policy*, 23 (2010), 1–2: 109–133.
- [Bre10a] Brenner, J. E., “The philosophical logic of Stéphane Lupasco”, *Logic and Logical Philosophy*, 19 (2010): 243–285.
DOI: [10.12775/LLP.2010.009](https://doi.org/10.12775/LLP.2010.009)
- [Bre10b] Brenner, J. E., “Levels of abstraction. Levels of reality”, *Knowledge, Technology, Policy* (in press).
- [Bre11] Brenner, J. E., “On representation in information theory”, *Information*, 2 (2011): 560–578. DOI: [10.3390/info2030560](https://doi.org/10.3390/info2030560)
- [Col03] Collier, J., “Fundamental properties of self-organization”, pp. 150–166 in V. Arshinov and C. Fuchs (eds.), *Causality, Emergence, Self-organization*, NIA-Piroda, Moscow, 2003.
- [Dea11] Deacon, T. A., *Incomplete Nature. How Mind Evolved from Matter*, W. W. Norton & Co., New York, London, 2011.
- [Flo10] Floridi, L., *The Philosophy of Information*, Oxford University Press, Oxford, U.K., 2010.
- [Fre10] French, S., “The interdependence of structure, objects and dependence”, *Synthese*, 175 (2010): 89–109. DOI: [10.1007/s11229-010-9734-2](https://doi.org/10.1007/s11229-010-9734-2)
- [Fuc06] Fuchs, C., “The dialectic of the nature-society system”, *triple-C*, 4 (2006), 1: 1–39.
- [Gri96] Grize, J. B., *Logique naturelle et communications*, Presses Universitaires de France, Paris, 1996.
- [He06] He, H.-C., and Z.-T. He, *Philosophy Significance of Universal Logic*, Northwestern Polytechnic University of China Press, Xi’An, 2006.
- [He05] He, H.-Can *et al*, *Principle of Universal Logics*, Science Press/NWPU Press, Xi’An, 2005.
- [He07] He, H.-C., “Dialectical contradictions and Universal Logics — The spectrum phenomenon in Flexible Logic”, in J.-Y. Béziau, H.-Can He *et al*. (eds.), *UNILOG’07*, 2007, www.uni-log.org
- [Hof09] Hofkirchner, W., “How to achieve a unified theory of information”, *triple-C* 7, 2 (2009): 357–358. <http://www.triple-c.at/index.php/tripleC/article/viewFile/114/138/>
- [Ily74] Ilyenkov, E. *Dialectical Logic*, Progress Publishers, Moscow, 1974. <http://www.marxists.org/archive/ilyenkov/works/essays/essayint.htm>
- [Lad07] Ladyman, J., and D. Ross, *Every Thing Must Go. Metaphysics Naturalized*, Oxford University Press, Oxford, 2007.
- [Ley09] Leydesdorff, L., “Redundancy in systems which entertain a model of themselves. Interaction information and the self-organization of anticipation”, preprint for *ENTROPY*, 2009.
- [Luh10] Luhn, G., “Towards an ontology of information and succeeding fun-

- damentals in computing science”, paper, 4th International Conference on the Foundations of Information Science, August, 2010, Beijing.
- [Lup47] Lupasco, S., *Logique et Contradiction*, Presses Universitaires de France, Paris, 1947.
- [Lup67] Lupasco, S. *Qu’est-ce qu’une structure?*, Christian Bourgois, Paris, 1967.
- [Lup87] Lupasco, S., *Le principe d’antagonisme et la logique de l’énergie*, Editions du Rocher, Paris, 1987. (Originally published by Éditions Hermann, Paris, 1951.)
- [Mag02] Magnani, L., in L. Magnani and N. J. Nersessian (eds.), *Preface to Model Based Reasoning: Science, Technology, Values*, Kluwer, Dordrecht, 2002.
- [Mar10] Mares, E., “The nature of information: a relevant approach”, *Synthese*, 175 (2011): 111–132. DOI: [10.1007/s11229-010-9737-z](https://doi.org/10.1007/s11229-010-9737-z)
- [Min03] Mindell, D., and S. Gerovitch, “Cybernetics and information theory in the United States, France and the Soviet Union”, pp. 66–95 in *Science and Ideology: A Comparative History*, M. Walker (ed.), Routledge, London, 2003.
- [Mon70] Monod, J., *Le hasard et la nécessité*, Point Seuil, Paris, 1970.
- [Pri89] Priest, G., “Dialectic and dialetheic”, *Science & Society*, 53 (1989): 388–415.
- [Ram98] Ramachandran, V. S., and S. Blakeslee, *Phantoms in the Brain. Probing the Mysteries of the Human Mind*, Harper, Collins, New York, 1998.
- [Que08] Queiroz, J., C. Emmeche, and C. N. El-Hani., “A Peircean approach to ‘information’ and its relationship with Bateson’s and Jablonka’s ideas”, *The American Journal of Semiotics*, 24 (2008), 1–3: 75–94. DOI: [10.5840/ajs2008241/36](https://doi.org/10.5840/ajs2008241/36)
- [Sar43] Sartre, J.-P., *L’être et le néant*, Gallimard, Paris, 1943.
- [Sei09] Seibt, J., “Forms of emergent interaction in general process theory”, *Synthese*, 166: 479–512. DOI: [10.1007/s11229-008-9373-z](https://doi.org/10.1007/s11229-008-9373-z)
- [Tay75] Taylor, C., *Hegel*, Cambridge University Press, Cambridge, U.K., 1975.
- [Var99] Varela, F. J., “The specious present”, in J. Petitot *et al.* (eds.), *Naturalizing Phenomenology. Issues in Contemporary Phenomenology and Cognitive Science*, Stanford University Press, Stanford, 1999.
- [Wu88] Wu Kun, “‘In the name of the natural’ to express nature”, in *Dialectics of Nature*, January 19, 1988.
- [Wu90] Wu Kun, *Natural Logic*, Xi’an, Northwest University Press, 1990.
- [Wu94-05] Wu Kun, “On a new realm of natural evolution”, *Journal of Northwest University (Social Science Edition)*, 2 (1994): 7–13. Pages

- 266–275 in *Philosophy of Information – Theory, System, Method*, Beijing: Commercial Press, 2005.
- [Wu02] Wu Kun, “Information thinking. A new kind of pattern of scientific thinking”, *Journal of the Xi’an Jiaotong University (Social Sciences)*, 23 (2002): 60–91.
- [Wu04] Wu Kun, “Objective reality, substance realism, energy doctrine” and “Non-hypostatization of materialism — on the scientific value of Lenin’s concept of material objective reality”, *Journal of the Xi’an Jiaotong University (Social Sciences)*, 24 (2004), 2: 69–75.
- [Wu10] Wu Kun, “The basic theory of philosophy of information”, paper, 4th International Conference on the Foundations of Information Science, August, 2010, Beijing.
- [WuB14] Wu Kun, and J. E. Brenner, “The informational stance: Philosophy and logic. Part II. From physics to society”, *Logic and Logical Philosophy*. DOI: [10.12775/LLP.2013.020](https://doi.org/10.12775/LLP.2013.020)

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