3 LIR AS A FORMAL ONTOLOGY

Abstract The components of LIR that will constitute it as a formal ontology, an interpreted formal system, from which the categories of LIR will be constructed, are completed in this chapter. The three components are: (1) its axioms; (2) the 'language' of LIR and its rather unusual semantics; and (3) the ontological constants and predicates which correspond to interpretations of the language. Additional sections address three concepts that are critical for the development of the LIR categories – dynamisms, processes and properties. A new definition of intrinsic and extrinsic properties is suggested. Comparison with classical logic is made in a section that reviews the metalogical properties of classical logics with those of LIR. The problem of the logical foundation of reality – being and existence – is discussed in relation to the fundamental LIR principle of dynamic opposition, and the position defended that metaphysics grounds logic and not the contrary. A brief discussion of abstract or non-spatio-temporal objects concludes the chapter.

3.1 REALISM AND FORMAL ONTOLOGIES

Before proceeding with the main development of my theory, a few comments are in order about the nature and role of a formal ontology and some associated logical and philosophical concepts, in particular, logical realism and natural realism. These ideas will be the basis for a later discussion of the particular LIR 'brand' of realism. Formal ontologies are generally divided into three kinds: representtational – a framework to represent information in as formal a mathematical manner as possible; descriptive – with the objective of correctly describing a certain domain of entities; and systematic – theories of what there is. Since LIR is a theory that is intended not only as description of the entities of reality but how they are related, I shall consider it a systematic ontology that is ontologically committed to those entities. In other words, in LIR, they are real and LIR is a realist system.

A potential problem arises here, however, since the term *formal* ontology is also understood as being a theory of logical *form* as well as a metaphysical theory about the ontological structure of the world. As such, it is subject to division into

another three kinds, based on three classical kinds of predication of universals: nominalism, which refers only to the use of universal terms in language; and conceptualism and realism, in which the universals provide the semantic grounds for determining whether a statement (predicate expression) is true or false of real things. Concepts do not exist independently of the capacity humans have for thought and language. The universals of realism underlie predication in reality – real states of affairs in natural realism, but also the propositions that constitute the objective truths and falsehoods of the world, the latter, as well as the former, are assumed to exist independently of the human capacity for thought and language. Logical realism, in this view, is a modern form of Platonism and its universals are assumed to exist independently of the causal structure of the world as well (Cocchiarella 1996).

The combination of logic and reality in the one phrase I have used to characterize my logical system might accordingly lead to a possible misunderstanding which it would be well to dispose of promptly. I have said that, LIR, the logic of and in reality, is a logic of real entities, and the latter implies that I am talking about a realist metaphysics. On the other hand, the term logical realism as indicated is usually taken to mean that the terms of *standard classical or neo-classical logics* are endowed with real characteristics. On this view, logical forms can provide a basis for logical necessities, and their connections could amount to logical 'facts'. This would yield a kind of logical realism as these 'facts' would be the ontological grounds for logical truth and inference.

Such a doctrine of logical realism (doctrine and not logic), that there could be any facts or matters of *logic* that obtain independently of our holding them to be true has been criticized by Resnik (1999). His argument is that logical (and mathematical) truths are obtained through deductive proofs and are insulated from experience, even although not immune to empirical revision.

The simplest thing to say is that logic in reality has nothing to do with logical realism, despite or better due to the fact that the PDO, the fundamental postulate of LIR is physical — as well as metaphysical. *It* is independent of human psychology, etc. in the same way in which other objects of our theories, but on other ontological grounds, since the logic that is referred to in logical realism is classical ideal and abstract logic.

If LIR then, can be clearly differentiated from logical realism, what about natural realism, as in Cocchiarella's conceptual natural realism? Natural realism, despite its name, is simply another system of predication about natural properties and relations with a mode of being that is analogous to that of predicable concepts: they are part of human cognitive capacities to identify, characterize and refer to real world objects. LIR supports this view: the fact that these capacities and concepts do not exist independently of human thought or language does not mean they are not "objective" as assumed in logical realism. On the contrary, I consider these entities to be *more* realist and hence more objective in the usual sense of the term.

In conceptualism, being and concrete/actual existence are formal, 'logical' concepts and not properties, or attributes, which things might or might not have. (The scare quotes around logical are the author's.) The being of natural properties or relations, that which is the subject of this study, on the other hand, does not consist in its being a characteristic of some object at some time or other, but rather the causal possibility of its being *in re* – that is, having a mode of being as such within the causal structure of the world. This is in other terms what the following categorial development of LIR will show.

3.2 THE LIR ONTOLOGICAL PREDICATES: DUALITY

Cocchiarella's view of formal ontology is "the systematic, formal, axiomatic development of all forms and modes of being". However, to repeat, it is difficult to assign anything more than formal existence to the entities of this ontology, much less any interactive or processual aspects (Cocchiarella 1991). LIR, on the other hand, is a theory about change. Change, or becoming, is thus *the* primary ontological predicate or categorial feature with which this theory is concerned as a formal ontology. The most significant ontological predicates of LIR that I will use are fundamental dualities that correspond to some fairly well defined commonsense notions, founded in what Seibt has called 'agentive' experience and intuition (Seibt 2001). The predicates implicitly defined by the initial axiomatization are the following, together with the notions to which they correspond:

• Actuality – potentiality	Present – absent
• Homogeneity – heterogeneity (diversity)	One(identity)–many

I have included as predicates actuality and potentiality that, since Aristotle, have been often considered categories rather than categorial features. I will leave them in this 'category' of predicates for the time being, since the emphasis, in Axiom **LR2** of Conditional Contradiction, is on the processes that 'are' potential or actual, as the case may be. I will return to *this* point after the ontology of LIR has been constructed.

Poli (2003) has shown the importance in philosophy of dual phenomena not only in ontology, but also in the relationship or correlation between their role in (classical) logic and ontology. Some additional pairs, which have been the subject of much philosophical discussion, are matter and form, one and many, and, especially, part and whole. Internal and external play an essential role in any discussion of biology.

The additional key ontological predicates that will receive an interpretation in LIR based on its axioms are the following:

• Intensity – extensity	Internal – external
• Local – global	Neighborhood–distance+xtensity part-whole

Other predicates that are also self-explanatory are

- Alternating
- Reciprocal

If the axioms indeed apply to these predicates, then one must accept, at this stage of the discussion, that they will display not only Conditional Contradiction, but also the relationships of Functional Association and Asymptoticity. Internal aspects of a phenomenon cannot be totally independent of its external aspects; similarly parts and wholes are not independent of one another.

It should be clear that at this point no characterization of these ontological predicates has been given, except that intuitively all predicates shown refer in some manner to dynamic aspects of reality. What this manner is and what relationships are involved will emerge from the further construction of the categories of LIR in Chapter 4.

3.3 THE DOMAIN OF ENTITIES: LEVELS OF REALITY

The domain of entities that is described by the axioms, language, constants and predicates of LIR is all of reality. This concept can be made more understandable by reference to the axioms, according to which entities and their opposites may be in states that approach classical limits of non-contradiction, in which case bivalent logic holds ‘to all intents and purposes’, or in states which instantiate contradiction or opposition between the two elements, eventually leading, in some cases, to the emergence of a new entity (T-state). The entities of LIR include all real physical and non-physical phenomena, including those in the former group. From a formal ontological standpoint, the sentences of LIR are thus interpreted over the domain of all reality, the extant domain.

3.3.1 Complexity Versus Levels of Reality

The notion of levels of reality outlined in Chapter 1 is useful in an additional connection, namely, to differentiate in a general way the domain of phenomena that are sufficiently complex or, in the Lupasco terminology, have an 'adequately' contradictorial relationship to require the use of LIR and those that are not. The key point is that complexity is not a smooth function of levels of reality. It goes from large values at the quantum level, through a minimum at the macrophysical level, increasing again at the biological level and reaching the largest values at the conscious human mental and social level.[1] Complexity is thus a function of the relative degree to which heterogeneity, diversity and contradiction (or opposition, antagonism) are the prevailing 'biological' tendencies as opposed to the 'macrophysical' tendencies toward homogeneity and identity. Domains exist throughout reality that are the consequence of what I might call emergent simplicity, and it is no more than commonsense to say that binary logic applies to them.

Energetic exchanges are a necessary but not sufficient condition for complexity. In a game of billiards, the cue stick and balls exchange energy, but the location of the complex processes of interest are in the mind of the player (intentionality, frustration, etc.). It is macroscopic systems that embody some form of coded internal representation of the processes being actualized that require a logic of the included middle.

3.4 LIR AS AN INTERPRETED FORMAL SYSTEM

A preliminary description of the logic of/in reality as an interpreted formal system can now be made: it is a formal system 'of a third kind' that is neither totally classical nor totally non-classical. This interpreted formal system can be designated as a formal ontology that is intended to structure all physical and non-physical reality, the *extant domain*. As such, it incorporates the elements of reality of both classical mechanics, described by classical logic, and quantum mechanics, which requires quantum logic, as well as 'everything else' at all levels of reality.

I do not wish, however, to conflate the notion of LIR as a formal, that is, categorial, ontology and LIR as metaphysics, since a more productive relation can be found between them. Smith (2004), for example defines ontology as the science or theory of being, of what is and how it is, but he makes no distinction between ontology and metaphysics. I do suggest, in addition, metaphysics specifically involves speculation about being, even about what may be beyond the range of human abilities to perceive or know. All knowledge is speculative to a certain

[1] My view of quantum systems should not be taken as implying some form of pan-consciousness.

extent. I rather prefer to see ontology on a par with metaphysics,[2] but that the latter be also concerned with aspects of reality that are to a certain extent non-rationalizable and have been consequently inaccessible to the formal (or orderly) procedures of logic. A new correlation between ontology, metaphysics and logic is thus possible, as will become clearer in the discussion of being in Section 3.7.

3.5 THREE CRITICAL CONCEPTS

The theory described in this book includes a number of unfamiliar perspectives. It will therefore be useful at this point to provide working definitions and discussion of three critical terms to be used, namely, dynamisms, processes and properties. The analysis of the current debate on the nature of properties provides a first illustration, at this early stage, of the operation of the LIR PDO in a philosophical context.

3.5.1 Dynamisms

I first propose that the term 'dynamism', used to designate intensity and extensity means, combining the dictionary definitions, that they are not only processes or mechanisms of the operation of energy, responsible for its development and motion, but also theoretical constructs that describe the universe in terms of energy. This definition of intensity and extensity, by this hypothesis, converges to that of dynamics, since they are themselves forces that together, in an antagonistic or contradictorial relation (conjunction), cause motion, activity and change.

If this is accepted, then what are the definitions and characteristics of actuality and potentiality and homogeneity and heterogeneity? These would appear to be intensive properties of real elements or entities to which could be assigned complex values as observables. At the same time, however, I have described change as involving actualization and potentialization, and the operation of homogenizing or heterogenizing forces, which as dynamisms would appear to have the character of processes. One now has the problem of the relation between actuality and actualization (or actualizing, homogenizing and so on). My preferred answer to this point is itself an illustration of LIR: the two terms, the noun and verb forms cannot be considered as totally separate and independent and one is not

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[2] Lowe (2006) has developed an alternate formal ontology as a basis of metaphysics. This approach retains, however, standard notions of categories and their underlying predicate logic that limit its applicability to real phenomena.

more basic than the other. There is always some degree of process to actuality and of property to actualization. One should be able to 'feel' an actuality-in-its-repressing of something antagonistic to it that would, if it could, cause it to change, rust, shatter, degrade, or disappear, on an appropriate time scale that is defined for each case.

This now leaves us with the two terms of process and property that require further explication and differentiation.

3.5.2 Processes

Process, like level, is one of those terms that are commonly used without sufficient attention to its implications. Processes can be defined simplistically as phenomena involving orderly change, a series of actions or operations taken to reach an end. However, if processes constitute the world of experience – from nature to social reality to perception and cognition itself – they should not be represented in a reductive fashion – in terms of their results, input-output pairs, or by static computational or discontinuous, step-wise interpretations involving static identities, in which the underlying dynamics has been occulted.

In my view there are two, related analytical jobs to be done. The first is to give processes their proper conceptual role in theoretical descriptions of nature *via* a proper ontological classification of types of dynamic entities, in other words, statements about types of dynamics. Here, as in any ontological category, the processes under discussion are theoretical entities and the dynamics involved are non-developmental. The second task is to describe real dynamisms or dynamics in terms of the fundamental properties of whatever it is that causes the change, which in my view can only be energy, subject to a needed revision of the concept of cause. Such a description has been started above. Complex processes, the consequence of the interactions of processes and processes of processes (systems of systems, illustrated by the series of series of ortho-deductions of Chapter 2) are defined as the result of the operation on energetic elements of logical operators that are themselves dynamisms (e.g., implication, conjunction, disjunction) involveing changes in energy, that is, considered as real, constructive actions.

To complete the description, however, we are still left with the need for a better understanding of the meaning of property and of the relation between property and process.

3.5.3 Properties

The concept of properties is a very old and complex one in philosophy (Swoyer 2000), but the point of introducing it here is that it plays a central role in

discussions of reality and description of reality in terms of laws of nature. In addition, since I discuss aspects of a wide variety of entities that are supposed to have something in common, the processes or dynamisms according to which they evolve in time, properties may provide a general way of explanation in the direction of some pattern or unification.

Properties can be: (1) *defined*; (2) their *nature established*; and then (3) *used* to explain phenomena in all the disciplines mentioned, including metaphysics, natural science or 'naturalistic ontology', the philosophy of mathematics and the semantics of natural language. I have designated several aspects of the elements of my system as 'properties', and it seems correct to say that they fit a general theory of properties. An acceptable minimum theory could include the following, recognizing that each of these points itself has given rise to debates, some of which I will address later:

- Properties include relations, as well as attributes, qualities and features of phenomena. Processes are instantiated or exemplified and the 'things' – processes, objects, relations, etc. – that exemplify a property are instances of it.

LIR: Being actual or potential, or being actualized or potentialized are thus properties.

- Properties can be cited to explain or account for change, as well as other phenomena of philosophical interest, provided adequate reference is made to additional background assumptions or underlying mechanisms rather than only state observations (pale skin yesterday, red skin today, but red due to staying in the sun too long, rather than just because paleness and redness were exemplified at different times). Properties are intensional entities that describe the *intensional* aspects of phenomena, and in this sense provide a picture of reality that is not 'abstract'.

LIR: My explanation of energy in Chapter 4 in terms of extensity and intensity as properties is metaphysical, since such properties are clearly not observables, for example, in the case of some electromagnetic radiation, but also physical since they are postulated by the best available physical theories. I will show later that LIR supports a specific kind of scientific realism. No properties or elements are invoked in LIR's account of properties that are outside the laws of physics, but the existence of dynamic opposition provides an additional element of structure.

- Properties can explain sentences in terms of a concept of logical linguistic form, and compound properties can be built up from simpler ones by logical operations equivalent to conjunction, negation, etc.

LIR: Properties can explain phenomena in terms of a concept of logical dynamic form. Complex properties can be built up from simpler ones by logical operations seen as dynamisms.

One area of controversy is that of the instantiation of properties. *Instantiation* has been viewed as a relation but not a normal one: as a link of an entity to a property, it would seem to result in a need for a relation of relations and consequently an infinite regress. In LIR, a relation of dynamic opposition can be postulated between entity and property such that they mutually instantiate each other as dynamic, real systems. It is these systems that are the *objects-in-reality* that are the equivalent, in my theory, to the logical objects of standard logic. One does not need concepts such as 'non-relational tie', metaphysical glue, or metaphors like links in a chain. It explains the idea that 'instantiation just relates', or is metaphysically self-adhesive. Further, iteration, in this case of *real* relations, stops after two or three stages because no new information is added by subsequent stages. An interesting example is the proposal of storing information in quantum systems, not in the relationship among quantum objects, but in the relationship among the relationships. I do not share the general view that such moves are further abstractions, since according to the principles of LIR they fit the category of dynamic opposition, and the consequent epistemology provides the necessary basis for stopping the potential infinite regress.[3]

As a corollary of the above, it is not necessary to call properties of phenolmena concrete as opposed to non-spatiotemporal entities like meanings or concepts. A stark dichotomy between the terms abstract and concrete in relation to properties can be avoided by seeing them, also, as the elements of a dynamic contradictorial conjunction (entity and its dual). Thus the properties or qualities 'of ' a phenomenon, or associated with one, are abstracted from it, not in the sense of being non-real, but for the purposes of analysis.

Finally, LIR solves the problem of *negative properties*, since no real properties are absolutely positive or negative, and a property *F* is a more or less actual or potential part of the negative property *being a non-F*. The absolute contradiction is removed by the interactive alternation of actualization and potentialization.

There are thus conclusions to be drawn regarding the relation between properties and processes. Seen dynamically, a property, redness, is a becoming, the result of a series of processes and processes of processes in different systems culminating, say, in the pigment in the skin of the tomato and my being positioned in front of the tomato, which then appears red to me. Processes can also be seen

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[3] Basically, the LIR idea is that the elements of knowledge and the knowledge of that knowledge are in a contradictorial relationship that exhausts the available mental configuration space. They are self-sufficient, and no new information is generated by additional iterations. It is possible to *imagine* the infinite regress as a process that does not stop, but in reality one stops it, or it stops itself.

not only as properties, but also as the consequence of sequences of properties as processes. But processes and properties do not have to be considered totally the same or different. They reciprocally define each other according to whether one focuses attention on the (relatively) static or (relatively) dynamic aspects of the phenomenon.[4] The definition is not circular since in reality, neither process not property return to the exact point of departure. Compound processes and properties are thus both the consequence of the exemplification of series of properties, the ones 'at the bottom' being those, as we will see, of energy itself.

The logics proposed to date as applicable to theories of properties have been standard, consistent, bivalent logics from which any principle of contradiction, conditional or otherwise, is absent. Much effort has been expended to define identity conditions in such classical logical approaches to properties, as well as other things. These are replaced in my LIR system by conditions of identity to-all-intents-and-purposes, without the absoluteness of identity as an *a priori* metaphysical or logical principle. If a logic contains the former notion of identity conditions, it will inevitably be an idealization, at least to this extent. The property of being a property is itself a property, but the LIR approach avoids the problem that the self-instantiation or self-exemplification of a property leads to paradox in binary systems: a property *does* exemplify itself, but in reality, not quite identically so.

3.5.3.1 Intrinsic Versus Extrinsic Properties: Relations

All properties are instantiated by things that exist in space and time or, if properties can themselves instantiate properties, each property is part of a descending chain of instantiations that may or may not bottom out in individuals. The *location* of exemplified properties refers to where they are instantiated in space-time. The principle of instantiation implies that properties are located in their instances, but they can be of two kinds, intrinsic or extrinsic. Intrinsic properties are normally defined as being those which an object may possess independently of everything else that exists. Typical properties are the mass and charge of particles in classical physics or the size and shape of an individual human being. All other properties are extrinsic or relational: weight, which depends on the presence of a gravitational field, relational properties such as being the brother of, and spatio-temporal location. In quantum systems, intrinsic properties are those that do not depend on the state of the system and extrinsic properties do.

The fundamental axioms of LIR imply a major change in the definition of intrinsic and extrinsic properties. No property of a system that is involved in some form of dynamic interaction, that is, at the quantum level and the biological and

[4] Similar considerations apply, I believe, to category and category feature, particularly in the case of actuality and potentiality (actual and potential). Since there are advantages to both uses, and no obvious disadvantages except to theory, I am inclined to take a pragmatic position on this issue.

mental levels can be, according to Conditional Contradiction, separated from its opposite or negation. All properties are partly intrinsic and extrinsic, their internal and external aspects alternately actualized and potentialized. Only at the level of macroscopic objects *qua* that level is it justified to one speak of a, for example, a spatio-temporal property as extrinsic to-all-intents-and-purposes. This will have important consequences for the ontology of LIR, that is, the entities by which it considers that reality is constituted, and for the LIR view of scientific and structural realism.

Following Esfeld (2003) I do not distinguish relations from relational properties. As noted, relations are also properties in that they are predicated of things, but for entities in an interactive relation, relations *are* the relational properties. The LIR approach to properties will find further application in the discussion of the metaphysics of relations, e.g., whether they require underlying properties upon which the relations supervene.

Implicit in the above discussion is the problem of the differentiation, in LIR, between an uninterpreted and an interpreted system, and how goes from one to the other. In the usual definition, the former applies only to the elements in the domain of theories and the latter to the theories *per se*. In LIR, this strict separation, which is, again, a reflection of the principle of bivalence, cannot be maintained.

3.6 SOME METALOGICAL CONSIDERATIONS

It should be clear by now that what I have proposed is a new way of 'doing logic' that is much more radical than a change in the established object-process-property terminology. This is a metalogical consideration, since it discusses the logic of a logical system and the major components of that system, its rules and relations.

The metalogical properties of a logic as a system of reasoning about propositions, capable of formalization in a symbolic language, are usually considered to be their completeness, compactness, soundness, among others. (Whether or not consistency is still an accepted metalogical principle has become, however, a matter of predilection with the advent of paraconsistent logics.) Metalogical properties are usually couched in a meta-language, which can be ordinary mathematical English, augmented by some metalinguistic symbols, in which accounts of the validity of inferences made in the formal language of the logic, the object language, are given. The two common notions of validity are semantic, or truth-preserving and proof-theoretic, for which the symbols are $\vdash$ and $\models$ respectively.

Consistency, completeness and soundness proofs in standard logical metatheory can be found in any standard text and will not be reproduced here.[5]

In comparing, for example, the foundations of two-valued logic with unrestricted acceptance of the principle of bivalence with the three-valued logic of Lukasiewicz, the number of values is a metalogical principle. In LIR, it is not only the *number* of values that is metalogical, but also their properties as properties of real processes.

The metalogical properties of LIR are thus of an entirely different kind, since it is based on a view of nature that does not consider fundamental either the abstract entities of pure classical propositional or mathematical logic or the anthropomorphic ontological concepts of phenomenology. The most fundamental metalogical principle of LIR is that of opposition or antagonism, without which, in this view, nothing could exist (see the next section). This is, therefore, at the same time the most fundamental metaphysical principle of LIR. Nothing exists independently of something else in the formal ontology of LIR.

A key metalogical question is, if there are several logics that are candidates for a particular application, how is one to choose between them? As put by Dummett (1991), if one has a metaphysical doctrine yielding consequences for logic, how can one decide (logically) for or against the metaphysical premises involved? The above metalogical concepts suggest the answer to this question about the logicality of the choice of logic. If one has a choice of logics, one may indeed have to look for non-logical criteria in order to decide between them. Thus, a choice between two logics *is* non-logical in classical terms, and one could be said not to be making a genuine (logical) choice. On the contrary, if the choice of logic is logical, can one be said to be choosing it?[6] This problem disappears in the metalogic of LIR, since in LIR no pairs of entities, including the dialectical processes of choice, are absolutely separate. An interactive connection involving their alternate (predominately, not absolute or complete) actualization and potentiallization is present at the level of their meaning and of the physical existence of their referents. Any choice one makes is both logical (in the sense of forced, in the direction of an identity) and non-logical (in the sense of being partly arbitrary, which is a notion of diversity), and this is a *logical* state-of-affairs in LIR. *I* may always choose LIR as my preferred logic, but the potential for my choosing classical logic is always present, and indeed I will actualize this choice in applicable cases.

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[5] Metalogic was extensively used by Lesniewski as a way of checking that contradictions were *absent* from a sequence of reasoning (Simons 2002). Curiously, in Lesniewski's early work, he seemed concerned that mathematics should be able to "capture the heterogeneous reality of the world" and that logical systems should retain a dimension of attachment to the real (Peeters 2006).

[6] The question of what logic to use to choose a logic for scientific rationality and criticism has been discussed by Bueno and da Costa (2007), who come to the obvious conclusion in favor of logical pluralism.

3.7 THE LOGIC OF BEING

This is a book about reality and its logic, but what is the reality that I am presenting a logic about? Some readers may feel that the description of reality and the real in Chapter 1 is too cursory. It does not give an adequate definition of what it means for something to be or exist, that is, an answer to the question of being, and to the related question of why anything exists at all. When I say that the limits of classical logic, among other things, do not exist in reality, I am making a statement that stamps me as someone capable of discerning what does and does not exist, but my position has not been justified.

Well-known attempts to provide answers to the questions of being are those of Heidegger and Sartre. Heidegger located a concept of being in the irreducible presence of the human mind in the world – *Da-Sein*. Sartre (1943) developed an ontology consisting of two distinct, irreducible and mutually exclusive categories of being-in-itself (*en-soi*), essentially unconscious, and being-for-itself (*pour-soi*) which is a characteristic of consciousness. The two are combined or mixed in human beings. The in-itself corresponds to physical matter considered as passive and inert and self-identical, while for-itself is dynamic and non-self-identical. It is a no-thing, the *néant*, an internal negation or nihilation of the in-itself. Both of these existential views are phenomenological, requiring a human a human observer, and are open to the critique that being, or most of it, seems to be independent of human observation.[7]

In his monograph on formal ontology, Jacquette (2002) criticizes such ontological approaches as circular, using aspects of about ourselves as human beings to define being. He challenges metaphysicians to answer the pure philosophical ontological question of existence before defining its various possible categories *via* an appropriate applied scientific ontology. I have accepted this challenge, that is, to carefully define, as far as possible, a concept of being as a matter of philosophical (metaphysical) ontology before developing an applied ontology of the kinds of things in the world that will be consistent with it.

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[7] There are many deep intuitions in Sartre of duality and alternating potentiality and actuality as fundamental, e.g., when he says that the both other and I are co-responsible for the existence of the other *via* two negations, such that I cannot experience one without its immediately masking the other (Sartre 1943). He is unable, however, to avoid the consequence of his total separation of the *en-soi* and *pour-soi* and the resulting contradiction in the appearance of consciousness in the *pour-soi*. LIR can be seen as an explanation of his phrase "everything happens as if the *en-soi*, in a project for founding itself, gave itself the modification of the *pour-soi*". The LIR metaphysics in fact provides a hypothesis for how this "absolute event arrived that crowned the individual adventure which is the existence of being." The *en-soi* had the potential for the *pour-soi* in the first place. Among other things, my approach avoids the need for trying to decide whether *être* or *néant* has ontological priority.

Jacquette's work is especially relevant to LIR because he bases his own response to the question of being on *logic*. Jacquette proposes that pure[8] classical logic can be used in a combinatorial fashion with reference to logical objects and their logical properties, combined into all possible logical states-of-affairs. The set of all such combinations is sure to include one maximally consistent (consistent and complete) combination that represents the actual world in its logical contingency. It should be pointed out, however, that Jacquette's position is that the questions of pure philosophical ontology for which classical logic offers insight are *conceptual*, asking what it *means* for something to exist, rather than an attempt to characterize what actually exists.

The problem with this picture is the major assumption implied by the statement that (classical) logic is entitled to speak in an ontically neutral and noncommittal way of objects and properties. "What could possibly be more basic than something's having or not having a property?" (Jacquette 2002) In my view, the assumption in the question about "something's having a property" *already* implies that (1) 'something', referred to without qualification, exists in some fully separate fashion; and (2) 'something' can only either have or not have a property. This raises the specter that the real world may not correspond to the above maximally consistent combination, if the assumption is incorrect. The logical objects and (properties) relations are those of pure classical binary logic, adapted from *its* use of linguistic forms. If these do not exist, then no combination of them, however, exhaustive, would include the real world and generate a meaningful description about the nature of existence.

Jacquette is aware that his view of the logical possibilities and logical properties of the world as existing constitutes an ontological commitment but believes it is minimal: it is logic that is ontologically committed to these logical possibilities, and only secondarily the combinatorial analysis that makes use of them. In fact Jacquette's argument as to why there is something rather than nothing is simply a restatement of this minor (?) ontological commitment: "…for there to be something is for a particular type of object-property combination to be logically possible. The actual world with no phenomenological baggage exists as the direct implication of pure logic involving a maximum consistent logically possible state-of-affairs or object-property combination". The alternative is dire: since logic is needed as a theory of logical possibilities and of the possession of properties by objects, if one does without logical possibilities, "then we will have to do without logic" (Jacquette 2002).

My conclusion is less pessimistic. Based on combinatorial analysis *only*, if the actual world is logically possible, it is logically necessary. In this conception its modal status is logically contingent, a matter of pure chance, a position ascribed to Hawking, Heisenberg, Einstein and Dirac, among others. In the alternative

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8 Jacquette also talks of pure philosophical ontology, but I must confess to an aversion to the term 'pure', used frequently by philosophers of the caliber of Husserl and Sartre. In my view, as a term of absolute exclusion, it fails in its objective of strengthening an argument or explanation, insuring only that its terms remain in a domain of abstractions.

realist logic I propose, a new definition of logical necessity and a contradictorial relation can be found between necessity and contingency, and the concepts of LIR and the insights of Jacquette partly converge. It thus may not be possible, with a pure philosophical ontology, in which concept and ontological commitment are kept separate, to say something meaningful about the world, and the question of why there is something rather than nothing may be badly posed. Ontology indeed demands a correct philosophical metalogic, but the principles of such a metalogic cannot be totally separated from the physics of the world, i.e., a scientific ontology.

My own first *logical* response to the question of being, that may meet the criterion of no prior commitment to *what* that being is, is to say that it is different from non-being. Being exists by virtue of this difference from, and in the LIR approach opposition to, non-being. To understand being means to me not only understanding non-being, but to understand the relation between them.

Rather than referring to standard 'pure' logical objects to further characterize being, in the metaphysics of LIR, it is assumed that at least one real system exists, composed of at least two process entities, plus the antagonistic relation that enables them to exist as that system (cf. Appendix 2 for further de-tails). Thus I claim that being as something fundamental in the universe cannot be delivered by bivalent logic, but it can by LIR. LIR is perhaps less purely *a priori* than Jacquette's system, but it is in my view the most that can still capture the real world. In other words, no logic, not even the logic of/in reality, can ground metaphysics; metaphysics grounds logic.

The reason is the following: without, as correctly emphasized by Jacquette, yet making any ontological specification of what any of the things in the universe are, I note the existence of duality, two-ness, even in bivalence. Another way of saying this is that 'as soon as' there is duality in the universe, being and non-being, one has *negation*, one thing *not* being the other, that is, at least *that* relation between them. I noted in Chapter 1 that classical logic expresses formally the requirement that one thing must exist but not that two must exist. This aspect of standard logic should not be taken as a 'proof' of anything; I call attention to it simply to compare with what I believe is a more realistic starting point for a discussion of being. I have discussed my view of properties above. Although most people would say that the difference between the properties of existence and non-existence is about as great as it can be, I feel the two entities and their relation also exist as a logical consequence of the fundamental postulate of LIR. In LIR, however, this does *not* require that to exist is to be predicationally maximally consistent.

The philosophical problem thus focuses on the nature of the relation between the minimum of two things in the universe: the 'two things' can be considered either an unconnected duality or a connected duality. Standard logics – bivalent, multivalent, intuitionist, paraconsistent, etc. are neither more nor less than expressions of the former position. LIR is the expression of the latter, and neither more nor less logical than the first.

The most significant statement made by Jacquette is that "it would make logic too important if we were to interpret the facts of the world, beginning with the descriptive facts and laws of natural science, as a matter of metalogical necessity", as this would, in his view, require that we give up the logical or even physical contingency of the actual world. He feels that this would collapse all presumably (sic) distinct logically possible worlds into the one and only actual world *vs.* the ordinary assumption that it is minimally logically possible for particular facts of the actual world to be other than they are. In my view, however, this argument tells us nothing about the real world. It is a category error (see Chapter 4), since possible worlds are totally separated from the actual world. The argument is simply a restatement of the logic assumed. The relation of necessity and contingency that I propose hopefully will reduce the fear that contingency will disappear below the phenomenological horizon.

3.7.1 Abstract, Non-real, Non-existent and Non-spatio-temporal Objects

I have already differentiated on several occasions between abstract or ideal objects, limits or relations and real or concrete ones. Since I now have a preliminary concept of being, these intuitive notions can and should be made more precise, since the different kinds of what are also called fictional or imaginary objects have been subjects of intensive debate since antiquity and still are.

Jacquette in summary says that non-spatio-temporal objects have only abstract being, a category separate from physical being or existence in applied scientific ontology. Jacquette develops a conception of the being of abstract entities using the same strategic combinatorial criterion: if an entity satisfies the requirement of maximum consistency, predicational consistency and completeness, then it exists in its domain. In this case, from the LIR standpoint, the argument works. We know what it means for abstract entities to exist, have being, because by definition they are self-consistent and complete. They meet the criterion because they do not involve energy nor undergo change, and the principles of classical logic obtain.

Priest (2005) makes a strong case for non-existent objects being a part of our real world, using a concept ('noneism'), and a classification that is consistent with an energetic mental process of the creation of such objects, as described by LIR for all such processes. Some of these non-existent objects are consistent, others are inconsistent, as one might expect in view of the generality of the application, in this domain, of the Gödel theorems.

The key point about non-existent objects is that they are real, that is, they are part of our real world, and, as originally indicated by Meinong, they can have properties. One has a long list of candidates for non-existent status – abstract

objects, properties, relations, propositions and above all mathematical objects and fictional objects. I first point out that all of these are the result of human mental processes, but they differ from the LIR point of view in their ability to undergo change. This is similar to Priest's useful counterfactual criterion that defines an abstract non-existent object as one such that if it did exist, it would still not causally interact with us. A concrete non-existent object is one such that if it did exist, it would (or could) casually interact with us. Examples of the former category are numbers, triangles and so on and of the second fictional characters, but the division is not absolute, and problem cases will not concern us here.

An example of greater interest is an 'object' such as a scientific theory. The abstract object 3 or a proposition of classical logic do not change, but a theory, which is non-existent according to the concept above, would seem to undergo changes that are different from simple iteration, adding 1 to 3 to get 4 and eventually all the integers.[9] Priest's concept is that a theory containing facts about non-existent objects can tell us about existent objects because a correlation exists, the properties of both have the same structure, and bridge laws or principles, which express this isomorphism, allow us to move back and forth between mathematical objects and physical states. What, however, might these bridge principles be that would be general enough to insure that one has the right properties in the right place?

My interim conclusion is that at least in some cases, it is not possible to maintain an absolute separation between the apparently non-existent and the existent, specifically, a theory and the data of that theory.[10] It is the interaction between the two, expressed by the LIR principle of dynamic opposition that insures the correlation and the co-evolution of the objects in the 'two worlds'. Theories then, like ideas and concepts, while not spatio-temporal in the usual sense, as models or informational structures share some of the dynamic properties of physically existent objects.

The conclusion of this discussion is that both of the above approaches contain valid insights into the complexity of what is designated as being and non-being, with a logical basis in either standard classical or paraconsistent propositional logics. LIR allows *axiomatically* a degree of incompleteness and inconsistency that is the justification for its acceptance as a theory of reality, and the principles outlined in this chapter will facilitate the LIR framework for the discussion of conceptual levels and relations in Chapter 5.

With this in mind, I will now construct the categories that will constitute the formal ontology of LIR. Before proceeding with this construction, some further general remarks are in order about ontology and categories, with which I will begin the next chapter.

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9 The nature of theory change is an important sub-topic of scientific realism for which an LIR interpretation will be given in Chapter 6, see also Boyd (2002).

10 In Section 3.1, I discussed Cocchiarella's view of formal ontology as "the systematic, formal, axiomatic development of all forms and modes of being". As we saw, it is difficult to assign anything more than formal existence to the entities of this ontology, much less any interactive or processual aspects (Cocchiarella 1991).

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