Uniwersytet
Kardynała Stefana Wyszyńskiego
w Warszawie

Towards a Contemporary Ontology

The New Dual Paradigm in Natural Sciences: Part II

Module 5: The formal ontology of the natural realism (NR): I

Course WI-FI-BASTI2

2014/15

Introduction

Module 5: ” The formal ontology of the natural realism (NR) I: logical vs. causal inference”

Course modules

Modules	Topic	Suggested Readings
	SECTION ONE	
0.	*Introduction and Course Overview*	
1.	QFT: an evolutionary interpretation of nature from cosmology to neuroscience	Refs.: **1-5.**
2.	QFT in fundamental physics and the Aristotelian-Thomistic ontology of nature	Refs.: **6**, chs. 5-6; **7-8.**
	SECTION TWO	
3.	Formal philosophy and formal ontology	Refs.: **9-11.**
4.	The formal ontology of the conceptual natural realism (CNR)	Refs.: **12-15.**
	SECTION THREE	
5.	The formal ontology of the natural realism (NR) I: logical vs. causal inference	Refs.: **16-18.**
6.	The formal ontology of the natural realism (NR) II: logical vs. causal inference: Aczel sets and coalgebraic modal logic	Refs.: **19-24.**
	SECTION FOUR	
7.	The formal ontology of the natural realism (NR) III: the duality logical/ontological truth	Refs.: **24-28.**
8.	*Conclusions*	

Bibliography

Bibliography of the Module 5

Bibliography

- **Main References**:

1. G. Basti, «From formal logic to formal ontology. The new dual paradigm in natural sciences», in *Proceedings of 1st CLE Colloquium for Philosophy and History of Formal Sciences, Campinas, 21-23 March 2013*, Fabio M. Bertato (ed.), Campinas UP , Campinas, 2014. [attached]

2. N. B. Cocchiarella, «Logic and ontology», *Axiomathes*, 12 (2001), 117-50; [attached]

3. Nino B. Cocchiarella, *Formal Ontology and Conceptual Realism* , Springer Verlag, Berlin-New York, 2007 (available as lecture notes series at PUL in a zipfile) [attached]).

- **Other references:**

4. J. W. Garson, «Quantification in modal logic», in *Handbook of Philosophical Logic. Second Edition, Vol. III*, D. Gabbay e F. Guenthner (eds.), Springer , Berlin-New York, 2001, pp. 267-324.

Bibliography II

5. G. Basti & M. Shahid (Eds.), *Ontologia formale e ontologie. Uno strumento per il dialogo interdisciplinare e interculturale,* Editrice Apes, Roma, 2015 (in press: with contributions of Habermas, Searle, Ales-Bello, etc.).
6. A. Ales-Bello, «Ontology and phenomenology». In: Roberto Poli – Johanna Seibt (eds.), *Theory and Applications of Ontology – Philosophical Perspectives*, Springer, Dordrecht 2010, chap. 14, 287-328 [attached]

Module 5

The formal ontology of the natural realism (NR) I : Logical vs. Causal Inference

Quine criticism to C. I. Lewis modalization of the logical implication I

- In the first chapter of one of his masterpieces, *Mathematical Logic,* W. V. O. Quine, rightly emphasizes the difference between **the semantic sense** of the term “implies”, strictly related with the notion of “truth”, and **the syntactic sense** of the logical connective “if… then” and of its symbol “⊃”.

- Based on these considerations too often neglected, Quine criticizes, on one side, **Whitehead and Russell**, who blurred in their *Principia* such fundamental distinctions, and, on the other side, **Lewis and Smith** who, trying to solve such a misunderstanding, essentially missed the point.

  - In Whitehead and Russell's exposition and terminology the distinction between predicate and statement connective is blurred. The notation “___⊃___” is explained indiscriminately in the sense of the truth-functional conditional and in the sense of material implication. It is translated not only thus:

    (14) If___then___

    but also thus:

    (15) If___is true then ___is true
    (16) ___is false or ___ is true
    (17) ___implies___

    (…) Actually, as we have seen, the blanks in (14) admit only statements, whereas those in (15)-(17) admit only **names of statements**. (…)

Quine criticism to C. I. Lewis modalization of the logical implication II

- On the topic of implication, Whitehead and Russell have many critics, who rightly object that the trivial relation of material implication expressed in (16) is too weak to constitute a satisfactory version of (17). But it is seldom observed that this objection does not condemn the truth-functional conditional '___⊃___' as a version of 'if___then___'.
- Lewis, Smith, and others have undertaken systematic revision of '___⊃___', with a view to preserving just the properties appropriate to a satisfactory relation of implication; but what the resulting systems describe **are actually modes of statement composition** - revised conditionals of a non-truth-functional sort - rather than implication relations between statements.
- If we were willing to reconstrue statements **as names of some sort of entities**, we might take implication as a relation between those entities rather than between the statements themselves; and correspondingly for equivalence, compatibility, etc. (…).
- The statement: 'All men are mortal' might be held to designate that abstract entity, whatever it is, which we ordinarily designate by the substantive 'that all men are mortal'. A deterring consideration, however, is the obscurity of these alleged entities. What are they like? And under what circumstances may the entities designated by two statements be said **to be the same or different entities?** (Quine, 1983, p. 31-32).

Quine criticism to C. I. Lewis modalization of the logical implication III

- With these words, it is evident that Quine is saying us that a satisfactory theory of ontological implication has to be:
  1. A theory of *metaphysical* and not *logical* implication, and hence of *causal* and not *logical* necessity, because it has to deal with relations among existing *entities* and not among statements on them.
  2. A theory able to justify on a causal basis either the “differences”, or the “identities” among the denoted entities.
  3. A theory able to illuminate, on the same causal basis, the alleged “obscurity” of such referential entities that are, in the light of Quine’s example and of the precedent discussion, “natural kinds” or, if we want to use a word banned from the modern philosophical jargon, “natural essences”, or in short, “natures”.
  4. Finally, a theory able to give also an ontological foundation of the notion of *truth,* given the strict relation existing between the notions of “implication” and of “truth”.
- Even though this is not in continuity with Quine’s teaching, who always criticized the notion of “natural kind” as “objects” to which the common names refer. “Natural kinds”, however, both in NR and CNR, are not “objects” at all.

A Middle-Age suggestion I

- So Aquinas commented a passage of the Aristotle *Physics,* where he distinguishes between the logical and the causal necessity.
- “Next where he [Aristotle] says, ‘Necessity in mathematics ...’ (200 a 15), he compares the necessity which is in the generation of natural things to the necessity which is in the demonstrative sciences. (…)
- Indeed, an ‘a priori’ necessity is found in the demonstrative sciences, as when we say that since the definition of a right angle is such, it is necessary that a triangle be such and so, i.e., that it have three angles equal to two right angles. Therefore, from that which is first assumed as a principle, the conclusion arises by necessity [i.e., the logical necessity of the *modus ponens*].
- The converse, however, does not follow, i.e., if the conclusion is, then the principle is. Because, *sometimes*, a true conclusion can be drawn from false propositions. On the contrary, it does follow that if the conclusion is not true, then, neither is the given premise true. Because, a false conclusion can be drawn only from a false premise [i.e., the logical necessity of the *modus tollens*].

A Middle-Age suggestion II

- **On the contrary, in things which happen for the sake of something** (*quae fiunt propter aliquid*), either according to technique, or according to nature, this converse does obtain [i.e., according to the connective of the *converse implication*]. For, if the final state (*finis*) either will be or is, then *it is necessary* that what is prior to the final state either will have been, or is [i.e., it is not question of time]. If, however, that which is prior to the final state is not, then the final state will not be, just as in demonstrative sciences, if the conclusion is not true, the premise will not be true [i.e., both in direct and converse implication if the antecedent is false, the consequent is false too].
- It is clear, therefore, that in things that come to be for the sake of a final state, **the final state holds the same order that the premise holds in demonstrative sciences**. This is so because the final state also is a principle, not indeed of action, but of reasoning. For, from the conclusion we begin to reason about those things that are the means for reaching such a conclusion. In demonstrative sciences, however, we do not consider a principle of action, but only a principle of reasoning, because there are no actions in demonstrative sciences, but only demonstrations.
- Hence, in things that happen because of reaching a final state, this properly holds the place that the premise holds in demonstrative sciences. Hence, there is a similarity on both sides, even though they seem related conversely **because of the fact that the end is last in action, which does not pertain to demonstration** (Aquinas, *In Phys.*, II, 15, 5) [Square parentheses are mine].

A Middle-Age suggestion III

- Aquinas suggestion is thus double:
  1. The logic of the emergent complexities in physics (form generation), and/or of the spontaneous symmetry breakdown of the infinitely many quantum vacuum conditions in QFT, **is the logic of the converse implication a far as it does not concern inferences, but actions**, i.e., the logic of the **causal necessity** (= formal causality) as irreducible to the logic of the **logical necessity**;
  2. If we want to have a proper formal ontology of the causal necessity, as far as it is not reducible to the logical necessity, we need to give *a* **modal version of the converse implication** as the proper logic (syntax) of the **causal entailment (semantics)***.*

A Middle-Age suggestion IV

- In other terms, just as the modal version of the material implication, i.e., the so-called “strict implication” of C. I. Lewis gives a definition of the **logical entailment** (from the premise(s) to the conclusion), i.e., **“*q* follows logically from *p*”** the opposite holds for the **causal entailment** (from the effect to its cause(s)), i.e., **“*p* precedes causally *q*”,** given that this latter is a **transition between states of the world,** while the former is an **inference between statements.**

The logic of the strict direct implication I

- As we know, C. I. Lewis defined the notion of strict implication for avoiding the well-known paradoxes of implication related to the notion of the truth-functional conditional “if-then”, interpreted as **material implication** of the mathematical logic.
- I.e., given the truth table of the material implication:

	p	q	$p \rightarrow q$
1.	1	1	1
2.	1	0	0
3.	0	1	1
4.	0	0	1

The logic of the strict direct implication II

- Several paradoxes, the so-called “paradoxes of the material implication”, follow from this truth table, such as (Huges & Cresswell, 1996, p. 194):
  1. $p \to (q \to p)$
  2. $\neg p \to (p \to q)$
- I.e.: (1) given a true proposition, any proposition, either true or false, can imply it; (2) if a proposition is false, it implies any proposition whatsoever. Moreover, since for any proposition *p,* either the antecedent of (1), or the antecedent of (2) must be true, also the following paradox holds:
  3. $(p \to q) \vee (q \to p)$.

The logic of the strict direct implication III

- For avoiding such paradoxes it is sufficient, Lewis suggests, to make “stronger” the notion of “implication”, so to distinguish between implications that hold materially, and implications that hold **necessarily or strictly**, namely, it is necessary that if *p* is true, so is *q*. From this the definition of the “strict implication”($\twoheadrightarrow$) follows:

$$(\alpha \twoheadrightarrow \beta) := (\Box(\alpha \rightarrow \beta)) \leftrightarrow (\neg\Diamond(\alpha \wedge \neg\beta))$$

- Practically, it is like if we eliminate from the truth table of the material implication the 2nd row, so to grant the fundamental law of logical semantics that *truth is always preserved in any valid inference*, that is:

The logic of the strict direct implication III

	p	q	$p \twoheadrightarrow q$
1.	1	1	1
2.	1	0	0
3.	0	1	1
4.	0	0	1

- This semantics, however, originates the so-called “paradoxes of the strict implication”. They, unfortunately, are **as many very strong ways for asserting that the so-called “principle of Pseudo-Scotus”** or the **“principle of explosion” (EP)** (*ex contradictione sequitur quodlibet*) **is a valid inference in logic** (see paradox (1) below). According to (Huges & Cresswell, 1996, p. 203) a list of such paradoxes is, indeed, the following:

The logic of the strict direct implication IV

1. $(p \wedge \neg p) \twoheadrightarrow q$
2. $q \twoheadrightarrow (p \vee \neg p)$
3. $\neg\Diamond p \to (p \twoheadrightarrow q)$
4. $\Box q \to (p \twoheadrightarrow q)$

- Now, Lewis himself stated that, if we want to avoid (1) and the other related paradoxes, we have to exclude other intuitively valid principles, before all the so-called **“principle of the disjunctive syllogism**”:

$$((p \vee q) \wedge \neg p) \twoheadrightarrow q$$

The logic of the strict direct implication V

- However, for excluding this principle, it is necessary to refer to the so-called **relevance logics** (Huges & Cresswell, 1996, p. 205), i.e., it is necessary to define **a valid criterion of *relevance* of a premise as to a given conclusion**,
- This means using **the notion of *paraconsistent* negation**, refusing the general validity of the **same extensionality** between a proposition **and its negation** (Béziau, 2000). After our semi-formal presentation of the NR formal ontology we see **that the logic of NR is precisely a relevant logic** introducing an ontological criterion of relevance of a given premise as to a given conclusion.

The logic of the strict converse implication I

- As a first step, following Aquinas suggestion, let us introduce now the notion of **converse implication** and of its **“strict”, modal version**. The truth table of the converse implication is the following:

	p	q	$p \leftarrow q$
1.	1	1	1
2.	1	0	1
3.	0	1	0
4.	0	0	1

- Anyway, if we interpret the converse relation **as a *syntactic* relation** among wff, it **has no relevance** for an ontology that, as such, is simply an interpretation of a modal calculus.

The logic of the strict converse implication II

- On the contrary, if we want to use the converse implication for justifying a formal ontology of the **causal** necessity as complementary of the **logical** necessity, we have to interpret also it **semantically**, as a ***strict* converse implication** relating **statements denoting *things causally related*,** as Quine required for justifying a notion of *ontological implication* (see above 4.1.1). In such a case, it makes sense to define **the notion of *causal* necessity**, as eliminating the possibility that an ***effect* (denoted by *q*) *exists* without its *cause* (denoted by *p*).**

	p	q	p ⇐ q
1.	1	1	1
2.	1	0	1
3.	0	1	0
4.	0	0	1

The logic of the strict converse implication III

- From this truth table, the semantic interpretation of the “strict converse implication” ($p \twoheadleftarrow q$) derives, with the meaning **“*q* entails *p*”,** i.e., ontologically, **“(the effect denoted by) *q* entails (its cause denoted by) *p*”,** which is the converse of **“*p precedes* causally *q*”.**

- This reading of an *ontological entailment* is the opposite of “*q follows* logically from *p*”, expressing the *logical entailment* of C. I. Lewis’ strict implication just discussed, because of **the reversal of the connective between the causal and the logical realm**. In this way, we can write the definition of the strict converse implication, as the key-notion of **the logic of the causal necessity, $\Box^c$.**

$$(\alpha \twoheadleftarrow \beta) := \left(\Box^c (\alpha \leftarrow \beta)\right) \leftrightarrow \left(\neg \Diamond (\neg \alpha \wedge \beta)\right)$$

The logic of the strict converse implication IV

- Because of the relationship between implication and inclusion, and because, in this case, the necessity condition is given in the antecedent of the conditional, we can define the notion of the **causal inclusion** $\boldsymbol{p \supseteq_c q}$ as complementary of the usual **logical inclusion** $\boldsymbol{p \subseteq q}$.

- Consequently, the semantic notion of **"*p precedes* causally *q*"**, or shortly, **"*p* causes *q*"**, is the ontological interpretation of the strict converse implication. That is, $\boldsymbol{p \rightarrow_c q}$ is the ***ontological* counterpart** in the natural realm of **the *semantical* reading of ($p \twoheadleftarrow q$),** as "the effect (denoted by) *q* entails its cause (denoted by) *p*" **in the logical realm.**

- This is the inversion of the direction of the inference between **the *ordo essendi* and *ordo cognoscendi*** ("what is first in being, is last in knowing") of the Aristotelian epistemology.

- Of course, the collection of the objects included in the domain of the same causal relation **do not constitute properly *a class*,** so that no class membership predicate <$\in$> holds for them, so to exclude the paradox between the distributive and the cumulative predication.

The logic of the strict converse implication V

- Because of the strict or “intrinsic” relationship between the notion of “implication” and the notion of “truth”, both on the ontological and on the logical sides, we can define on this basis an *ontological* and not *logical* condition of membership to the Universal Class **V.**

- We can suppose, indeed, **that through a common dependence (causal inclusion) on a causal relation** – effectively an “ontological entailment” – of each element of the Universal Class **V** with one only **“primary generator” <Γ>,** a **“secondary” transitive-symmetrical-reflexive** relation among these dependent elements **could be constituted**, and hence, an equivalence domain among them.

- In this way, not only the **necessary,** but also the **sufficient** condition for the full membership to **V** – and hence for the **“full (actual) existence”** of each of its member – is given, according to a proper **Ontological Axiom of Foundation** (**OAF**) of such a formal ontology, the NR formal ontology, as we see.