Łukasiewicz and Leśniewski on Contradiction

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It was in 1911 that Łukasiewicz and Leśniewski met. Leśniewski himself reported that at that time he had read Łukasiewicz's masterpiece *On the Principle of Contradiction in Aristotle* (1910),[1] and, as Lejewski knew from Łukasiewicz, he said he had come to criticize the author.[2] In the same year Leśniewski wrote "An Attempt at a Proof of the Principle of Contradiction", which was published in 1912 on *Przegląd Filozoficzny* and was addressed on the whole against Łukasiewicz's book.[3]

Whereas the role played by the principle of contradiction in the development of Łukasiewicz's ideas is generally speaking correctly underlined,[4] it is not so in Leśniewski's case. Surely the oblivion which covered Leśniewski's early writings prevented the scholars from regarding the issue worthy of inquiry in his philosophy. Yet the controversy between Leśniewski and Łukasiewicz on the principle of contradiction may be considered quite rightly a touchstone between their very distant philosophical attitudes, which remained that way also later.

It is hard to exaggerate the great weight Łukasiewicz's monograph had in the Polish logico-philosophical scene. Although polemically inspired, Leśniewski did acknowledge the importance of Łukasiewicz's work:

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[1] Cfr. Leśniewski [1927/31], p. 169 (Engl. transl. p. 181).
[2] Cfr. Lejewski [1989], p. 7.
[3] Cfr. Leśniewski [1912].
[4] Cfr. for instance Woleński [1990], p. 191; [1989], p. 119; [1987], p. XXXIV.

> <My> results [...] on the whole oppose the theoretical theses supported by Łukasiewicz [...] But the polemical character <of some passages> should not arouse in the reader the erroneous conviction that I turn a blind eye to the theoretical value of Łukasiewicz's work, which I regard as one of the most interesting and original of the entire 'philosophical' literature known to me.[5]

Łukasiewicz's *On the Principle of Contradiction in Aristotle* (1910)

Even if the appendix included in Łukasiewicz's monograph, "The Principle of Contradiction and Symbolic Logic" - written to the model of Louis Couturat's *Algčbre de la logique* (1905) - was not the first publication in formal logic in Poland,[6] it was surely the most popular handbook among Polish philosophers. Perfectly appropriate to the context of the book, the appendix was probably the best contribution to Łukasiewicz's fundamental claim that the principle of contradiction - in the form $1 \rightarrow \neg(\alpha \wedge \neg\alpha)$ - is by no means the supreme principle of logic, being an ordinary theorem that in the simplest case may be inferred from other 11 theorems;[7] moreover, it keeps on remaining true even denying the Postulate of Existence of non-contradictory objects ($1 \neq 0$), although in this way it turns out to be true also $1 \rightarrow \alpha \wedge \neg\alpha$.

To mark the distance between Aristotle's and his own positions, Łukasiewicz presents a *résumé*, more or less like the following.[8]

J1. There are three formulations of the Principle:

Ontological (**OPC**) No object may at the same time possess and not possess the same property;

Logical (**LPC**) Two judgements of which the first ascribes to an object exactly that property which the second denies to it cannot be true at the same time;

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[5] Leśniewski [1912], p. 202. Translations are mine, unless otherwise indicated.
[6] The first was Stanisław Piątkiewicz's *Algebra w logice* (1888), cfr. Batóg-Murawski [1996].
[7] Cfr. Łukasiewicz [1910a], *Dodatek*, §9, pp. 185-96 (Germ. transl. pp. 231-45).
[8] Cfr. Łukasiewicz [1910a], pp. 135-42 (Germ. transl. pp. 165-73).

Psychological (**PPC**) Two opinions to which correspond contradictory judgements cannot exist in the same intellect at the same time;

OPC, **LPC**, **PPC** are not *synonymous* formulations, because they contain different concepts (object/property, judgement/truth, opinion/temporal co-existence), nevertheless, given that true judgements (positive and negative) correspond to objective facts, i. e. relations of possessing and not possessing of properties by an object, **OPC** is *equivalent* to **LPC**; **PPC** cannot be an *a priori* certain judgement, but at most an empirical law.

J2. **PC** in the formulation **OPC** or **LPC** requires a proof, since it is not an ultimate principle. For 'ultimate principle' it is to be understood a judgement not to be proved from other judgements, since it is true by itself. The sole judgement true by itself is the definition of true judgement.

J3. **PC** is not the supreme law of logic, neither the necessary, nor the sufficient condition for the other laws of logic. The proof is that we can deductively and inductively infer without it.

J4. **PC** is different both from the Principle of Identity and from the Principle of the Double Negation and it cannot be inferred from any of them, neither from the definition of false judgement, nor from the concept of negation. Applied to contradictory objects, **PC** is false, although the Principle of Identity and the Principle of Double Negation are both true. It is not possible to prove **PC** neither referring to its immediate evidence (evidence is not a truth criterion, since even false judgements may turn out to be evident; besides, **PC** is not evident to all people), nor to its psychological necessity (which, fixed as it seems in our mental organization, forces us to admit **PC)**; from the psychological point of view false judgements may be necessary, too; moreover, not everybody feels the necessity to admit **PC**.

J5. The only formal proof of **PC** is based on the definition of object as 'what does not possess contradictory properties': it is, however, a *formal* proof and not a *concrete* proof.

J6. A *concrete proof* of **PC** would require the proof that everything that is an object in the first sense (it is something and not nothing) is an object in the second sense, too (it does not contain contradictions); but such a proof *cannot be carried out*. Indeed, on one side there are several contradictions among *a priori* mental constructions (transfinite numbers, Russell's antinomy), on the other side there is not any guarantee that even apparently non-contradictory constructions do not contain contradictory properties; besides, in *reality* it is possible that there is contradiction in the continuous change which the entire real world is subject to. If experience does not demonstrate that contradiction, it does not deny it: neither in this case is there any guarantee that apparently non-contradictory things and phenomena do not contain contradictory properties.

J7. Since **PC** cannot be proved, notwithstanding it requires a proof, it is devoid of logical worth. At the same time it possesses an extraordinary ethico-practical worth: it is the sole weapon we have against errors and lies.

Leśniewski's "Attempt at a Proof of the Ontological Principle of Contradiction" (1912) as published in *Logical Studies* (1913)

As already clear from the title, Leśniewski pays attention exclusively to the *ontological* version of **PC**, i. e. **OPC**. Leśniewski opposes Łukasiewicz that **OPC** requires a proof indeed, but it may be carried out, so that **OPC** is not "devoid of logical worth" at all. The philosophical heart of the controversy mostly centres on **J5**, **J6**, **J7**, that is the opposition Łukasiewicz draws between a *formal* and a *concrete* proof of **OPC**; the claim that *there are contradictory objects* in formal constructions and maybe in reality, too; that **OPC** *cannot be proved*.

In actual fact, Leśniewski did not turn a blind eye to Łukasiewicz's work. On the contrary, his eye was wide-open: with his typical maniacal analysis, he turned against Łukasiewicz many of the latter's ideas and results, "entangling him in his own web".[9]

The *Attempt* was re-handled and translated by Leśniewski himself together with his first paper, "A Contribution to the Analysis of Existential Propositions" (1911) in the booklet *Logical Studies* (1913), which contains a re-organization of the materials presented in the two papers.[10] The changes are very radical in the case of the *Contribution*, slighter for the *Attempt* - apart from a different order of the treated issues and a decisive addition: the famous critique of general objects, which appeared for the first time in *Logical Studies*, and not in "The Critique of the Logical Principle of the Excluded Middle" (1913), where it was only repeated.[11] Since *Logical Studies* presents a better exposition of Leśniewski's ideas and it marks a crucial step for the development of Leśniewski's thought,[12] from which he would not return, my analysis will be based on the first part of the booklet corresponding to the *Attempt* (labelled henceforth *Attempt*^{2}) more than on the *Attempt* itself (*Attempt*^{1}), critique against general objects included.[13]

Leśniewski's proof is preceded by some logical, semantic and ontological premises. Thanks to them and to some *conventions* he introduces, he concludes - through some synonymous formulations - that **OPC** is true.

The main points of the *Attempt*^{2} may be outlined as follows:

S1. Linguistic expressions may or may not have *symbolic function*, that is the property to symbolize or not an object. They can be also *connotative*, i. e. to connote some properties, or, equally, to *signify* something, or not. Connotative expressions are those expressions that can be defined *per genus proximum et differentiam specificam*. Below are some examples given by Leśniewski himself:

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[9] The rich image is Kotarbiński's (Kotarbiński [1921], p. 105), who, nevertheless, uses it for other purposes.
[10] Cfr. Leśniewski [1913c].
[11] Cfr. Leśniewski [1913b], pp. 317-20 (Engl. transl. pp. 49-53).
[12] Cfr. Betti [1997a] and [1997b].
[13] Leśniewski [1913c].

Expressions	Connotative	Non-connotative
with symbolic function	'man' 'green' 'the possessing by every man of the property of mortality'	'object'
without symbolic function	'round square' 'centaur' 'the possessing by every man of the property of immortality'	'for' 'abracadabra

In particular, 'object' is a symbol of anything, and is non-connotative because it cannot be defined *per genus proximum et differentiam specificam* unless we fall into a *regressus in infinitum*, since 'object' is synonymous with 'being', and 'being' is *summum genus*. Expressions may or may not have the property of *symbolic disposition*: an expression which has this property only seems to symbolize something, no matter whether it does or not. *Sentences* are those expressions that all have *disposition of symbolizing relations of inherence*. A sentence is *true* when it has symbolic function, it is *false* when it has not; the symbolic function of a sentence depends on the symbolic functions of the component terms. *True sentences* of the form '*a* is *b*' *symbolize* relations of inherence. The sentences

(1) 'Every man is mortal'
(2) 'A hippocentaur possesses the property of horseness'

are linguistic expressions with symbolic disposition, that is both have disposition of symbolizing a relation of inherence, i.e. the possessing by every object denoted by the subject of the properties connoted by the predicate, but (1) has symbolic function, while (2) has not.

S2. The Ontological Principle of Contradiction is the sentence **OPC**. We may substitute several synonymous formulations to **OPC**. In order to see if any two sentences are or are not synonyms we need to reduce them to the *canonical form 'a is b'*. The convention re-written as follows is an example of such a reduction:

(3) Any sentence of the form 'x is $b \rightarrow x$ is c' is synonymous with the sentence 'xb is c',

that is to say that a conditional sentence of the form 'x is $b \rightarrow x$ is c' is synonymous with the sentence in canonical form 'x-with-the-property/ies-connoted-by-b is c'.

S3. From **S2** it stems that the sentence

(4) If x is an object, then x cannot have and not have at the same time the property c

is *not synonymous* with **OPC**. The proof follows from applying (3) to (4), where b is represented by 'object'. Since 'object' is non-connotative, no object is denoted by 'xb', i. e. is the object with the properties connoted by 'object'; for this reason (4) and **OPC**, whose subject denotes anything, are not synonyms. The sentences

(5) Every A is B
(6) If something is A, then it is B

are not synonyms, too.

S4. As *philosophia prima*, *metaphysics* - as Aristotle indicated - is the system of all the true sentences about all the objects in general.[14] From **S3** it follows that metaphysics can be built not as a system of *conditional* sentences, but as a system of *categorical* sentences.

However, metaphysics has nothing in common with sentences about the so-called 'general objects'. Conceptions about general objects lead to non-objectual speculations, and we might get rid of those conceptions once and for all by the following proof. Let a 'general object' be an object which is *general* with respect to a certain group of individual objects. Such an object may possess only those properties which are common to all the individual objects corresponding to it, for instance triangularity for the 'triangle in general' which does not possess equilaterality, or isoscelesness, etc.

Proof.

(Premise) A certain object P_k[15] is a general object corresponding to the individual objects $P'_1, P'_2, P'_3...P'_n$.

i. For every individual object P'_k it is always possible to find a property p_k not common to the individual objects $P'_1, P'_2, P'_3...P'_n$.

(I)   The general object P_k has not the property p_k.

ii. The individual object P'_k having the property p_k does not possess the property of not possessing the property p_k; otherwise, if it were non-possessing p_k, it would be a contradictory object, because it would be an object possessing and at the same time non-possessing the property p_k.

iii. The property of not possessing the property p_k is not common to all the individual objects $P'_1, P'_2, P'_3...P'_n$ since the individual object P'_k possesses the property p_k.

(II)   (For this reason) the general object P_k has not either the property of not possessing the property p_k, i. e. it is not non-possessing the property p_k; that is, it possesses the property p_k.

From comparing (I) and (II) it turns out that the premise leads to a contradiction. Thus the sentence that a certain object P_k is a general object is false, that proves at the same time that no object is a general object.

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[14] Leśniewski quotes the *incipit* of Aristotle's *Metaphysics* (D 1003, 20): "Estin ™pist»mh tij   θεωre‹ tÕ ×n Â ×n kaˆ t¦ toÚtJ Øp£rconta kaθ' αØtÒ". Cfr. Leśniewski [1913c], *Remark* IV to §3, p. 139 n. 81.

[15] Corrected from 'object P'' in Leśniewski [1913c], *Remark* V to §3, p. 141. Cfr. also Leśniewski [1913b], *Remark II* to §1, p. 319 (Engl. transl. p. 50).

S5. Establishing linguistic *conventions* has nothing in common with *conventionalism:* linguistic conventions are not indemonstrable sentences about objects and properties over which one has no power, but *true sentences* about states of affairs (*stany rzeczy*) created by whoever establishes them.

S6. **OPC** is a true principle and it can be proved. The proof is divided in two parts:

I. Proof that every object is non-contradictory;

II. Proof that the sentence "Not every object is non-contradictory" is *a priori* false.

Leśniewski *versus* Łukasiewicz

The real heart of Leśniewski's *Attempt*[2] is the semantic analyses presented and the theoretical tension associated by Leśniewski with **OPC**. Leśniewski requires that if a sentence '*a* is *b*' has to be true, the subject *a* must have symbolic function (or must be not *empty* or *non-denotative* or *non-objectual*);[16] therefore the sentence

(7) A hippocentaur is a horse

is false, because 'hippocentaur' is an empty name. In a remark which advances the conclusions of the *Attempt*[2], from this point of view the most important of the paper, Leśniewski proclaims his disagreement with Łukasiewicz's statements, according to which 'hippocentaur'

denotes truly something of non-existing, but it is not <expression> devoid of meaning

and 'the square built by rule and compasses and identical as regards the surface area to the circle of a radius of 1' denotes "an object with contradictory properties".[17]

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[16] Leśniewski [1913c], *Remark* II to §18, p. 132 = Leśniewski [1912], p. 220 (Engl. transl. p. 40), with minor changes.

[17] Leśniewski [1913c], *Remark* II to §4, p. 126 = Leśniewski [1912], p. 213 (Engl. transl. p. 32), with minor changes; Łukasiewicz [1910a], pp. 65-6 (Germ. transl. pp. 80-1).

> Classical examples of c o n t r a d i c t o r y o b j e c t s are 'wooden irons' [...] 'square rounds' or 'round squares'. Some regard these funny combinations of words as empty sounds, sounds devoid of meaning. As to me, I deem that they are not simply empty sounds, like 'abracadabra' or 'mohatra', but yet they mean something. In fact it is possible to predicate about the round square that it is a round, that it is a square, a contradictory object, etc., while it is not possible to predicate something about 'abracadabra', because this word does not mean anything. [...] 'the square built by rule and compasses and identical as regards the surface area to the circle of a radius of 1' [...] is therefore a contradictory object, and yet it means something, is something, is an object.[18]

Although also for Leśniewski the *meaning* of 'hippocentaur' and of 'object with contradictory properties' is perfectly determined (for instance 'hippocentaur' connotes the property of humanity and the property of horseness),[19] neither 'something of non-existing' nor 'object with contradictory properties' denote any object, because no object is 'something of non-existing', since

> no object has any property of 'non-existence' connoted by that expression <'something of non-existing'>.[20]

I should also remark that Leśniewski's definition of synonymous sentences differs from Łukasiewicz's in so far as the first requires the subjects to be not only *denoting* the same objects, but also *connoting* the same properties, so that the sentences

(8) Aristotle was the creator of logic

(9) The Stagirite was the creator of logic

are not synonyms in Leśniewski's view ('Aristotle' connotes the property of having the name 'Aristotle', while 'Stagirite' does not).[21] Moreover, Leśniewski does not discuss the difference *synonymousness/equivalence*: all the transformations of sentences he deals with are *salva significatione,* and synonymousness seems to be the relation between sentences he wants to preserve in inferences. The argument in **S3**. is addressed directly

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[18] Cfr. Łukasiewicz [1910a], pp. 60-1 (Germ. transl. 74-5).

[19] Cfr. Leśniewski [1913c], *Remark II* to §4, p. 126 = Leśniewski [1912], p. 213 (Engl. transl. p. 32), with minor changes.

[20] *Ibidem.*

against Łukasiewicz: Łukasiewicz asserts that **OPC** is synonymous with its conditional formulation (4),[22] since

> every general judgement, positive or negative, presents a link between two judgements: 'Every A is B' means in fact that 'if something is A, then it is B' [...] There is not any doubt about the synonymousness of these forms.[23]

Leśniewski refutes the synonymousness of **OPC** with (4) for the non-connotativity of 'object'. On (4) Łukasiewicz founds the sole *formal* proof of the Principle of Contradiction: [24] (4) is indeed the appendix's theorem

T30. $1 \rightarrow \neg(\alpha \wedge \neg\alpha)$

which is proved on the basis of definition of 'object' as 'something which is non-contradictory' and is

> like all the laws of symbolic logic, only a hypothetical theorem which establishes that if P is an object, then P cannot at the same time have and not have c. But it does not follow from this that P is an object, i. e. is simply an object and is not at the same time a non-object.[25]

To obtain a *concrete* proof of **PC** it would be necessary to prove not (4) but

(10) If *P* is something and is not nothing, then *P* is a non-contradictory object. [26]

Leśniewski is not seeking for any concrete proof of **OPC** beside the formal one: on the contrary, to prove **OPC** means to prove that **OPC** is a true sentence in so far as accepted conventions and semantic premises allow. Well, for Łukasiewicz the impossibility to prove

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[21] Cfr. Leśniewski [1913c], *Remark* to §8, p. 119 = Leśniewski [1912], p. 204 (Engl. transl. p. 22).
[22] Łukasiewicz [1910a], p. 43 (Germ. transl. p. 52).
[23] *Ibid.*
[24] Cfr. Łukasiewicz [1910a], *Dodatek*, p.185 (Germ. transl. p. 231).
[25] Łukasiewicz [1910a], *Dodatek*, p. 195 (Germ. transl. pp. 244-5).
[26] Cfr. Łukasiewicz [1910a], *Dodatek*, p. 152 (Germ. transl. p. 186).

PC concretely (10) and not only formally (4) - where for 'concrete proof' is meant an answer to the question 'Are there contradictory objects?' - was opening new and fruitful perspectives to logic. We know actually that from this moment Łukasiewicz was driven to theorize a non-bivalent system of logic ('non-chrysippean' he was to christen it later):[27] reality does not prove nor deny **PC**, so if it is an ordinary theorem and not a principle and less than ever the supreme law of logic,[28] as Łukasiewicz tried to show, other logics are possible.

The disputation between Leśniewski and Łukasiewicz seems from these first remarks to centre in its fundamental features on pure ontology, if it is true that - according to Kotarbiński's 1966 definition - Łukasiewicz's appendix was a treatise of *general theory of objects*.[29] If the crucial element to be noticed appears to be a purely ontological controversy between Łukasiewicz and Leśniewski , that is the possibility - admitted by the first, denied by the second - that in reality there are contradictory (and fictitious) objects, the controversy ends up by regarding different ways of understanding 'object'. In this respect there are several matters to be considered from the historical point of view, that lay in the background of this discussion. One should not forget that Łukasiewicz's position, according to which 'object' is that which is something and not nothing - distinct from the object that is something but *also exists*, so that there are objects which exist and objects which do not exist - recalls on one side immediately Twardowski's ideas,[30] on the other side has the very redundant ontology of Meinong as background, with the distinction *Sein-Sosein*. It is not a mystery that Meinong had a considerable influence on the development of Łukasiewicz's logical ideas. It should be noticed that - as regards the genesis of three-valued logic - Łukasiewicz launched his attack simultaneously against **PC** and the Principle of the Excluded Middle:[31] in the latter case a non-marginal role was played by meinongian *incomplete objects*,[32] more than twardowskian *general objects*, to which - however - the former owed very much. Łukasiewicz not only quotes several times Meinong's name in the

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[27] Cfr. Kotarbiński [1967], p. 2.
[28] Cfr. Łukasiewicz [1910a], Chap. XVI, *passim*.
[29] Kotarbiński [1966], p. 158.
[30] Cfr. Twardowski [1894], pp. 37-8 (Engl. transl. p. 35).
[31] Cfr. Łukasiewicz [1910c].

book and in the dense German abstract which he published,[33] but immediately after having drawn up the work on Aristotle he was as *privatdozent* in Graz, where at that time Meinong was teaching.[34] Meinong's name appears for the first time in a note Leśniewski added to the *Attempt²,* where he cites the second edition of Meinong's *Über Annahmen*, but presumably Leśniewski knew Meinong's ideas much before, for one of his teachers, Hans Cornelius, had discussed them in his *Versuch einer Theorie der Existentialurteile* (1894).[35] Well, one could hardly conceive of a more distant position from Meinong's ideas than Leśniewski's. That *no object is a contradictory object* is a metaphysical claim - which semantically expresses itself as: *there are empty names* - that one meets in all the works by Leśniewski , and 'to be something' and 'to be a non-contradictory object' appear for the latter to be one and the same thing, besides the 'square circle' is not a non-existing object: it is not an object at all. In Leśniewski , contrary to what Meinong was thinking*, the totality of objects coincides with the totality of what is real or existing*, hence to be an object, to be existing, to be something, to be an individual object, to be real, to have defined spatio-temporal dimensions are in the final analysis the same thing. In this perspective it has no sense to ask for a concrete proof of **PC** as distinct from a formal one, as Łukasiewicz did. Moreover, it was not by chance that Leśniewski included his critique against general objects in the *Attempt²* (see **S4**). The nearest target of the critique was Twardowski, guilty for having enriched his ontology of such unlikely objects.[36] If one thinks that in Twardowski general objects are nothing but special cases of contradictory objects, characterized both of them by the fact that they may be presented non-intuitively and indirectly and, furthermore, by their non-existence,[37] the critique finds its natural place in the *Attempt²*. Besides, the key passage in Leśniewski's proof is **S4.** ii., in which

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[32] Cfr. Łukasiewicz [1910a], p. 112 ff. (Germ. transl. p. 137 ff.).

[33] Cfr. Łukasiewicz [1910a], p. 13, p. 28, p. 42, p. 110 and first of all pp. 112-3 (Germ. transl. pp. 13, 33, 41, 60 n. 1, 135 n. 1 and 137-8); cfr. also Łukasiewicz [1910b], pp. 17, 35 (Engl. transl. pp. 488, 506-7).

[34] Cfr. for instance Simons [1989], p. 251-2 and 4., pp. 256-8; cfr. also Simons [1993], p. 210. Łukasiewicz even quotes Meinong's 1908/09 academic lectures, cfr. Łukasiewicz [1910a], p. 112, n. (Germ. transl. p. 137 n. 1).

[35] Cfr. Cornelius [1894] and Husserl [1896].

[36] "The field on which <Twardowski> opposed Bolzano [...]<is> that eminently *ontological* of the object, on which Bolzano had been much more careful than Twardowski was at that time, or, even worse, than it was to be Meinong shortly afterwards", Casari [1986], §1, p. 3.

[37] Cfr. Smith [1989], p. 329.

Leśniewski shows that in order to build a general object from individual objects one should violate **OPC**, and since the latter is true, that construction is impossible. For this reason Leśniewski was not considering general objects to be objects violating the ontological *tertium non datur*. Undoubtedly it is true that - as Küng wrote - Leśniewski's argument is applicable only to *concrete* objects, since an abstract object (a class, a universal idea) [...] cannot be defined as an object which possesses the properties of the concrete individuals subsumed under it, because an object must possess properties that are not assignable to any of the individual at issue". [38] Anyway, on one hand 'to be constructable from individual objects' seems to be Leśniewski's requirement for an object to be admitted in his universe, on the other hand Leśniewski's aim, as a matter of fact, is precisely to exclude general objects from *reality*, just as there are not contradictory objects in the constructions of thought, of which - as to Łukasiewicz - Russell's antinomy was a sample. But, according to Leśniewski , since there is only one ontological level and only one existence (spatio-temporal), to exclude something from reality is to deny it *tout court*, for there is not any other world or realm where this something could be. It is easy to see how much Łukasiewicz does not agree with these ideas:

> Logical and ontological principles are not only surer, but also more general than metaphysical principles; in fact they regard equally metaphysical beings, constituting the essence of the world (*istotę*) as the objects of experience and creations of human intellect which do not really exist, in general everything that is something and not nothing. If Aristotle's principle of contradiction is only a metaphysical law, then it would not be improbable as of now the assertion that its logical and ontological meaning is not great.[39]

The distinction Łukasiewicz draws between *ontology* and *metaphysics*, which seems to be a difference between "possible structures of beings [...] and the research on ontology as realized in 'our world'",[40] is clearly rejected by Leśniewski . Leśniewski accepts the

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[38] Cfr. Küng [1967], p. 103.
[39] Łukasiewicz [1910a], p. 89, my emphases (Germ. transl. p. 110).
[40] Woleński [1987], pp. XXII-III. See also Meinong: "It may sound strange to hear that metaphysics is not universal enough for a science of Objects [...] Without doubt, metaphysics has to do with everything that exists. However, the totality of what exists, including what has existed and will exist, is infinitely small in comparison with the totality of the Objects of knowledge [...], cfr. Meinong [1904], p. 486 (Engl. transl. p. 79).

distinction between *logical* and *ontological* principles, but certainly for him there is not one between *metaphysical* and *ontological* ones: *ontology* and *metaphysics* are interchangeable names to speak of the system of the sentences about all the objects in general, where 'object' always stands for 'existing object'. Leśniewski does not claim **LPC** to be equivalent with **OPC** "since they correspond to objective facts". On the contrary, they are to be kept rigorously separated: an ontological principle is about *all* the objects in general, while a logical principle is about sentences, which are only *some* of the objects. For instance in the *Critique* it will be clear that the Ontological Principle of the Excluded Middle is true, but the Logical one is false. Leśniewski was to write that between ontological and logical principles there is a certain kind of 'correspondence', unfortunately not specified by Leśniewski better than it is (thanks to this particular sharing-out of ontological/logical, Leśniewski could theorize the idea of a *hierarchy of languages*, which in principle seems to be infinite, that must have played a crucial role in the development of Tarski's semantic inquiries).[41]

As Woleński claims, a fundamental thing in Łukasiewicz's book is his *ontologism*, that is a strongly ontological view of logic thanks to which logic always has an ontological interpretation.[42] It would be according to this feature that **OPC** and **LPC** are said to be equivalent, although one should accept the hypothesis that Łukasiewicz was not to believe in a 'true' logic. Leśniewski's ontologism seems to have been stronger than Łukasiewicz's, even at that period, and to have been kept on that way later, since actually Leśniewski's research shows itself to have always been the pursuit of The True Logic. The issue recalls the large place the discussion about *conventionalism* has in the *Attempt*[2] (see **S5**). Leśniewski introduces his logico-semantic ideas by means of what he calls 'conventions', pointing out carefully that they are true sentences about objects created by whoever establishes them, and not indemonstrable sentences about objects over which one has no power. The polemic against Poincaré and conventionalism as a matter of fact seems to be directed at Łukasiewicz, in accordance with whom the ethico-practical worth of **PC** is similar to that of the laws of Euclidean geometry:

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[41] Leśniewski [1913b], p. 322 (Engl. transl. p. 54).
[42] Cfr. Woleński [1987], p. XX.

> Although the proof of the principle of contradiction is not complete, we should not despise it. Also for other principles we have not better proofs. The laws of geometrical figures, just as the principle of contradiction, base themselves on definitions, and we are right in doubting the truth of them in application to real figures as we doubt the principle of contradiction in application to the real world. We do not know in fact whether the definition of Euclidean space corresponds to real space, nor have we guarantees that the definition of object corresponds to real objects. But since in applying these laws to reality we do not meet any obstacle, we make use of them without scruple and we will act in this way as long as we succeed in doing it.[43]

It seems, however, that Łukasiewicz was not thinking at that time that the choice of one or other logic was a matter of convention (he neither had built a *system* itself of 'non-Aristotelian logic', yet).[44] And still in 1936 he was convinced that the choice at issue depended on experience.[45] But perhaps the accent he put on the *practical* worth of **PC** drove Leśniewski to stress his distance from conventionalism, in any case. While it is easy to become aware of the fascination the parallel - to which he was to be faithful for many years -[46] between non-Euclidean geometry and the 'new logic' exerted on Łukasiewicz, noticed among others by Kotarbiński,[47] Leśniewski is not attracted by the new logic - be it 'symbolic' or 'non-Aristotelian' - nor would he still have been for years. Leśniewski's efforts will always be directed to a *modernized traditional logic*,[48] for the moment conceived in a non-symbolic language. Leśniewski's shift to symbolic logic - which was less dramatic than is commonly believed to be -[49] did not signify anyway a shift to 'non-Aristotelian logic', too. Leśniewski in this sense was very conservative, and that sort of old-fashioned flavour his logic emanates - entangled with remarkably modern and far-seeing peculiarities - is due to his faith to traditional logic. As clear from chapter XV of *On*

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[43] Łukasiewicz [1910a], pp.131-2 (Germ. transl. pp. 161-2). *La Science et la méthode* was first published in Polish in 1911. See also p. 8 above.

[44] Cfr. Woleński [1987], pp. XXXI.

[45] Łukasiewicz [1936], p. 206-7 (Engl. transl. p. 233).

[46] Cfr. *ibid.* and Łukasiewicz [1918].

[47] Cfr. Kotarbiński [1967], p. 2.

[48] Cfr. Leśniewski [1927/31], Ch. I, p. 166 (Engl. transl. p. 176). Kotarbiński [1966], p. 158 might give birth to the erroneous conviction that the encounter with Łukasiewicz marked a sudden turn in Leśniewski in a logico-mathematical sense, while Leśniewski started to master the fundamentals of the "theory of deduction" only in 1918-1919 and to operate with symbolic language only in 1920, cfr. Leśniewski [1927/31], Ch. XI, p. 154 (Engl. transl. pp. 364-5)

[49] Cfr. Betti [1997a].

the Principle of Contradiction in Aristotle, Łukasiewicz started in 1910 to get interested in the theoretical meaning of a system of non-Aristotelian logic, whose possibility was connected, as said previously, with the dethronement of **PC** from the royal chair of the Supreme Principle of Logic. One cannot evoke such matters without remembering that 'non-aristotelian' logic is linked not only with the debate on **PC**, but equally with that on the Principle of the Excluded Middle and the Principle of Bivalence, already noticed previously. Nevertheless, since the issue would deserve an entire paper, which should include at least Kotarbiński's contribution,[50] I will not consider it in detail. I will just recall some philosophical traits connected with non-bivalent logic which are strictly related to the points presented here. When Łukasiewicz announced the discovery of the three-valued system of propositional calculus, he emphasized that this system "has, above all, a theoretical significance as a first attempt to construct a system of non-Aristotelian logic".[51] As Jordan wrote, "whether it may be shown to have also a 'practical significance' cannot be decided until the consequences of the principle of trivalence are investigated in their relation to empirical knowledge [...] The question of the application of the trivalent system of logic, of finding a set of objects in which the axioms of this system are satisfied, is a distinct problem and independent of the theoretical discovery which should be judged by itself, irrespective of its application".[52] On this point Łukasiewicz and Leśniewski had the opportunity of showing in the clearest way their very different opinions. In 1938 Łukasiewicz delivered a lecture to the Circle of Scientists in Warsaw, "Genesis of three-valued logic". Leśniewski took part in the discussion and his words are the sole evidence we have of his ideas on many-valued logics.[53] Łukasiewicz outlined the discovery of trivalent logic saying among other things that the importance of polyvalent logic was overcoming that of non-Euclidean geometry, and that it showed that "non equivalent ways to speak of reality" were possible. The fundamental idea in the birth of three-valued logic was adding a third value to the matrix of bivalent logic, with the proviso of finding an intuitive interpretation of it. Without this,

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[50] Cfr. Kotarbiński [1913].
[51] Łukasiewicz [1920], p. 170 (Engl. transl. p. 88).
[52] Jordan [1963], p. 8.
[53] Cfr. Łukasiewicz-Smolka-Leśniewski *et al.*[1939], pp. 235-237.

> if there had not existed at least a *shadow* of possibility to interpret intuitively this third value, then trivalent logic would not have been born. The author would have been accused of having had a thought devoid of sense.[54]

The interpretation Łukasiewicz had in mind was linked with Aristotle's *Perihermeneias* and sentences on future contingent facts, that were in his view neither true nor false. Leśniewski contrasted this position as strongly as he contrasted Łukasiewicz's non-existent objects in the *Attempt*². For him the third value had no sense, because "no one had been able until now to give to the symbol '2' introduced in trivalent logic's matrix any intelligible sense, which may ground this or that 'realistic' (*rzeczywistościowej*) interpretation of this 'logic'". Leśniewski declared never to have met in science any situation such as had required an integration of ordinary calculus of propositions that followed from the introduction of any third logical value in argumentations. Leśniewski was arguing that any 'intensional function' such as, for instance, 'is possible that *P*' had to be 'de-intensionalized' in order to be examined on the basis of extensional and bivalent logic, since he did not know any system of intensional logic that on his opinion was satisfactory. Łukasiewicz's answer was particularly meaningful: he explained his end had been to build a system of pure logic without consideration for the applications it could have, although remarking his feeling obliged of giving an intuitive interpretation of it. Finally, Łukasiewicz disclosed the real issue of the disagreement with Leśniewski , that is indeterminism and Principle of Causality:

> If there existed in the world an omniscient man [...] he could not infer, basing himself on the laws of nature, that tomorrow there will or not will be a sea battle, if it were not conditional already now; besides, he could not state if such a battle took place in the past, if its consequences had notlasted till now. At that moment, thus, the sea battle passes into the 'realm of possibilities', and this is not because we do not know anything about it, but because this is just the structure of the world.[55]

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[54] Cfr. Łukasiewicz-Smolka-Leśniewski *et al.*[1939], p. 234.
[55] Łukasiewicz-Smolka-Leśniewski *et al.* [1939], pp. 239-40.

Here I am obliged to leave out of my account a lot of things, Leśniewski's views on the subject included, which are chiefly contained in his "Is Truth only Eternal or is it also Sempiternal?"; I limit myself to remark that the most important point in this respect is once more an exclusively ontological controversy: for Leśniewski there are not indeterminate sentences[56] *in the structure of the world* which symbolize undecided facts as future contingent ones - which, furthermore, are not contingent at all. In Leśniewski objects seem to be set up *ab aeterno* in space and in time:

> it is already now true that [...] I shall choose this rather than another profession, that of two crossroads I shall take the right rather than the left one, that at a given moment a certain thought will cross my mind as summoned by my attention, that at times I will give, refuse, keep or break my word of honour.[57]

Łukasiewicz's opposition ontology/metaphysics kept on remaining still valid when he passed from a *local* (the inquiry on logical laws) to a *global* understanding of logic (the study of logical systems). *Ontological* pictures of the world vary according to the system of logic one chooses: yet the world itself, from a *metaphysical* point of view, is as it is, and in the real choice one should be guided by experience, not by logic.[58] Leśniewski's *post* 1920 logical systems were built with a completely different theoretical attitude: for him there was just Our World and The True Logic, which was just Leśniewski an, constructed on axioms which he believed firmly to be true, although being uncapable to explain why it was he believed so.[59]

Russell, Chwistek and the beginnings of Mereology

Leśniewski was right in ascribing to *On the Principle of Contradiction in Aristotle* an importance that largely overcame his declared dislike for Łukasiewicz's positions. In fact the work did not cause a sudden shift of his thought, but left a long-lasting mark in the development of his ideas: he met Russell's antinomy of the class of the classes which are

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[56] Cfr. the proof against them in Leśniewski [1913b], pp. 350-2 (Engl. transl. p. 85).
[57] Leśniewski [1913a], pp. 514-5 (Engl. transl. p. 103, reproduced with slight changes).
[58] Cfr. Jordan [1963], p. 9.

not subordinated to themselves for the first time in Łukasiewicz's book. Everyone who knows even very little about Leśniewski is aware that Mereology was born in consequence of the attempt of solving the antinomies of set theory. But maybe few know the whole story, which starts with the *Attempt*[1]. As already seen, Russell's antinomy was regarded by Łukasiewicz as a contradictory object, but Leśniewski at that time was deeply convinced that there were not such objects, and probably was not really interested in Russell's antinomy until he actually tried to analyze it. Leśniewski wrote his paper on Russell's antinomy, "Is the Class of Classes not Subordinated to Themselves Subordinated to Itself?" (1914) after the *Critique*. The latter criticizes the logical principle of excluded middle on the basis of the convention which he called 'The Restricted Principle of the Excluded Middle', i. e.

RTND A sentence with denotative subject and connotative predicate is true if and only if its singular contradictory is false,

which was already elaborated in the *Attempt*[1]. In the *Critique* Leśniewski quotes a paper by Leon Chwistek, "The principle of contradiction in the light of Bertrand Russell's more recent inquiries" (1912), and, indeed, in the *Critique* seems to take most of the materials from Chwistek's paper as a starting point of his analysis. The important issue for the present ends in the *Critique* is the treatment of sentences with empty subjects: given Leśniewski's theory of truth from which **RTND** stems, antinomies like Nelson-Grelling's or Meinong's Paradox could be solved simply by showing that the sentences which contradict themselves are both false, that means by showing that their subjects are empty. Leśniewski considers a series of antinomies which not only are exactly the antinomies Chwistek presents in his paper, of which the last and the most important is Russell's one, but even the pages of the works quoted by Leśniewski are the same quoted by Chwistek.[60] Although there would be a lot of important things to notice about the remarkably pioneering

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[59] Cfr. Leśniewski [1916], pp. 5-7.
[60] See for instance Chwistek [1912], p. 16 [283], n. 3 and Leśniewski [1913b], p. 330 n. 26 (Engl. transl. p. 63 n. 26).

solution of Epimenides' Paradox, I should notice only that Leśniewski solved it more or less in a similar way, putting in addition a restriction to connotative self-referential names.[61] Well, the impression one has in reading Leśniewski's *Class of Classes* is that it is actually the last chapter of the *Critique* published separately. Leśniewski's approach to Russell's Antinomy is the same as all the others solved in the *Critique*: he tried to show that the Antinomy was based on sentences with empty subjects. The brand new fact was that in this case it was not enough to restrict the expressive power of *language*, as in the solution of Epimenides' paradox, though very brilliant. To show that 'the class of classes not subordinated to themselves' was an empty expression required to specify which kind of *object* was understood by 'class'. And that was the birth of Mereology. So Łukasiewicz was an important source for Leśniewski's approach to formal logic, but one should also consider the importance Chwistek's paper had in this respect, and first of all one should not despise the idea that it was Leśniewski's conviction that there were not contradictory objects in the one world there was that gave rise to Mereology.[62]

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[61] Leśniewski's discussion on the artificial nature of scientific language connected to that restriction is quite outstanding, both for the development of Leśniewski's logic and of Tarski's semantic ideas, cfr. Leśniewski [1913b], pp. 343-9 (Engl. transl. pp. 77-82).

[62] Cfr. Leśniewski [1927/31], Ch. II, pp. 185-6 (Engl. transl. p. 201).

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