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Stanisław Leśniewski's Logical Systems: Protothetic, Ontology, Mereology

Contents of this Section

This part of the section **Ontologists of 19th and 20th centuries** includes the following pages:

[Stanisław Leśniewski's Logical Systems: Protothetic, Ontology, Mereology \(Current page\)](#)

[Bibliography of the studies in English on Stanisław Leśniewski:](#)

[A - Ind](#)

[Ino - Lej](#)

[Lep - Sim](#)

[Sin - Z](#)

[Bibliographie des études en Français sur Stanisław Leśniewski](#)

Polish ontologists:

[Kazimierz Twardowski on the Content and Object of Presentations](#)

[Tadeusz Kotarbinski from Ontological Reism to Semantical Concretism](#)

[Roman Ingarden and the Realism/Idealism Debate](#)

[Roman Suszko and the Non-Fregean Logics](#)

[Bogusław Wolniewicz on the Formal Ontology of Situations](#)

[Jerzy Perzanowski: Modal Logics, Ontology and Ontologies](#)

Introduction

"Leśniewski defined ontology, one of his three foundational systems, as 'a certain kind of modernized 'traditional logic' [On the Foundations of Mathematics (FM), p. 176]. In this respect it is worth bearing in mind that in the 1937-38 academic year Leśniewski taught a course called "Traditional 'formal logic' and traditional 'set theory' on the ground of ontology"; cf. Srzednicki and Stachniak, *Leśniewski's Systems: Protothetic*, 1988, p. 180. On this see Kotarbinski *Gnosiology. The Scientific Approach to the Theory of Knowledge*, 1966, pp. 253-54 [the Polish original was published in 1929], which Leśniewski praised in [FM]: see in particular pp. 373 ff. Kotarbinski noted that Leśniewski "calls his system 'ontology' in harmony with certain terms used earlier (as in the 'ontological principle of contradiction)", and in strict relation to the Greek root of 'ontology' as the participle of the verb 'to be'. Leśniewski's 'ontology' is therefore "closely connected with traditional Aristotelian formal logic, of which it is an extension and an improvement, while on the other hand it is a terminal point in the attempt to construct a calculus of names in the area of logistic ... If in spite of these reasons we do not use the word 'ontology' here as a name for the calculus of names, this is only because of the fear of a misunderstanding. Misunderstanding could arise from the fact that this name has its roots already in another role, i.e., it has been long agreed to call 'ontology' the enquiry 'on the general principles of existence' conducted in the spirit of certain parts of Aristotelian 'metaphysical' books. It has to be admitted however, that if the Aristotelian definition of the main theory (*prote filosofia*) discussed in those books is interpreted in the spirit of a 'general theory of objects', then both the word and its meaning, can be applied to the calculus of names of Leśniewski", Kotarbinski 1966, pp. 373-374. Leśniewski commented on Kotarbinski's remarks thus: "I used the name 'Ontology' to characterize the theory I was developing, without offence to my 'linguistic instincts' because I was formulating in that theory a certain kind of 'general principles of existence'" [FM, 374].

Given these premises, we gain clearer understanding of his interest in the principles of non-contradiction [PC] and excluded middle [EM], as well as his references to the theory of conversion (p. 68 ff), of the *suppositio* (p. 18) and of the validity of the syllogism (p. 71 ff). This inquiry was encouraged by his interest in the history of logic and in the formal treatment of the problems of classical philosophy by the Lvov-Warsaw school. Jan Łukasiewicz's (1886-1939) research into the history of propositional calculus, the Aristotelian syllogistic and the principle of non-contradiction are well known. (...) Twardowski, the founder of the school, was also interested in traditional logic. As a lecturer at the University of Lvov, for many years he taught a course on Attempts to reform traditional logic, in which he outlined the theories of Bolzano, Brentano, Boole and Schröder; cf. Damska *François Brentano et la pensée philosophique en Pologne: Casimir Twardowski et son École*, *Grazer philosophischen Studien*, 5, 1978, p. 123." (pp. 187-188)

From: Roberto Poli and Massimo Libardi, "Logic, Theory of Science, and Metaphysics According to Stanisław Leśniewski", *Grazer Philosophische Studien*, 57, 1999, pp. 183-219.

"In the period between the two world wars, Stanisław Leśniewski (1886-1939), one of the founders and a prominent member of the Warsaw School of Logic, created a system of the foundations of mathematics comprising three deductive theories: Protothetic, Ontology, and Mereology. The point of departure for the construction of this system was his study of logical paradoxes and, in this context, a distinction between the distributive and collective interpretations of a class. This distinction between the two interpretations was reflected in the development of two deductive theories, the theory of collective classes, which he eventually called Mereology, and the theory of distributive classes, called Ontology. Finally, in order to combine Mereology and Ontology into a logically rigorous system, he constructed Protothetic -- the system of "First principles." Leśniewski's ambition was "not to add one more calculus to the variety already invented, nor even to prove general metatheorems about alternative formal calculi, in the interests of "comparative logic"; it was instead to perfect a universally valid classical system of logic and foundations of mathematics, in which he could rigorously formulate generalizations expressible only in the metalanguages of systems poorer in means of expression, [...] and on which he could rely as a true instrument of deduction and scientific investigation (Luschei, *The logical systems of Leśniewski*, 1962, p. 24)." This program was initiated by Leśniewski in 1914 with his studies on a general theory of sets (later to be named 'Mereology'). The first version of Mereology appeared in print in 1916 under the title *Foundations of a General Theory of Sets. I* (in Polish).

In 1919, Leśniewski joined the University of Warsaw as a professor of the philosophy of mathematics. He met a group of gifted mathematicians, Zygmunt Janiszewski, Stefan

Mazurkiewicz, Waclaw Sierpidski, whose research interests, like those of Leśniewski, were focused on the foundations of mathematics. In 1920 this group, joined by Jan Łukasiewicz, founded the mathematical journal *Fundamenta Mathematicae* with Mazurkiewicz and Sierpiriski as editors, and Leśniewski and Łukasiewicz as members of the editorial board. The name, scope, and membership of the editorial board of the journal adequately reflected the research activities of the Warsaw schools of mathematics and logic during the first decade of the journal's existence.

The construction of Ontology in the period between 1919-1921, marked the next step in the formation of Leśniewski's system of the foundations of mathematics, although it was not until 1930 that Ontology appeared in print (cf. Leśniewski, 1930).

The construction of Protothetic began in 1922 and went quickly through numerous improvements and modifications, to be concluded in 1923. By then, Leśniewski's system of the foundations of mathematics was formally ready and, to quote Jordan, it was "the most thorough, original, and philosophically significant attempt to provide a logically secure foundation for the whole of mathematics" (cf. Jordan, 1945).

Even such a critic of the importance of Leśniewski's contribution to modern logic as Grzegorzczuk admitted that "Leśniewski's treatment of logic was in his times the most exact; it was simpler than *Principia* [*Mathematica*] and had it been published simultaneously with the second edition of the *Principia*, it would have played a considerable part in the development of logic" (Grzegorzczuk, 1955, p. 78)."

The roots of Protothetic can already be found in Leśniewski's early writings between 1912 and 1914. The "deductions" in his 1916 work on the general theory of sets are based on his logical intuitions which eventually were captured in the axioms and directives of Protothetic and Ontology." (pp. VII-VIII)

From: "Editor's Foreword" to Jan Srzednicki, and Zbigniew Stachniak (eds.), *Leśniewski's Systems: Protothetic*, Dordrecht: Kluwer 1998.

Applications of Leśniewski's Ontology

Tadeusz Kotarbinski (1) made the following comment on Leśniewski's ontology: " It must be however admitted if the Aristotelian definition of the supreme theory... be interpreted in the spirit of a "general theory of objects", then both the word ["Ontology" -- C. W.] and its meaning are applicable to the calculus of terms as expounded by Leśniewski".

Leśniewski (2) himself fully shared this opinion: "I used the name "ontology" to characterize the theory which I was developing without offence to my "linguistic instincts" because I was formulating in that theory a certain kind of "general principles of existence" (3).

Both quotations suggest looking at Leśniewski's ontology (hereafter LO) for insights for philosophical ontology. This is precisely what I would like to do in this paper (4).

That Leśniewski's logical systems have interesting applications in philosophy has already been pointed out by several authors. For example:

- Lejewski's (5) works about multicategorical and unicultural languages and ontologies. In particular, Lejewski shows how Leśniewski's ideas help in speaking on non- existents without falling into Platonism or Meinongianism;
- Simon's (6) study on parts and wholes ;
- Lejewski's and Wolenski's (7) attempts to interpret Kotarbinski's reism by means of LO (8) ;
- Waragai's (9) formalization of fundamental ontological principles in the framework of LO ;
- Henry's (10) uses of LO in his reconstructions of medieval logic and semantics.

My concern here is more general. I will try to show how to attack the concept of being by means of Leśniewski's logic. Before going on to do this, however, I would like to make some comments on the relation of Leśniewski's logic to nominalism. The first impression is that mereology is particularly important in this respect. Certainly, this is correct, because mereology formalizes the part/whole relation which is crucial for nominalism. The usual interpretation of mereology provides a formalization of the theory of physical parts in Brentano's sense. Simons (11) shows that one can also obtain a nice mereological interpretation of "being a part in the metaphysical sense". Now there remains the problem of mereology which would be suitable for a theory of logical parts. This is probably equivalent to finding a mereology similar in its expressive power to set theory.

At first glance, both first-order logic and Lo seem to be equally good as logical bases for nominalism. However, this is not the case because, although first-order quantifiers range over individuals, the standard semantics for elementary quantification theory must appeal to sets and relations Leśniewski's Logic and the Concept of Being as referents of predicates. On the other hand, if we take Lejewski's (12) ontological tables as semantic models of nominal phrases in LO, we easily see that all nominal expressions exclusively refer to individual things. Moreover, the identity predicate is definable in elementary ontology, though it must be added as a new primitive to elementary logic or defined by second-order means. Finally, looking at nominalism through "Leśniewskian glasses" we can see that the metaphysical nature of individuals is not especially important for nominalism. Now it is not especially surprising that Quine's ontology is sometimes qualified as nominalistic Platonism. It is only strange for anybody who thinks about nominalism as a kind of materialism. What Lo shows is that nominalism consists in abandoning general objects, essences common to many individuals and the like. I am not claiming that the marriage of nominalism and Lo secures victory for the former. My intention rather, is to show that Lo helps nominalists much more than does first-order logic." (pp. 94-96)

Notes

1. T. Kotarbinski, *Gnology, The Scientific Approach to the Theory of Knowledge*, tr. by O. Wojtasiewicz, Pergamon Press Ossolineum, Oxford-Wroclaw, pp. 210-211.
2. S. Leśniewski, "O podstawach matematyki" [On the Foundations of Mathematics], *Przegląd filozoficzny* 34, 142-170 ; Eng. tr. in Leśniewski, *Collected Works*, ed. by S. J. Surma, J. T. Szrednicki, D. I. Barnett and V. F. Rickey, Kluwer: Dordrecht 1992, p. 374.
3. This translation seems inadequate. It should rather be "general principles of being" (in the Polish original, we have "*ogolne zasady bytu*", not "*ogolne zasady istnienia*"). Leśniewski clearly distinguished "being" [*był*] from "existence" [*istnienie*].
4. The same also concerns Leśniewski's mereology.
5. Czeslaw Lejewski "A System of Logic, for Bicategorical Ontology", *Journal of Philosophical Logic*, 3, 1976, 99-117, "Ontology and Logic", in *Philosophy of Logic*, ed. by S. Korner, University of California Press, Berkeley and Los Angeles, pp. 1-28.
6. Peter Simons, *Parts*, Clarendon Press, Oxford, 1987.
7. Czelsaw Lejewski, "Outline of Ontology", *Bulletin of the John Rylands University Library of Manchester*, v. 59, n° 1, pp. 127-147, 1976, "On the Dramatic Stage in the Development of Kotarbinski's Pansomatism", in *Ontologie und Logik / Ontology and Logic*, ed. by P. Weingartner and E. Morscher, Duncker und Humblot, Berlin, pp. 197-214, 1979. J. Wolenski, "Reism and Leśniewski's Ontology", *History and Philosophy of Logic*, 7, pp. 167-172, 1986.
8. Of course, Kotarbinski himself applied LO to his ontology.
9. "Ontological Law of Contradiction and its Logical Structure", *The Annals of the Japan Association for Philosophy of Science*, v. 6, n° 1, pp. 43-58, 1980.
10. D. Henry, *Medieval Logic and Metaphysics*, Hutchinson, London, 1958. î.
11. P. Simons, *Parts*, Clarendon Press, Oxford, 1987.
12. "On Leśniewski's Ontology", *Ratio*, 1, pp. 150-176, 1958.

From: Jan Wolenski, "Leśniewski's Logic and the Concept of Being", *Recherches sur la Philosophie et le Langage*, Cahier n. 15, *Stanisław Leśniewski aujourd'hui*, (1995) pp. 93-101.