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Review of

S. LEŚNIEWSKI, *COLLECTED WORKS, VOLS. I-II*, ED. BY S. J. SURMA, J. T. SRZEDNICKI, D. I. BARNETT AND V. F. RICKEY

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The history of this book is long and dramatic. If you inspect the list of volumes of "Synthese Library" (formerly Reidel, now Kluwer) you can observe the lack of the volume 118. It was reserved for Leśniewski's collected works and scheduled for 1978. The book was projected as a joint enterprise of PWN - Polish Scientific Publishers and Reidel. According to the agreement, the Polish side was responsible for the production of the whole collection. The book required special signs, because Leśniewski used a special, highly unusual logical notation. Since appropriate print characters were not accessible in Poland, they had to be ordered abroad. Unfortunately, stupid bureaucratic resrictions, typical for communist countries, prevented Polish companies, including publishing houses, from buying anything for foreign currency without special permission from the government. Since I was involved myself in the matter and, on behalf of Reidel, I negotiated with one printing house in Kraków, I remember very well that its manager was completely helpless against stupid rules. Finally, the project was given up. When computer setting of books became more popular, the editors returned to the project. Kluwer agreed, but the book, due to the efforts of J. T. Srzednicki, was moved to "Nijhoff International Series" and published in 1992.

Who was Stanisaw Leśniewski (1886-1939)? He was one of the most distinguished representatives of the Warsaw School of Logic, established by him with Jan Łukasiewicz. Leśniewski's scientific development can be divided into two periods. In the first "philosophical" period (1911-1916), he worked on problems on the borderline of logic and philosophy, but in his second period (1916-1939), he concentrated on mathematical logic. Leśniewski intended to build a comprehensive

system of logic which might be the basis for all knowledge. His system, unorthodox in many points, consists of three parts: protothetic (a generalized sentential calculus), ontology (a calculus of names), and mereology (a theory of the whole/part relation).

Leśniewski influenced the development of logic in Poland very strongly. Together with Łukasiewicz, he trained many logicians, including Tarski, Lindenbaum, Wajsberg, Sobociński, Słupecki, and Lejewski; Tarski was Leśniewski's doctoral student (the only one who obtained his Ph.D. under Leśniewski's supervision). Sobociński and Lejewski became the main followers of Leśniewski; the other logicians mentioned here only occasionally contributed to Leśniewski's systems. In spite of his unorthodoxy in logic, Leśniewski invented several ideas which belong to the standard logical canon: he initiated the theory of syntactic categories, reintroduced Frege's language/metalanguage distinction and used it to diagnose the Liar paradox. He also established conditions for correct formal systems commonly accepted by Polish logicians. His own logical ideas lie on the margin of the mainstream of logic. However, the interest in Leśniewski's logical systems constitutes a considerable ingredient of logical investigations and it is quite vital in many parts of the world, particularly in Poland, England (among Lejewski's students — the Manchester School), and the USA (among Sobociński's students — the Notre Dame School). Various problems are studied, especially the properties of Leśniewski's systems, and their relations to standard theories, like first-order logic, Boolean algebra and set theory. There are also attempts to apply Leśniewski's ideas in the analysis of natural language, for example ontology is interpreted as a theory of plural terms.

Leśniewski's logical ideas also influenced philosophy. In general, his ontology is truly nominalistic, because it admits only particulars as values of variables. Especially, Leśniewski's ideas influenced Kotarbiński and his reism. It can be certainly said that there is a distinctive Leśniewskian paradigm in logic. No wonder that the collection of his papers in English was awaited for a long time, not only by the 'Leśniewskians', but also by everybody interested in the history of mathematical logic. It filled a serious gap in the logical literature, also because Leśniewski's works were not easily accessible because some of them had appeared in Polish. Their publication in English means their introduction into a fairly international scientific market.

Except for reviews and one polemical paper on the foundations of set theory (1916), the reviewed collection contains everything that Leśniewski published in his life-time. Let me add that Leśniewski left several manuscripts, among others a finished book on logical paradoxes.

Unfortunately, his *Nachlass* was completely destroyed during the war. The papers included in the book are ordered chronologically. The first volume opens with an introduction written by Surma. Then, there are the following papers: A Contribution to the Analysis of Existential Propositions (1911, Leśniewski's Ph.D. dissertation); An Attempt at a Proof of the Ontological Principle of Contradiction (1912); The Principle of the Logical Principle of Excluded Middle (1913); Is All Truth Only True Eternally or is It Also True Without a Beginning (1913); Is Class of Classes not Subordinated to Themselves, Subordinated to Itself? (1914); Foundations of the General Theory of Sets (1916); On the Foundations of Mathematics (1927-1931).

The papers of volume I can be divided into two groups. The first five belong to the early period of Leśniewski. In his Ph.D. dissertation, Leśniewski argued for a view that all negative existential sentences (*e.g.* sentences of a type 'x does not exist') are self-contradictory. This thesis was a direct consequence of a view that every sentence refers to an object. Leśniewski's doctoral dissertation was written from the point of view of a very traditional grammar and logic; Leśniewski at that time was very strongly influenced by Cornelius, Mill, Marty, and Husserl. Leśniewski's other investigations in the first period concerned the principle of contradiction, the principle of the excluded middle, the concept of truth. and the Russell paradox. He tried to prove the ontological principle of contradiction via proving the sentence 'no object contains contradictions'. As far as the matter concerns the principle of the excluded middle, Leśniewski doubted its universal validity because he maintained that sentences of the type 'a is b', with empty names in the place 'a', are false; thus, both 'a is b' and 'a is not b' are false. Leśniewski also defended the absolutism of truth: every truth is eternal and sempiternal. Leśniewski was seriously bothered by the Russell antinomy. After unsuccessful attempts within the standard set theory, he decided the concept of class must be changed. He adopted the mereological concept of set as aggregate. With this understanding of set, the expression 'the class of all classes which are not elements of themselves' has no reference and the antinomy disappears. Leśniewski's analysis of the concept of class was the starting point for his mereology. Leśniewski's own evaluation of his early works was decisively negative: "Living intellectually beyond the sphere of [...] 'Mathematical Logic', and yielding to many destructive habits resulting from the one-sided 'philosophico'-grammatical culture, I struggled in the works mentioned [*i.e.* works published in 1911-15 — J. W.] with a number of problems which were beyond my powers at that time [...] I have mentioned those works desiring to point out that I regret that they have appeared in

print, and formally 'repudiate' them herewith [...] affirming the bankruptcy of the 'philosophical'-grammatical work of the initial period of my work." (pp. 197-98)

The paper on the foundations of set theory (in fact, it was published as a booklet) opens a new period in his development: mathematical logic. This work outlines a system of mereology, that is the theory of classes based on the concept of aggregate, contrary to the standard set theory which considers classes as collections of objects satisfying a given property. An important difference between these conceptions of class is that the elementhood in mereology is transitive, but the membership in set-theory is not: if x is a mereological element of y and y is a mereological element of z, then x is also a mereological element of z, but the analogous rule does not hold for the membership relation in set theory. Another peculiarity of mereology is that there is no empty set. For Leśniewski, the mereological concept of class is more intuitive than the concept of set in the distributive sense. He argued that intuitions concerning collective classes are perfectly consistent with Cantor's famous statement that any manifold which can be considered as a unity is a set. Naturally, a problem arises whether mereology is as strong as set theory. The answer is negative: mereology is weaker.

The paper on the foundations of mathematics is the longest work published by Leśniewski (209 pp.; originally it was published in six parts). It outlines Leśniewski's whole project in the foundations of mathematics and it was designed as a much longer work. The main part is devoted to an extensive presentation of mereology; ontology and protothetic were left for further chapters. However, the published version also contains many extremely interesting general points, for example a critique of conventionalism in logic, an analysis of obscurities in *Principia Mathematica*; as a matter of fact, Leśniewski was probably the first who pointed out that Frege achieved much more precision than Russell did), and remarks on sentences of the type 'a is b' (it was the fundamental logical structure in Leśniewski's ontology). All the papers collected in volume I, even the last two, are written informally, without an extensive use of symbolism. In the 20s Leśniewski, under Chwistek's influence, began to employ formal languages as tools in doing logic, first in hs lectures, then in publications (but not in "On the Foundations of Mathematics"). His formalism was very extreme in the sense that he required a complete codification of the languages of formal systems. On the other hand, Leśniewski rejected formalism understood as a view that logic and mathematics are games with symbols devoid of meaning. He called his view 'intuitionistic formalism'; note, however, that this view has nothing to do with intuitionism as a

position in the foundations of mathematics. Leśniewski was a radical nominalist. He understood formal systems as consisting of concrete expressions (symbol-tokens to use a popular label). Thus, in his view, formal deductive systems are always finite in the number of formulas. On the other hand, they are "unfinished" or "unbounded", because it is always possible to add a new formula to the old ones. Hence, Leśniewski's systems are equipped with very precise directives for introducing new expressions into the body of a system. A special rôle is played by the rules of definition of new signs. Leśniewski was the first logician who explicitly stated the principles of correct definitions in formal systems. Leśniewski's systems are axiomatic, but he also used techiques of natural deduction.

The above (and other) features of Leśniewski's systems are demonstrated by papers included in volume II: On Functions Whose Fields, with Respect to These Functions are Groups (1929): On Functions Whose Fields, With Respect to These Functions are Abelian Groups (1929) (these two papers are the only ones that were purely mathematical among Leśniewski's writings); Fundamentals of a New System of the Foundations of Mathematics §§1-12; (1929); an exposition of protothetics (the original contained only §§1-11, but this edition adds §12 which was prepared for the journal *Collectanea Logica*; all copies of the two first volumes of the journal were destroyed during the war, only offprints remained); On the Foundations of Ontology (1930); On Definitions in the So-Called Theory of Deduction (1931); Introductory Remarks to the Continuation of my Article: 'Grundzüge eines neuen System der Grundlegung der Mathematik' (this paper was prepared for *Collectanea Logica*, only offprints remained). All the papers of volume II were originally published in German. Except for the two papers on the theory of groups, they develop protothetics and ontology as formal logical systems.

Prototheticis a generalized sentential calculus, *i.e.* the sentential logic with quantifiers binding sentential variables, functorial variables ranging over functors forming sentences of sentential arguments, functorial variables ranging over functors of functors, *etc.* In general terms, quantifers in the theorems of prototheticbind variables of an arbitrary semantic category which are definable when we start with a category of sentences. The full system of prototheticis based on equivalence as the sole primitive term. Prototheticis, in a sense, an absolute sentential logic, because the principle of bivalence and the principle of extensionality are among its theorems. Thus, prototheticcan be considered as an adequate representation of the classical idea of logic. Prototheticis consistent, but the problem of its completeness is not yet fully solved.

What is known is that elementary prototothetic (*i.e.* prototothetic with quantifiers restricted only to sentential variables) is complete.

Ontology is a system which arises when a functor 'is' is added to prototothetic. This functor forms sentences from names. Ontology considers the grammatical structure 'a is b'. Such a sentence, called singular, is false, if its subject is empty or refers to more than one object. This meaning is captured by the axiom of ontology which informally stated says: for any a and b, the sentence 'a is b' is equivalent to the conjunction of sentences (i) for some c, c is b, (ii) for any c and d, if c is a and d is a, then c is d, (iii) for every c, if c is a, then c is b. Informally speaking, 'a is b' is true if and only if 'a' is non-empty, there is only one object to which 'a' refers ('a' is a singular name), and whatever falls under 'a' also falls under 'b'. This formulation of the axiom of ontology is equivalent to 'for any a and b, a is b if and only if for some c, a is c and c is b. Ontology allows defining in it several sentence-forming functors operating on names. Some of them are interesting from the philosophical point of view. Two examples illustrate this matter (these are informal wordings): (i) for any a, a exists if and only if for some x, x is a, (ii) for any a, a is an object if and only if for some x, a is something; (i) gives a definition of existence, and (ii) gives a definition of being an object. Leśniewski's ontology is consistent, but the question of its completeness is still open. Ontology performs the rôle of predicate logic, but there are also important differences. For example, identity is definable in first-order ontology, whereas it is not definable in the standard first-order logic, and the theorems of ontology are true in any domain, including the empty one. Why was this system called 'ontology'? Leśniewski chose this term because he regarded ontology as a logical theory which offers a general theory of objects in the sense of Aristotle and his followers.

The reviewed collection was a serious challenge for the editors, the translators and the people who worked on its setting. Unfortunately, the result is not perfect. There are several errors and inaccuracies. Since their list was compiled by P. M. Simons in his review of this book (*History and Philosophy of Logic* **15** (1994), pp. 227-236), I will not provide details. As an example, I only note that some titles do not sound well in English. For example, "Is All Truth Only True Eternally or Is It Also True Without a Beginning" should be replaced by something like "Is the Truth only Eternal or Both Eternal and Sempiternal" which fits much better the Polish original ("Czy prawda jest tylko wieczna czy też wieczna i odwieczna?"). V. F. Rickey prepared an extensive bibliography, but it ends with papers published in 1978. It is a pity that no continuation was included. However, in spite of

some reservations concerning the editorial side of the collection, it is certainly an important event in the world of logical literature. Thus, we owe very much to the editors who overcame the first difficulties and succeeded in completing the whole project.

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