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IN MEMORIAM: JERZY ŁOŚ
1920–1998

Jerzy Łoś died in Warsaw on June 1, 1998, at the age of 78, just two years after he suffered a serious brain stroke.

Łoś was born on March 20, 1920 in Lwów. He entered the Jan Kazimierz University in Lwów in 1937, but his studies were interrupted two years later by the outbreak of World War II. In 1945 he resumed his studies at the Maria Skłodowska-Curie University in Lublin, and in 1947 he was awarded a master's degree in philosophy on the basis of the thesis, *Podstawy analizy metodologicznej kanonów Milla* (The foundations of a methodological analysis of Mill's method) [6, 12]. He then moved to Wrocław, where a very active group of mathematicians, including H. Steinhaus, B. Knaster and E. Marczewski, started to build a new department. In 1949 he received a Ph.D. in sciences from the University of Wrocław. His thesis, *Teoria matryc logiki wielowartościowej* (Theory of truth tables for many valued logics) [7], was written under the supervision of Jerzy Słupecki. Finally, in 1955 the Institute of Mathematics of the Polish Academy of Science awarded him a degree of Doctor of Science in mathematics, a degree which, for a few years during the Stalinist period, replaced the traditional Polish degree of "doktor habilitowany" corresponding to the German and French habilitation. His habilitation thesis consisted of two papers, *The algebraic treatment of the methodology of elementary deductive systems* [9] and *On the extending of models* [10]. In 1957 he was given the title of "profesor zwyczajny", and in 1964 he was elected a member of the Polish Academy of Sciences.

Łoś's academic career was, by Polish standards, quite unusual. Unlike most Polish post-war mathematicians he changed his place of employment many times. He started his career in Lublin, then moved to Wrocław, later to Toruń, and finally to Warsaw, where he worked in three institutes: the Institute of Philosophy, the Institute of Mathematics, and finally the Institute of Computer Science. His presence had a significant impact on the scientific life in each of these places. His research interests were exceptionally broad, and varied throughout his career. He published papers on philosophy, logic, algebra, probability theory, and the mathematical foundations of economics. In all of these domains he exerted a strong influence.

Łoś was not the type of mathematician who proves difficult technical theorems. Rather, his main strength lay in his ability to make important

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observations and to define fundamental new notions. His work inspired new directions for research in various branches of logic. For example, he was among the first logicians to study model theory, and it was in this domain that he made his most celebrated contribution: he introduced the notion of an ultraproduct of structures and proved the Fundamental Theorem of Ultraproducts (*viz*., a first-order sentence is preserved under the formation of an ultraproduct of structures if and only if it holds in almost all of the structures) [11]. The notion of an ultraproduct has found many applications in model theory and in other branches of logic and mathematics (for example, in set theory, algebra, nonstandard analysis, and geometry). Indeed, for a long time it was the most powerful and most often used tool of model theory. J. L. Bell and A. B. Slomson, in their book *Models and Ultraproducts* [1], write: *After proving Łoś's theorem, which is fundamental to everything else we do* ... . Authors of other monographs (for example, [2, 5, 4]) also have devoted large portions of their books to the theory of ultraproducts.

Łoś [8], and independently R.L. Vaught [15], introduced the notion of a first-order theory being *categorical in power*. It was Łoś who formulated the famous conjecture that a countable first-order theory categorical in one uncountable power is categorical in every uncountable power. The positive solution of this conjecture by M. Morley in the seminal paper [13], and the solution by S. Shelah of the generalization of the Łoś conjecture to uncountable languages, led directly to the creation of stability theory, one of the deepest and most intensely developed branches of model theory.

Finally, Łoś's paper *On the extending of models* [10], together with Tarski's paper [14], stimulated intense research by many mathematicians on questions regarding algebraic characterizations of logical notions and, conversely, logical characterizations of algebraic notions. Typical of these results are the Łoś-Tarski Theorem and a related result of Łoś: (1) a first-order sentence is preserved under the passage to substructures if and only if it is equivalent to a universal sentence; (2) a class of structures is axiomatizable by a set of first-order universal sentences if and only if it is closed under substructures and ultraproducts (and isomorphisms).

Łoś also published several papers on the foundations of probability theory. In 1962 he was invited to give a talk on this subject at the International Congress of Mathematicians in Stockholm.

In 1951, during the years of central planning in communist countries, the Mathematical Institute of Polish Academy of Science decided to develop algebra in Poland. Łoś was sent to Toruń with the task of creating a group in algebra. Together with his students J. Słomiński, E. Sąsiada, and S. Balcerzyk, he succeed in creating, out of nothing, a strong research center in algebra. His main contributions were to the theory of Abelian groups and to the study of pure subgroups. The notions of a slender group (see e.g., [3]) and of a hereditarily generating sequence are due to him. He also studied, in the context of groups and semi-groups, the algebraic and topological notions of compactness.

In 1961 Łoś moved from Toruń to Warsaw. This move marked a major shift in his research interests, from pure mathematics to mathematical economics. For several years he was very active in this field, publishing some 20 papers and supervising 18 doctoral dissertations. One of his principal interests during this period was the study of equilibria in von Neumann models of economic processes. Together with the economist Cezary Józefiak, he ran a "dissident" seminar during the 1970s which was attended by many established economists, and in which participants openingly voiced their opinions about sensitive economic and political matters; their remarks were often critical of the ruling communist regime.

During his lifetime, Jerzy Łoś received numerous honors and awards, and held many important positions in Polish and international scientific organizations. For example, from 1979 to 1983 he served as President of the Division of Logic, Methodology and Philosophy of Science of the International Union of History and Philosophy of Science.

Łoś was a gifted mathematician with many original ideas, and a talented organizer. He was also a man of strong convictions, convictions that he was not willing to compromise for the sake of political expedience. He spoke out against decisions he felt were wrong, even when many others chose to keep quiet. When "Solidarity" started its fight for freedom and independence in Poland, he often provided workers with advice and ideas. With his passing, Poland has lost a focal point of its scientific and intellectual life, and a forceful advocate for human rights.

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