Professor Oldřich Kowalski Passed Away

It was with great sadness to learn about the death of Professor Emeritus Oldřich Kowalski of Charles University in Prague, Czech Republic - one of the world‘s leading experts in Riemannian geometry. O. Kowalski died at the beginning of this year, on 2nd January 2021, at the age of 84 years.

O. Kowalski (or Olin, for friends) was born in Brno, in Moravian part of the Czech Republic, on June 19, 1936. He studied mathematics at the Masaryk University Brno and graduated in 1959. His first job was at the Technical University in Brno, Faculty of Civil Engineering, where he spent 10 years between 1959 and 1969 as assistant and associate professor. It was during this period when his scientific career took off. A crucial moment for his scientific work came when Prof. Alois Švec, another famous Czech geometer (the student of Prof. Eduard Čech) recognized his great talent and offered him a position. In 1970, Kowalski moved to Prague and became an Associated Professor at Mathematical Institute of Charles University. In Prague, Kowalski entered a stimulating environment allowing him to focus on his scientific work. In his own country as well as abroad, he took part in numerous international conferences on differential geometry and its application, several of which he helped organize. Thus, he collaborated on various projects with many people from around the world. His courses on geometric methods of mathematical physics, foundations of Riemannian geometry, elements of mathematical analysis on manifolds, foundations of differential topology etc. attracted several students from abroad, some of which he supervised during their PhD.

Professor Kowalski belongs to the elite of Czech geometers. An important part of his work is devoted to the field of Riemannian geometry. This is a branch of differential geometry that deals with the study of differentiable manifolds, and in particular with the properties of surfaces of arbitrary dimension, for which a Riemannian metric is given. That is the tangent space at any point is endowed with a scalar product that varies from point to point differentiably. This enables one to make measurements on the surface, such as angles, lengths, areas etc. Although the topic is rather classical and many mathematicians worked on this subject for many years, O. Kowalski belongs to those who discovered new directions in this field. He posed and resolved new problems, generalized previous results, and suggested alternative easier proofs. His writing style was both aesthetic and exact. Among others, he was the first to explain explicitly the fundamental (and quite non-trivial) difference between local homogeneity and global homogeneity of a Riemannian manifold. This allowed him to improve and make precise some previous incomplete results from affine Riemannian differential geometry that were published originally by K. Nomizu and I.M. Singer. This part of geometry is still quite relevant nowadays as some of its generalizations are closely related to mechanics and physics, particularly to general theory of relativity.

Prof. Kowalski co-authored more than 170 scientific publications in mathematical international journals. He collaborated with many mathematicians from other countries, particularly from Belgium, Italy, Japan, Romania, Russia, Morocco, Spain and others, namely with M. Sekizawa, L. Vanhecke, F. Tricerri, S. Nikčević, M.T.K. Abbassi, T. Arias-Marco etc. He published *Classification of generalized symmetric spaces of dimension* ≤ 5, in Rozpravy ČSAV, MPV 8, 85 (1975). He is world famous as an author of the monograph *Generalized symmetric spaces*, Lecture Notes in Mathematics 805, Springer Verlag 1980 (translated also to Russian) and *Riemannian spaces of conullity two* (World Scientific 1996, coauthors E. Boeckx and L. Vanhecke).

We would like to mention that mathematicians and physicists who followed his talks during various international conferences as well as students who had an opportunity to attend his regular courses at Charles University appreciated and enjoyed his excellent lectures. Thus, some of the excellent lectures of O. Kowalski for students were printed and published. Lecture notes *Základy matematické analýzy na varietách* (Elements of mathematical analysis on manifolds) was edited by Charles University Prague (Univerzita Karlova, 1973 and 1975), a translation to German was published 1981 in the series Teubner-Texte zur Mathematik, row 39. Lecture notes *Úvod do Riemannovy geometrie* (Introduction to Riemannian geometry) was published by Charles Unversity (1995 and 2001), and due to his friend and co-worker M. Sekizawa, also in Japanese translation (Nippon Hyoronsha Publishers, 2001).

Prof. Kowalski also helped with organizational duties in the mathematical community. Among others, he was a member of editorial boards of several journals, such as: Annals of Global Analysis and Geometry (Springer) - since 1983; Archivum Math. (MU Brno) - since 1991; Comment. Math. Univ. Carolinae - 1976-2007; Differential Geometry and its Applications (Elsevier) - since 1983; Editor-in-chief 2002-2007; Note di Matematica (Lecce) - since 1997; Pokroky matematiky, fyziky a Astronomie (Advances of Mathematics, Physics and Astronomy) - since 1972, Editor-in-chief 1972-2001. For the last one, he selected a series of interesting papers and contributions from foreign sources, and translated (from English) for Czech readers, to popularize mathematical work. He was a vice-dean of Faculty of Mathematics and Physics of Charles University (MFF UK) and a member of Scientific board of MFF UK for many years. He helped to organize regular international conferences *Differential Geometry and its Applications* where he was a head of the section of Riemannian geometry. For many years he was active in JČSMF (Jednota československých matematiků a fyziků – Union of Czechoslovak Mathematicians and Physicists). In 1998 he was elected as a member of Learned Society of Czech Republic (Učená Společnost České republiky). He was a member of Scientific board of Silesian University in Opava. For his important work, he obtained Gold medals from both Charles and Silesian Universities.

Since 1990, Prof. Kowalski shifted his attention to projects that rely on the computer for search algorithms and simulations (particularly his joint work with Z. Vlášek, and later on with PhD students Teresa Arias-Marco and Z. Dušek). This proved to be a very fruitful idea in both classical and modern directions, especially in classification problems, as it was necessary to prepare a more algebraic setting for

solving certain geometrical problems. Together with Vlášek, they classified (locally) torsion-less locally homogeneous affine connections on 2-dimensional manifolds via group-theoretical approach (which completed partial results of B. Opozda). With Arias-Marco, they continued and succeeded in classification of such connections with arbitrary torsion.

In the framework of the scientific supports of the Grant Agency of Czech Republic, Prof. Kowalski cooperated with J. Mikeš and A. Vanžurová since 1994 till the very end of his scientific work in 2019, and later, since 2003, also with his PhD student Z. Dušek.

A significant extent of his final explorations was devoted to homogeneous Riemannian and affine manifolds. We mention an interesting question concerning classification of homogeneous affine connections or investigation of homogeneous geodesics. A homogeneous geodesic is a geodesic which can be obtained as an orbit of one point under action of one-parameter group of isometries, or affine diffeomorphisms, respectively. There is an interesting class of homogeneous manifolds on which all geodesics admit this property. In all these topics, computer support was very helpful.

In 2010, O. Kowalski and A. Vanžurová initiated the investigation of a quite new generalization of homogeneous Riemannian spaces, locally homogeneous manifolds and k-curvature homogeneity, originally called the class of curvature-homogeneous spaces of type (1,3) and later mentioned as homothety curvature homogeneous spaces. This study inspired P. Gilkey and his collaborators to make similar investigations in the pseudo-Riemannian case.

Another direction of research in which O. Kowalski had a major impact was the geometry of tangent bundles. He was the first to find a way to calculate the curvature of the Sasaki metric on the tangent bundle of Riemannian manifolds. Then, with M. Sakizawa, he gave a classification of natural transformations of Reimannian metrics on a manifold to metrics on its tangent bundle, which gave rise to the so-called class of g-natural metrics, a concept that boosted research in the field of the geometry of tangent bundles.

During the last several years, O. Kowalski cooperated also with C. L. Bejan. They studied special curves and their mappings, which naturally arise in the study of electro-magnetic fields.

Finally, a number of geometers from various countries acknowledge the role played by O. Kowalski in their academic lives. Through his active and kind nature, he not only contributed to the development of the subject, but he also influenced the careers of those around him. The network of collaborators that he built as well as the ideas and advice that he shared with them shall last and continue to have an impact on the mathematical community.

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