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Czechoslovak Mathematical Journal, Vol. 39 (1989), No. 1, 181–186

Persistent URL: http://dml.cz/dmlcz/102291

Czechoslovak Mathematical Journal, 39 (114) 1989, Praha

IN MEMORIAM PROFESSOR MILAN SEKANINA

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Professor RNDr. Milan Sekanina, CSc. died on 21 October 1987 after a long severe illness.

Milan Sekanina was born on 30 April 1931 in Prostějov where he attended the secondary school, passing his final examination in 1950. In the years 1950–1954 he studied mathematics at the Faculty of Science, J. E. Purkyně University in Brno. In 1954–1957 he was research student (aspirant), working in geometry under the supervision of Prof. K. Koutský. He received his Candidate of Science degree in 1958 on the basis of his thesis „Decompositions in Euclidean spaces". Already in 1957 he became Assistent Professor in the Department of Mathematics, J. E. Purkyně University, and in 1963 he was appointed Associate Professor in the Department of Algebra and Geometry of the same university.

With Prof. Sekanina we had always admired his zeal and energy with which he set about all tasks. He transferred these properties to his colleagues and students. His share in the development of mathematics, especially in Moravia and Slovakia, has been of considerable importance. His activity in teaching mathematics can be characterized by its wide scope – he lectured on classical algebra and geometry as well as on modern disciplines such as the theory of graphs, theory of automata, coding, or mathematical economy. He had continual interest in the theory of teaching mathematics and its practical implementation. He was author of 11 textbooks and lecture notes, including a series of secondary school textbooks of geometry, and co-author of Group Theory for Physicists. We should also mention his useful activity in the Society of Czechoslovak Mathematicians and Physicists.

The scientific life-work of Prof. Sekanina was extensive and comprised many fields, especially algebra, graph theory, theory of ordered sets and topology. He started by the study of decompositions of Euclidean spaces into congruent subsets and looking for fundamental sets in Euclidean spaces with respect to the groups of motions. These were derived from the classical questions contained in Hilbert's problems; they are studied in [3]–[5] and [13] and compiled in the dissertation for the CSc. degree. K. Reinhardt in his work on decomposition of the plane (1918) used a certain result on number sequences. M. Sekanina generalized this assertion to an interesting result on Euclidean spaces: a set M, $\emptyset \neq M \subset E_m$ is connected and compact iff there exists a sequence of points $A_n \in E_m$, $n = 1, 2, \ldots$ such that

$\lim_{n\to\infty} \varrho(A_{n+1}, A_n) = 0$ and $\{A_n | n = 1, 2, \ldots\}' = M$ (see [2]). The study of sequences with the former property led to his well known theorem on the third power of a graph [8], which is cited in present monographs on graph theory. We will mention Sekanina's work in graph theory later; nonetheless, the situation is typical for his

ability to gain impulses for abstract and generally directed research from particular problems. The theory of decompositions of Euclidean spaces has a clear group-theoretical aspect. M. Sekanina developed it in [6], [7], [11], [12] and [16], summarizing the results in his habilitation paper. There he studied decompositions of groups into direct sums of complexes. The geometrical situation leads to the case of the additive group of real numbers. The group of integers is studied as well.

Prof. Koutský influenced also the set of papers [1], [9], [10], [14], [17], [29] on general topological spaces in the sense of E. Čech. It continued by the paper [19], which is a contribution to the study of lattices of topologies, which was especially popular in late sixties and early seventies. In this way M. Sekanina came to the theory of ordered sets, which remained a subject of his interest through all his scientific career. The paper [18] is immediately motivated by [19] and deals with orderings $\leqq$ of the family 2^X of all subsets of a set X such that

$$A \leqq B \Rightarrow f(A) \leqq f(B)$$

for every permutation of X.

Further development of this idea naturally leads to the category theory and to the problem of functional ordering of sets of subobjects. Sekanina's papers on this subject [27], [33], [43], [46], [49], [50], [54] and [58] brought him as far as to the modern theory of monads. He solved the problem in particular for ordered sets and graphs. Let us add that Sekanina got acquainted with the category theory in 1966 during his stay in Moscow with Prof. A. G. Kurosh, and considerably contributed to the progress of this modern algebraical discipline in Czechoslovakia. From further papers on ordered sets we can mention [23] and [24] dealing with the problem of compatibility of a topology with an ordering, or [26] in which he gave a topoogical representation of complete ortholattices. Recent papers [60] and [63] are devoted to finite ordered sets.

A stay in Winnipeg (1968 – 1969) with Prof. G. Grätzer raised M. Sekanina's interest in the problems of universal algebra. Let us mention the papers [30], [34], [35] and [38], which deal with the number of polynomials in universal algebras – a subject then intensively studied. A typical feature of Sekanina's approach was that he studied the problem in connection with ordered and topological algebras.

Let us now pass to a large group of papers devoted to the category theory. Their characteristic feature is the use of the language of the category theory for a study and comparison of mathematical structures. The paper [37], motivated by a problem put forward in [21], shows the impossibility of representation of Čech topological spaces by systems of subsets; [40] discusses the number of such representations for various types of (the most common) topological spaces. Similar representations of ordered sets by topological spaces are examined in [28], while [32], [36] and [39] study representation of ordered sets by universal algebras, in particular semigroups, and [44] is devoted to representations of graphs by algebras. Following M. Sekanina, a number of Brno mathematicians studied representation of structures; this field is closely connected with the theory of full embeddings developed by the "Prague school" (Z. Hedrlín, A. Pultr, V. Trnková and their students). We have already mentioned the functorial ordering of sets of subobjects. Similarly, sets of subobjects can be functorially topologized (see [47], [51]) – this is connected with the classical topologies on sets of subsets, as well as with the modern theory of monads and their algebras. The category of ordered sets was investigated in [22], [27] and [42].

In the end, let us describe M. Sekanina's contribution to the graph theory. We have already mentioned the circumstances that had brought him to the theory.

Although Sekanina considered his work in this field only a supplement to his main scientific interesets, he was one of the pioneers of the graph theory in Czechoslovakia, and contributed considerably to its high and generally acknowledged level. His above mentioned theorem on the third power of a graph asserts that the vertices of an arbitrary finite connected graph can be ordered into a sequence $a_1, \ldots, a_n$ such that $\varrho(a_i, a_{i+1}) \leqq 3$. In late sixties it was re-discovered independently by J. Karagnis and also by G. Chartrand and S. F. Kapoor; nonetheless, the priority of M. Sekanina is generally recognized. The theorem laid the foundation for an intensive study of hamiltonian properties of powers of graphs, which is still going on. M. Sekanina himself contributed to it by the papers [15], [25], [31], [41], [48], [52], [53], [55], [59] and [64]. In them he studied, for instance, algorithms for finding hamiltonian paths in powers of graph ([31], [41]), second powers ([53], [55]), and powers of infinite graphs ([48]). The paper [56] deals with functorial extension of graphs to hamiltonian graphs (the third power may serve as an example). In the last period M. Sekanina studied also other domains of the graph theory, as is shown by [62]. He substantially contributed also to the applications of the graph theory in organic chemistry ([57], [61]).

The results of the research work of Prof. M. Sekanina represent a significant contribution to several branches of mathematics and have been frequently cited by Czechoslovak as well as foreign authors. We can only regret that he was not given time to carry through his further plans. His departure means a severe loss for the mathematical community. Prof. M. Sekanina will be remembered as an outstanding scientist, devoted teacher, honest man and kind friend.

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