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THE 70th ANNIVERSARY OF PROFESSOR MILAN KOLIBIAR

On February 14, 1992, Professor Milan Kolibiar, one of the leading personalities of mathematical sciences in Slovakia will celebrate his seventieth birthday.

Milan Kolibiar was born in Detvianska Huta, district of Zvolen. After attending the secondary school in Zvolen and in Kláštor pod Znievom, Kolibiar began his mathematical and physical studies at the brand-new Faculty of Sciences of the Slovak University in Bratislava in 1942. He graduated from the university in 1946 and became Assistant, Associate Professor (1956) and Professor (1965) at the same university (later renamed Comenius University). Kolibiar received his RNDr. in mathematics from the Comenius University in 1950 and the Degree of Doctor of Sciences (DrSc.) in 1965. In 1964 he was appointed head of the newly established Department of Algebra and Number Theory. He held this position till his retirement in 1987. Now he is still teaching special courses and seminars.

M. Kolibiar belongs to the first generation of Slovak mathematicians which graduated at the university of Bratislava. Because of the scarcity of good professors, lack of traditions and connections with research centres, it was very difficult for a young mathematician in Bratislava at that time to start research in mathematics. Kolibiar and his friend and contemporary J. Jakubík started a research circle by reading the Russian translation of G. Birkhoff's book on lattice theory. They were encouraged to do so by professors O. Borůvka from the Masaryk University in Brno and Š. Schwarz from Bratislava.

Kolibiar's scientific interests concentrate on partially ordered sets, lattices and universal algebra. But he examined the border fields between algebra and topology as well.

The paper [A1] deals with the well-known problem proposed by G. Birkhoff (cf. [1], Problem 8) concerning isomorphisms of unoriented graphs of lattices. The question was: when does the isomorphism of lattices follow from the isomorphism of the corresponding unoriented graphs? In [A1] the following theorem is proved: The unoriented graphs of two finite distributive lattices S and S' are isomorphic if and only if there exist lattices A and B such that

$$S = A \times B \quad \text{and} \quad S' = A \times \bar{B}, \tag{1}$$

where $\bar{B}$ is the lattice dual to B and $\times$ denotes the operation of direct product of partially ordered sets. (Cf. also the quotations of this result in [3] and [4].) Kolibiar returned to the relation (1) in several other connections and under different assumptions (see [A6], [A9], [A11], [A29], and [A35]).

For a lattice S let $CSub(S)$ and $I(S)$ be the lattice consisting of all convex sublattices of S or closed intervals of S, respectively. In [A27] and [A31] M. Kolibiar studied couples of lattices S and S' such that $CSub(S)$ and $CSub(S')$ are isomorphic. He proved that this is the case if and only if $I(S)$ and $I(S')$ are isomorphic; next he showed that this is equivalent to the condition when S and S' can be written in the form (1). In the paper [A32], weak homomorphisms of several types of algebraic structure are studied, especially of lattices. This leads again to condition (1).

Already in the paper [A1] the importance of studying ternary operations and ternary relations on lattices was mentioned, e.g. the median operation

$$(a, b, c) = (a \wedge b) \vee (a \wedge c) \vee (b \wedge c) = (a \vee b) \wedge (a \vee c) \wedge (b \vee c), \tag{2}$$

and the ternary relation "between" axb defined by

$$(a \wedge x) \vee (x \wedge b) = x = (a \vee x) \wedge (x \vee b). \tag{3}$$

The papers [A4]–[A6], [A9], [A15], [A18], [A20], [A23], [A32], [A35], [A37] and [A39] are related to these problems. There are many reasons why ternary relations and operations on lattices are studied. The first result in this direction was the well-know theorem of V. Glivenko, who restricted the problem to metric lattices (recall that every metric lattice is a modular one) and proved that the metric relation "between" defined by the equality

$$\rho(a, x) + \rho(x, b) = \rho(a, b)$$

is identical with the relation "between" determined by relation (3). Relation (3) turned out to be more suitable as a starting point because it can be introduced on arbitrary lattices. The problem consisted in finding conditions for a ternary relation axb defined on a set L under which there exists a lattice $(L; \vee, \wedge)$ having the property that (3) holds identically on L.

This problem was settled for modular lattices by L. M. Kelly and by M. F. Smiley with W. R. Transue for bounded lattices. M. Kolibiar [A9] solved this for general lattices (cf. also [7]). In the paper [A6] he proved that if two lattices S and S' are constructed by the method of [A9] from a set L with a ternary relation, then S and S' need not be isomorphic but must have the form (1). A further impulse to investigate ternary operations on lattices was given by an article of G. Birkhoff and S. Kiss and by Problem 66 of Birkhoff's monograph [1] concerning the characterization of a lattice by means of a ternary operation. M. Kolibiar [A5] (cf. also [7]) partially solved this problem (namely, he found a solution for bounded lattices, using a partial ternary operation of the form (2)).

M. Altweg (see also [7]) investigated a system of axioms for abstract description of the ternary relation

$$a \leqq x \leqq b \qquad \text{or} \qquad b \leqq x \leqq a$$

in partially ordered sets. M. Kolibiar in [A11] and [A15] examined some modifications of Altweg's conditions and applied them to generalizing some results of [A9] to the case of directed multilattices.

New methods of using the ternary relation "between" on partially ordered sets to the study of classical notions are developed in the papers [A10], [A11], [A5] and [A18]. In terms of the "betweenness" relation M. Kolibiar defined the notion "line" (a particular case of line being a chain). By means of the notion of a line he was able to formulate and prove several far-reaching generalizations of theorems of the Jordan-Hölder type.

The very important result of the paper [A7] (cf. also the monographs [2]–[4] and [7]) consists in finding two identities in terms of the operations $\vee$ and $\wedge$ which characterize modular lattices. According to a result of R. McKenzie and R. Padmanabhan (cf. [4]) modular lattices cannot be characterized by means of a single identity involving the binary operations $\vee$ and $\wedge$.

In the paper [A8] M. Kolibiar succeeded in describing relatively complemented distributive lattices in five different ways (extending several previous results); L. A. Skornjakov [8] called

this result the Kolibiar-Hashimoto-Grätzer-Schmidt Theorem. Paper [A22] also deals with distributive lattices; it essentially extends a result of B. Jónsson.

The papers [A13], [A17], [A28] and [A30] have two common aims: to establish an algebraic description of partially ordered sets P such that the interval topology on P is Hausdorff, and to apply this description to proving fixed point theorems for isotonic mappings.

The papers [A3], [A14], [A25], [A36], [A38], [A40] and [A41] are of purely universal algebraic character. Already in Birkhoff's book [1] it was shown that the direct product decompositions $A = A_1 \times A_2 \times \ldots \times A_n$ of an algebra A are in a one-to-one correspondence with systems of permutable congruence relations $\Theta_1, \ldots, \Theta_n$ on A fulfilling certain conditions. In 1957 J. Hashimoto investigated direct product decompositions of algebras of the form $A = \Pi(A_i : i \in I)$, where the set I can be infinite. M. Kolibiar [A19] did the same under more general assumptions (namely, for relational structures); cf. also [A14], [A36], [A38] and [5].

In recent years Kolibiar initiated a systematic study of median groups, i.e. groups with ternary relation, such that any l-group is a special median group (see [A37], [A39] and [A40]).

Professor M. Kolibiar has devoted a good deal of his time and energy to the education of young mathematicians dealing with algebra. His scientific and pedagogical work has essentially influenced two generations of Slovak mathematicians. He has been continually interested in problems of teaching mathematics at secondary schools, universities and technical universities. Professor Kolibiar was one of the enthusiastic founders of the secondary-school student competition "Mathematical Olympiad" in the fifties.

The University has conferred several duties upon Professor Kolibiar. Besides, for many years he has been a member of the Scientific Board for Mathematics at the Czechoslovak Academy of Sciences and of the Committee for Mathematics at the Slovak Academy of Sciences, member or chairman of several committees for doctoral and post-doctoral dissertations, member of editorial boards of the journals Acta Mathematica Univ. Comenianae and Mathematica Slovaca, etc. He is one of the founders of the traditional summer schools on partially ordered sets and universal algebra in Czechoslovakia.

On the occasion of his seventies the whole Czech and Slovak mathematical community wish Professor Kolibiar good health and much further success in his life and work.

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