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PROFESSOR TIBOR KATRIŇÁK WILL BE SEVENTY NEXT YEAR

Tibor Katriňák, one of the emblematic figures of Slovak mathematics, will be seventy next year. Festive issues like this, in honour of a person on the occasion of a significant anniversary, are usually planned to appear shortly after the birthday. However, in spite of the best intentions of their authors and editors, they often only appear a year after or so. For reasons which do not matter enough to be analyzed here, this felicitation appears almost exactly a year in advance. We know some readers (mainly the superstitious ones) could blame us for that. However, the excellent condition, both physical and mental, Tibor still enjoys gives a reliable promise that he will remain in good health and continue his diverse activities not just for the next year but also for many years to come. Needless to say, we wish him all that from the heart.

Tibor Katriňák came into this world on March 23, 1937, in Košice, the metropolis of Eastern Slovakia. However, he grew up and gained his primary and secondary education mainly in Spišská Nová Ves, a smaller town in the heart of the Spiš region. In 1955 he entered the Faculty of Sciences of the Comenius University in Bratislava and commenced his study of mathematics. He received his master's degree in 1960, and *CSc.* (PhD) in 1965, under the supervision of the late Professor Milan Kolibiar. Tibor remained faithful to the Comenius University for his entire professional life, spent at the Department of Algebra and Number Theory. The department, originally belonging to the Faculty of Sciences, became part of the Faculty of Mathematics and Physics, founded in 1980 and renamed the Faculty of Mathematics, Physics and Informatics in 2001.

Katriňák's talent was soon recognized and during the period of the Prague Spring his career was launched in a highly promising way. He defended his habilitation in April 1968, together with Milan Hejný and Štefan Znám (1936–1993), two of his colleagues who also became respected members of the mathematical community in Slovakia. The first notable international acknowledgement came at the same time. The next academic year 1968-69 he spent with the Department of Mathematics of the University in Bonn as a *Humboldt-Stiftung* fellow. While staying there, he was appointed a *docent* (associate professor) at the Comenius University in October 1968.

At the same time, however, the invasion by Soviet troops and their allies in August 1968 ended the hopes for a democratic political development in Czechoslovakia. In spite of various endeavors to preserve at least some of the recent changes, within a year the destructive impact on the circumstances and atmosphere in the whole society as well as in the academic environment became evident. In particular, the Humboldt fellows were regarded as politically unreliable, and especially Tibor, with his wife Helene coming from West Germany. As one of the consequences, he was not allowed to follow up numerous invitations from foreign academic institutions. Though Tibor achieved the scientific degree *DrSc.* (Doctor of Sciences) in 1980, he was not promoted to full professorship at the Department of Algebra and Number Theory until 1990, after the changes in November 1989.

Professor Katriňák is a world-recognized authority in the fields of lattice theory and universal algebra and a leading specialist in the area of pseudocomplemented lattices and semilattices.

Together with his former teacher and close colleague, the legendary Professor Milan Kolibiar, he has been the central personality of the "Bratislava School of Universal Algebra and Lattice Theory", established in the 1960s, and has made a considerable contribution to the good name of Slovak and Czechoslovak mathematics, as well as to the reputation of Comenius University.

Katriňák's research interests have always been primarily focused on lattices and semilattices, in particular, on lattices and semilattices with pseudocomplementation. The theory of pseudocomplemented lattices (p-algebras) and pseudocomplemented semilattices, motivated by the study of non-classical logics, has become a vital branch of lattice theory since the early 1960s, and Katriňák's contribution was enormous. His results became classics of the subject and were cited in several monographs like [S69], [G71], [Bl-J72], [B-D74], [Je76], [G78] (which quotes 20 of Katriňák's papers!), [S82], [Bl-V94], and in hundreds of research articles.

Perhaps the most significant Katriňák's achievements are his characterizations of various classes of pseudocomplemented lattices and semilattices by means of triples of simpler structures, associated with each member, and a systematic treatment of the triple constructions.

The triple construction was discovered by W. Nemitz [N65] for Heyting semilattices, and improved by P. V. R. Murty and V. V. R. Rao [Mu-R74]; see, e.g., C. C. Chen and G. Grätzer [C-G69] for its description in Stone algebras. Later on Katriňák extended and modified their construction to work for all distributive pseudocomplemented lattices (which include Heyting algebras) in [15], [18]. A somewhat different version of the triple construction originated in Katriňák's papers [9], [20], and was subsequently developed and modified by W. Cornish [Co74], P. Mederly [M74], J. Schmidt [JS75], and again by Katriňák with P. Mederly in [27], [42], [54]. In particular, the last paper, where the previous triple methods were generalized to the largest possible class of "decomposable" pseudocomplemented semilattices, can be regarded as effectively the last word on the topic.

A *pseudocomplemented semilattice* (PCS) is a bounded meet-semilattice $(S; \wedge, 0, 1)$ such that for every $a \in S$ there exists the *pseudocomplement* $a^\star$ of a, defined by $a^\star = \max\{x \in S : x \wedge a = 0\}$. A PCS which is in fact a lattice is called a *pseudocomplemented lattice* (PCL). A *p-algebra* $(S; \wedge, \vee, {}^\star, 0, 1)$ is a PCL with the pseudocomplement operation included into its signature. A p-algebra is respectively *distributive* or *modular* if its underlying lattice has that property. An element a of a PCS S is said to be *closed* if $a = a^{\star\star}$, and an element $d \in S$ is called *dense* if $d^\star = 0$. The sets of all closed and of all dense elements of S are denoted by $B(S)$ and $D(S)$ respectively. $B(S)$ is a Boolean algebra and $D(S)$ is a semilattice with 1, and even a lattice filter in S in the case when S is a PCL. Unfortunately, these two "substructures" associated with S do not entirely characterize S. However, in the late 1960s W. Nemitz and, independently C. C. Chen and G. Grätzer showed that, under certain conditions, a third piece of information, namely a kind of a connecting map $\varphi_S \colon B(S) \to D(S)$, is sufficient to characterize S by means of the triple $\big(B(S), D(S), \varphi_S\big)$. This initiated the development of "triple methods" in the theory of PCSs, PCLs and p-algebras, elaborated mainly by Katriňák.

In order to present the main results of the seminal paper [54] by Katriňák with P. Mederly, we have to introduce some concepts and notation. A PCS S is said to be *decomposable* if for every $x \in S$ there is a $d \in D(S)$ such that $x = x^{\star\star} \wedge d$. In a decomposable PCS S one can define, for every $a \in B(S)$, a semilattice congruence relation $\theta_S(a)$ on $D(S)$ by $x \equiv y \mod \theta_S(a) \iff a^\star \wedge x = a^\star \wedge y$. Then the assignment $a \mapsto \theta_S(a)$ gives rise to a 0 and 1 preserving isotone map $\theta_S \colon B(S) \to \operatorname{Con} D(S)$, and the triple $\big(B(S), D(S), \theta_S\big)$ is called the *triple associated with the decomposable* PCS S. On the other hand, an abstract triple (B, D, θ) consists of a Boolean algebra B, a $\wedge$-semilattice D with 1, and a $(0,1)$-isotone map $\theta \colon B \to \operatorname{Con} D$. Two (abstract) triples (B, D, θ) and (B', D', θ') are *isomorphic* if there is an isomorphism of Boolean algebras $f \colon B \to B'$ and an isomorphism of semilattices $g \colon D \to D'$

such that the diagram

$$\begin{array}{ccc} B & \xrightarrow{\theta} & \operatorname{Con} D \\ {\scriptstyle f}\downarrow & & \downarrow{\scriptstyle \overline{g}} \\ B' & \xrightarrow{\theta'} & \operatorname{Con} D' \end{array}$$

commutes, where $\overline{g}\colon \operatorname{Con} D \to \operatorname{Con} D'$ stands for the isomorphism of congruence lattices induced by g.

The essence of the generalized triple method presented in [54] lies in the following two results:

1. Two decomposable PCSs are isomorphic if and only if their associated triples are isomorphic.
2. Let (B, D, θ) be an (abstract) triple. Then one can construct a decomposable PCS S such that its associated triple $\big(B(S), D(S), \theta_S\big)$ is isomorphic to (B, D, θ).

It is worth noting that the idea of decomposing a PCS S into a triple using congruence relations on $D(S)$ occurred already in Katriňák's most cited paper [9] and that in particular his paper [20] brought a new idea which later on led to this final form of triple construction. Other important achievements of [54] can be summarized as follows:

3. Connections between all previous triple constructions were clarified.
4. It was shown that all the previously studied decomposable PCSs were "filter-decomposable", i.e., every congruence $\theta_S(a)$ was determined by the filter $D(S) \cap [a^\star)$.
5. A triple construction for a large class of so-called *quasi-modular* PCLs, obtained by weakening the concept of modularity for PCLs to the quasi-modular identity

$$\big((x \wedge y) \vee z^{\star\star}\big) \wedge x = (x \wedge y) \vee (z^{\star\star} \wedge x)\,,$$

was presented.
6. It was shown how homomorphisms and congruence relations of PCLs can be studied by means of triples.
7. Possible directions of further development of the topic were indicated.

In [19] the Stone and Post algebras of order n were studied. Almost the whole paper was absorbed into the monograph [Ba-D74; Chap. X]. G. Epstein and A. Horn [E-H74] consider the Stone algebras of order n introduced in [19] to be one of the most interesting generalizations of Post algebras which are known as algebraic models of multi-valued logics.

In [17] and [32] triples associated with free Stone algebras with m generators are characterized. This solved the problems formulated in [C-G69] and [G71; Problem 54]. By 1982, all the existing papers describing free p-algebras were concerned with distributive p-algebras. In [51] Katriňák extended these results, giving a characterization of free algebras in the whole variety of p-algebras.

Another area of research interests of Professor Katriňák lies in the study of subdirectly irreducible algebras in certain varieties of p-algebras ([16], [23], [25], [44]), and in the study of varieties of p-algebras ([24], [56]). In [24] it is shown that the lattice of lattice varieties can be embedded into the lattice of all varieties of p-algebras, answering a problem formulated in [G71] and explaining the major difficulties one meets when dealing with p-algebras.

A series of papers of Katriňák is devoted to the study of double p-algebras, mainly to the properties of distributive double p-algebras ([21], [28], [53]), and to the constructions of regular double p-algebras ([29]) and modular double p-algebras ([40]). His results about injective double Stone algebras [30] were used by R. Beazer, B. Davey, A. Romanowska, A. Urquhart and many others. Representations by congruence lattices of distributive p-algebras are investigated in [38] and [65]. Many results of Katriňák concern characterizations of lattices and

algebras whose congruence lattices belong to some variety of p-algebras: [58], [59], [60], [62]. A characterization of projective p-algebras within the class all p-algebras is given in [63].

In more recent years and right up to the present time, Professor Katriňák has remained admirably active, both in teaching and research. In the last decade he gave a solution of the abstract characterization problem for congruence lattices of pseudocomplemented semilattices in [67], and in [68] he gave an intrinsic algebraic characterization of free algebras in all Lee's subvarieties $\mathcal{B}_n$ of the variety of distributive p-algebras, using a new approach of constructing the free extensions of posets in the class of distributive lattices. Together with J. Hedlíková he continued in his study of the lattice betweenness relation ([64]), and provided a generalization of König's lemma in [66]. With Z. Heleyová [69] he presented a characterization of the free products of pseudocomplemented semilattices, including the free pseudocomplemented semilattices. In [70] with M. Žabka he showed that every non-trivial double Stone algebra can be characterized in terms of weak Boolean products of pure double Stone algebras and gave a new characterization of free regular double Stone algebras. Projective extensions of semilattices were characterized in a joint work with J. Guričan [71].

Professor Katriňák has always been an inspiring teacher whose positive influence was felt by many Slovak mathematicians of the middle and young generations. Eight students, Peter Mederly, Zuzana Ladzianska, Tomáš Hecht, Pavol Zlatoš, Jaroslav Guričan, Sanaa El-Assar, Miroslav Haviar, and Zuzana Heleyová, wrote and defended their PhD theses under his supervision. However, the number of those who benefited from his kindly advice in their scientific careers and profited from his careful and competent guidance is much bigger and hardly possible to estimate.

Professor Tibor Katriňák has accepted many responsibilities within the Faculty of Mathematics and Physics of the Comenius University and both the Czecho-Slovak and the Slovak mathematical communities, having devoted to them a lot of time and energy and served them in many ways. He devoted a lot of professional and organizational work as chairman of the Committees for *CSc.*, *PhD* and *DrSc.* dissertations in Algebra and Number Theory, as a member of the Slovak Grant Agency for Mathematical and Physical Sciences, as a member of the Scientific Boards, both at the University and Faculty levels, as editor in chief of Acta Mathematica Universitatis Comenianae (AMUC) and as a member of the editorial boards of Mathematica Slovaca, Czechoslovak Mathematical Journal, and Proceedings of Mathematics, Physics and Astronomy. He also was organizer and co-organizer of several summer schools and conferences. And we could add many other more or less formal responsibilities like, for example, his long-lasting heroic involvement in keeping up to date the Faculty library.

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PROFESSOR TIBOR KATRIŇÁK WILL BE SEVENTY NEXT YEAR

Professor Tibor Katriňák kindly agreed to answer some our questions and share with us his rich memories and personal opinions.

Prof. Katriňák, please could you remind us of your beginnings in mathematics and the people who most influenced you in forming your research interests and attitudes to teaching?

Decidedly, Professor Milan Kolibiar. Besides him I learnt a lot from Professor Tibor Neubrunn and Professor Tibor Šalát. I admired Professor Otakar Borůvka who regularly travelled from Brno to Bratislava to lecture twice a month in the late 1950s. At that time he was the incarnation of a genuine university professor to me: a man of noble manners, an excellent lecturer with broad knowledge and a clear view of mathematics. Later on, I understood the immortal part he had in waking up the Slovak mathematics from a long sleep. I regret only relatively lately becoming acquainted with Professor Ján Jakubík and Professor Štefan Schwarz.

What were your beginnings like at international level?

It was in 1966 in Ľubochňa, I think, where we organized the first international Summer School on Universal Algebra and Ordered Sets. If I am not mistaken, we were the first, at least in Europe, who started to regularly organize international meetings devoted to these topics. In the early 1970s Hungarians started with similar activities and later on they were followed by (West) Germans (thanks mainly to Professor Rudolph Wille) and Poles. From time to time also algebraists from East Germany and the Soviet Union took their turn.

But let's come back to the conference in Ľubochňa 1966. Prof. E. Marczewski of Wroclaw arrived there with his two daughters. Also Prof. E. T. Schmidt of Budapest was there — at that time I first met him personally though I already had known him fairly well through studying his papers. I got acquainted with Prof. Jürgen Schmidt of Bonn, too, who later on became my official supervisor during my Humboldt fellowship. He was accompanied by his young colleague Dr. Peter Burmeister, and we became friends. A rather big delegation of Soviet mathematicians arrived from Sverdlovsk (now again Yekaterinburg). Last but not least, I remember well Jurek Plonka and Kažek Glazek, both of Wroclaw. With Kažek we soon became friends, too. Alas, he suddenly passed away last year.

How do you remember constituting of the "Bratislava School of Universal Algebra and Lattice Theory", the people around it, and the rise of its international reputation?

The first seed was planted by Professor Borůvka. He recommended to Jakubík and Kolibiar that they study lattice theory. However, Jakubík moved to Košice for rather prosaic reasons — a flat was allocated to him there. Remaining in Bratislava alone, Kolibiar successfully started to involve students in his research in algebra. That was a great thing! Two of them, Pavol Brunovský and Beloslav Riečan, though later on they moved to different areas of mathematics, even published their first-fruits in universal algebra and lattice theory under his supervision. I followed — in fact I was the first official graduate student of Prof. Kolibiar. With an increasing number of graduate students, like Eva Gedeonová, Hilda Draškovičová, Oľga Klaučová, Ivan Korec, Anton Legéň, Zuzana Ladzianska, Ivan Žembery, to mention just few of them, the group grew considerably. Since 1962 we started to organize regular Summer Schools in Universal Algebra and Ordered Sets, which brought a considerable increase of quality, as well. As already mentioned above, as early as 1966 they received international participants. From that time, every year in September (except for 1968) the conference has been organized alternately in Bohemia or Moravia on one hand or in Slovakia on the other. Thanks to Prof. Kolibiar and our

colleagues from Brno, Prof. Miroslav Novotný, Prof. František Šik and Doc. Milan Sekanina, it survived the critical decade 1970-1980 when its very existence was threatened.

As the level of Czech mathematics was higher than ours, we have profited greatly from the contacts with Brno and, later on with Prague, too. By the irony of fate, our fellow colleagues in Brno fell out of favour with the authorities in the second half of the 1970s. They were not allowed to teach and two of them even had to leave the University. As a consequence, our scientific contacts narrowed willy-nilly for almost a decade.

When the monograph *Universal Algebra* by George Grätzer appeared in 1968, having raised a considerable increase of interest in the topic, its author soon became a kind of "guru" in the field. Can you tell us something about your early contacts with him?

I do not think that it had anything to do with the publication of *Universal Algebra*. Around 1965, Kolibiar wrote to Grätzer and sent him my solution of a problem concerning Stone algebras from the paper [G-S57] by Grätzer and E. T. Schmidt. In his response Grätzer recommended to publish the result. This happened in [3]. Later on, in Bonn, I heard from Rudolph Wille about a preprint by Grätzer containing new results on Stone algebras. I wrote to him and he quickly sent it to me. Based on it I wrote the paper [9] and sent it as a preprint to Grätzer. Shortly after I received my first invitation to Canada through him. Later on, he invited me several times, especially in the early 1970s. However, all my attempts to follow them up were turned down by our authorities and I never was told the reasons. At that time it was customary not to reply to applications and justify the decisions.

Could you remind us of the changes in the academic environment after August 1968 and during the 1970s?

There were three groups of people. Some were worried and anticipated the future, the second, small group consisted of people who sensed their chance, and finally, many people were passive. At the beginning there were just "ε-changes", mainly due to the widespread "salami" or "Švejk" tactics: pretended obedience or even fervour were combined with a phlegmatic attitude to obeying orders and doing one's own job. However, after 1971 everything speeded up. The period called "normalization" began and lasted practically up to the change in 1989. Purges started everywhere and people were vetted for their "political reliability". The process went from the top down to the bottom. It happened that even well-known personalities lost their positions and had to wrestle with existential problems. Something similar took place also at our university and our department. As far as mathematics departments are concerned, Professor Kolibiar was the only department head who was not a member of the Party. He had to face accusations of tolerating "anti-socialist elements", and even the threat of abolition of his department. Several colleagues (from other departments) had to leave the Faculty.

There was also quite an exceptional case: one of our colleagues who did not satisfy the vetting committee and was fired, sued the Faculty. The very first sitting of the court ended up rather embarrassingly — the jury postponed the sitting in front of a huge crowd, having realized that this was not a work-related issue but a highly explosive political case. Later sittings of the court took place already behind closed doors; at the same time there was strong pressure on the faculty and staff not to attend them. Our fellow geometer lost the case "for not carrying out his duties at work". It was a heavy shock for many. And, in some sense, it lasts to this day.

The last decade before the change in 1989 already took place at the new founded Faculty of Mathematics and Physics which split from the Faculty of Science in 1980. What are your memories of this period?

The normalization was gradually getting weaker, however, financial problems emerged. This was also one of the reasons for the splitting of the original Faculty. However, it took ten years to split the common library. Since 1982 there was much less money available for buying literature. We came up with a new idea: instead of buying journals we tried to focus on producing their microfiche copies. But this also collapsed within few years. It was impossible to get Xerox machines of sufficient quality anywhere in the Eastern block. Even the prestigious *Carl Zeiss Jena* Company was unable to produce them. I remember that our Faculty had just one "Xerox" machine of domestic production. It was pretty miserable. There was an office worker established who copied something for you only against written permission approved by the Faculty dean or secretary. It was similar with business trips abroad. The only difference was that the latter required considerably more stamps and signatures ...

The change in November 1989 aroused many hopes in the academic environment, as well as in the whole of society. How do you see these events?

I myself was surprised by the events of November 1989. I did not expect them. What surprised me most was the weakness of the old system. It broke down within a few days. The whole huge security and political machinery disappeared without slightest attempt to defend itself. There arises a natural question: How is it possible that society allowed itself to be manipulated by such incapable people for several decades? Should all the measures and habits described above, established as rules for keeping order and discipline, have disappeared suddenly? Was the situation destined for chaos, as predicted by some of our colleagues who could not imagine their lives without Party directives and political meetings? Neither did I expect the further development leading to a new wave of nationalism and, ultimately, to the splitting of Czechoslovakia.

How did the changes influence the situation at the Faculty of Mathematics and Physics, and more generally, in the academic environment in Slovakia?

I was surprised by the chaotic development of academic institutions in Slovakia. I doubt that it is for good that a nation of five millions has 27 universities. This inevitably leads to a decrease of quality. The educational system is underfed financially and teachers find themselves almost at the bottom of the social ladder. Universities lost many capable people of the middle generation. They are either abroad or have white-collar jobs in banks, insurance companies, etc..

How do you see the future of mathematics and its education in Slovakia?

I hope that, in spite of all the negative influences, Slovak mathematics will survive. There are still many mathematical talents born in our country. If only one third of them decide to do mathematics, it should be enough to guarantee the survival of mathematical research in Slovakia in the future.

Compared with the older generation, young people today, especially the gifted ones, have considerably more opportunities to choose for their future. Would you still recommend them to study mathematics and pursue an academic career? And if yes, then why?

Absolutely. The pleasure and joy experienced with new discoveries cannot be weighed even in gold. This is of course true of science in general not just of mathematics.

Professor Katriňák, thank you very much for your time and efforts in responding our questions. Accept, please, our sincere wishes of good health and happiness and lots of satisfaction both in your personal and professional life.

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Miroslav Haviar and Pavol Zlatoš

PROFESSOR TIBOR KATRIŇÁK WILL BE SEVENTY NEXT YEAR

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