

Ivo and Szeged

The name of Ivo Rosenberg is well known for the readers of this text. However, not everyone could locate Szeged on the map (I mean without Wikipedia, of course). Szeged is a small university town in Hungary, which is a "strong center of activity" in universal algebra, as three distinguished researchers of that topic stated in their monograph [1]. It is hard to believe that Ivo is 77 as this fall he was enjoying a hike of ten-plus-something miles in the Czech mountains.

Anyway, 77 is a fine number. Although it is not a prime (like my 79 years), it has a nice algebraic property: there exists only one group of order 77. Quasigroups of the same number of elements do exist in abundance. This fact indicates the importance of associativeness, which is an excellent property not only for algebraic operations but also for mathematicians. Our esteemed friend Ivo has written papers with 53 colleagues, an impressive number of co-authors (and, by chance, the number of all essentially different quasi-primal algebras on a three-element set :-)

I remember our first meeting in Klagenfurt, at a conference organized by Winfried Müller, 34 years ago. At that time, Ivo was already well known for his celebrated completeness theorem of many-valued logics, a.k.a. the primal algebra characterization theorem. Although the result was published in a two and a half page long article in *Comptes Rendus* (Paris) in 1965, the full proof (about eighty pages) did not appear until 1970, as a separate volume of *Rozpravy* (a series of short monographs issued by the Czechoslovakian Academy of Sciences). However, by that time Ivo has already left Czechoslovakia for Canada, and, as a consequence, the distribution of his book was banned in his homeland. Luckily a common friend of ours, Milan Sekanina, managed to secure a copy for me.

Ivo liked my talk in Klagenfurt on homogeneous algebras and invited me for a four months stay in Montréal. This is how the decades long cooperation of Ivo with

algebraists of Szeged began. Circumstances did not permit me to visit Montréal until 1982, and thus the first visitors to Ivo from our university were my best young co-workers of that time, Ágnes Szendrei and László Szabó. Their joint work with Ivo is testified by the quality of their papers [2],[3],[4]. Unfortunately, I am not a member of the above mentioned 53-element set: during my visit in Montréal, we proceeded in distinct even if close directions: Ivo proved the classification theorem of minimal clones [5], while I finished the list of all minimal clones on a three-element set [6]. (The case of four elements has not been clarified till now; two of the three crucial subcases were settled by Ivo's student Bogdan Szczepara [7] and my student Tamás Waldhauser [8] in the 90's.) The next step was a series of lectures on clones delivered by Ágnes in Montréal which resulted in a slender but highly influential monograph [9]. This happened before the end of the big political schism on our planet (in 1984 [!]), hence that time we did not trumpet the fact that the lectures of Ágnes were held under the auspices of the North Atlantic Treaty Organization...

The story continues with Ivo and Gábor Czédli, who studied tolerance kernels (e.g., in [10]). Then the next generation took the relay baton: Benoit Larose, a student of Ivo, cooperated with László Zádori (a student of Ágnes and Joel Berman, now our youngest professor) during his stay in Montréal in algebraic aspects of posets [11]. A series of joint publications followed, the topic of which went beyond the classical universal algebra, and which included algorithm theory and constraint satisfaction problems as well. I conclude with two points which cannot be omitted. For a long time, the primal algebra characterization theorem was our daily bread (see, e.g., [12]), and, a couple of years ago, Ivo was the official reviewer of the Ph.D. thesis of Tamás, my best young co-worker of *this* time.

We—the algebraic people of Szeged—take the occasion to wish him strength and further good ideas. We would like to see him again in Szeged in the near future.



Ivo with good friends George McNulty and Hajime Machida.
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References:

- [1] McKenzie, R. N., McNulty, G. F., Taylor, W. F., *Algebras, lattices, varieties. I.*, Wadsworth, Monterey, 1987.
- [2] Rosenberg, I. G., Szendrei, Á., Submaximal clones with a prime order automorphism. *Acta Sci. Math. (Szeged)* 49 (1985), no. 1-4, 29-48.
- [3] Rosenberg, I. G., Szendrei, Á., Degrees of clones and relations. *Houston J. Math.* 9 (1983), no. 4, 545-580.
- [4] Rosenberg, I. G., Szabó, L., Local completeness. I. *Algebra Universalis* 18 (1984), no. 3, 308-326.
- [5] Rosenberg, I. G., Minimal clones. I. The five types. *Lectures in universal algebra (Szeged, 1983)*, 405–427, Colloq. Math. Soc. János Bolyai, 43, North-Holland, Amsterdam, 1986.
- [6] Csákány, B., All minimal clones on the three-element set. *Acta Cybernet.* 6 (1983), no. 3, 227-238.
- [7] Szczepara, Bogdan, Minimal clones generated by groupoids. Ph.D. Thesis, Université de Montréal, Montréal, 1995.
- [8] Waldhauser, T., Minimal clones generated by majority operations. *Algebra Universalis* 44 (2000), no. 1-2, 15-26.
- [9] Szendrei, Á., *Clones in universal algebra*. Séminaire de Mathématiques Supérieures, 99. Presses de l'Université de Montréal, Montreal, QC, 1986. 166 pp.
- [10] Chajda, I., Czédli, G., Rosenberg, I. G., Kernels of tolerance relations. *Acta Math. Univ. Comenian. (N. S.)* 65 (1996), no. 2, 189-193.
- [11] Larose, B., Zádori, L., Algebraic properties and dismantlability of finite posets. *Discrete Math.* 163 (1997), no. 1-3, 89-99.
- [12] Szendrei, Ágnes, The primal algebra characterization theorem revisited. *Algebra Universalis* 29 (1992), no. 1. 41–60.

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