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Obituary: Ivan Rival

Dr. Ivan Rival died suddenly in Ottawa on 22 January, 2002, of heart failure at the age of 54. His passing deeply saddened his family, his wife Hetje, children Robert, David and Katia, daughter-in-law Chantal, parents Edith and Zoltan, and all those with whom he lived and worked as a mathematician and entrepreneur.

Ivan began his mathematical studies at McMaster University, completing a B.Sc. in 1969. With a faculty that included Gunter Bruns, Bernard Banaschewski and Gert Sabidussi, McMaster provided his first contact with lattice theory, universal algebra, and relational structures. After graduation, he entered the doctoral program at the University of Manitoba. There, a very active universal algebra and lattice theory group was organized around George Gratzer and a semi-weekly seminar. Ivan published a number of research papers on lattice theory and completed a dissertation in 1974, under the direction of Professor Gratzer, which consisted of more than a dozen research articles. His early work included contributions to planar lattices and dimension theory, notions of dismantlability for lattices and partial orders, sublattices of distributive lattices, and investigations of modular lattices motivated by Dilworth's covering theorem. He had fruitful collaborations with David Kelly, and later, with contemporaries in the Manitoba doctoral program, Brian Davey and Bill Sands.

Holding an NSERC postdoctoral fellowship, Ivan first traveled to Caltech to visit R. P. Dilworth and his former students Ralph Freese and J. B. Nation. He became fascinated with the problem of characterizing sublattices of free lattices and with the fixed point problem for finite partially ordered sets. At this time, while attending a research meeting in Holland, Ivan met Hetje, his future wife.

His next mathematical stop was the Technische Hochschule Darmstadt and Arbeitsgruppe 1, the group of lattice theorists and algebraists that included Rudolf Wille. Productive collaborations were established with Wille, and colleagues Bernhard Ganter and Werner Poguntke.

By the time Ivan and Hetje arrived in Calgary in the fall of 1975, he was already well known as a leading proponent of a type of lattice theoretic work that emphasized the diagram and covering graph associated with a [usually but not exclusively] finite lattice. He had also begun to think about partially ordered sets, rather than lattices, as the primary mathematical objects. Much of his work on order theory was driven by two fixed points problems: characterizing the condition, particularly in the finite setting, and determining if the fixed point property is preserved by products.

At this time, his research also brought him into contact with a group of mathematicians and logicians associated with Professors E. Corominas and R. Fraisse, notably Maurice Pouzet and Robert Bonnet in Lyon. Research from this period reflected their interests in general relational structures, completions and linear extensions of orders, and Ramsey-like problems. With his universal algebra background and familiarity with structure theory and Birkhoff's theorem, he and Dwight Duffus proposed a structure theory for ordered sets founded on the retract and product constructions. At the same time, Ivan was intrigued by the combinatorially flavored dimension theory investigations of Tom Trotter [which he had first encountered with David Kelly at Manitoba] and several problems, first proposed by Garrett Birkhoff, involving products and powers of ordered sets.

At Calgary, Ivan moved quickly through the academic ranks, promoted to Associate Professor in 1978 and Full Professor in 1981. He directed two doctoral students, Dwight Duffus and Nejib Zaguia, and established research collaborations with other students, including Richard Nowakowski and Mohamed El-Zahar, and faculty colleague Bill Sands, that would continue productively for many years.

In September 1981, the two-week NATO-funded *Symposium on Ordered Sets* took place. Ivan acquired substantial funding, solicited and organized refereeing of 23 manuscripts in advance of the meeting, and constructed a scientific program, with Robert Dilworth and Rudolf Wille, that stretched to all corners of orderings and their applications. It was a most significant point in the creation of an "order theory community". While a continuation of pioneering lattice theory conferences in Charlottesville [1938] and Monterey [1959], it marked the emergence of order theory, with links to lattice theory, combinatorics, set theory, and computer science.

Ivan organized many subsequent conferences: *Graphs and Order* [NATO Advanced Study Institute, Banff, 1984], *Combinatorics and Ordered Sets* [AMS-IMS-SIAM Joint Summer Research Conference, Arcata, 1985], *Algorithms and Order* [NATO Advanced Study Institute, Ottawa, 1987], and *Order and Decision Making* [Ottawa, 1996].

Throughout his academic career, Ivan [and his growing family] traveled extensively. Sabbaticals included several trips to Europe, often to Darmstadt, an ex-

tended stay at Emory University, and a memorable visit to Russia and China that included the length of the trans-Siberian railway. As well as being frequent travellers, he and Hetje were gracious hosts to a long list of visiting mathematicians, in Calgary and Ottawa and during their sabbaticals.

In 1984, the first issue of this journal, *Order*, was published with Ivan as editor. The 17-person editorial board included lattice theorists, combinatorists of several flavours, universal algebraists, and more. The journal was intended to become "the authoritative forum on new and important developments in the subject" and as "an interdisciplinary journal devoted to the applications of the theory of ordered sets throughout mathematics, operations research, computer science, and the physical and social sciences". Its first issue featured a range of articles, book reviews and a set of eight problems chosen by the editors as the leading order-theoretic challenges of that time. Ivan regarded the successful launch of the journal as a coming of age for the new community.

In 1986, Ivan left Calgary to become chair of Computer Science at the University of Ottawa. In adjusting to the environment of a CS department, he organized the algorithms laboratory and directed a weekly seminar with participants from Ottawa, Carleton University, and the University of Quebec at Hull. Research topics included combinatorial optimization, graph theory, and computational geometry, with applications ranging from motion planning to broadcasting. He was an active disseration director, graduating PhD students W. P. Liu, K. Ewacha, S. M. T. Hashemi and M. Alzohairi.

His own work there centered on more applied themes, particularly on the use of orders in data structures, scheduling, and computational geometry. He formed new research partnerships with colleagues Jorge Urrutia, Jurek Czyzowicz and Andrzej Pelc that produced work on order theory and computational geometry, including topics such as motion planning, and representations of orders via geometric objects. Visualization had always been an important theme in Ivan's work, with early papers with Wille and Sands on drawable lattices, and now it became an explicit focus. Former PhD student Nejib Zaguia joined the Ottawa faculty in 1990, and he and Ivan continued work on problems involving linear extensions, related to representing ordered sets and scheduling. But they became preoccupied with drawing orders and the use of orders as keys to visualization and data management.

In retrospect, it may seem natural that Ivan's interests in applications, in orders as a key to data structures, and in visualization, should lead to what eventually became DAG, Decision Academic Graphics, founded in late 1993 with Nejib Zaguia. In 1994, the first ideas for the software that became known as Degree Navigator were developed. This is now a powerful and adaptable degree audit and academic advising tool in use in universities across North America. Today, DAG products include full student information systems and e-learning management systems. DAG itself is a robust commercial concern, with scores of employees and contracts across the continent. As both Nejib Zaguia and Guy-Vincent Jourdan, the CEO and CTO of DAG, have pointed out, the success of this organization is rooted in Ivan's

energy as a scientist, his drive to see ideas incorporated into useful and saleable commercial products intended to serve the academic community, and his ability to find solutions, define directions, and marshal the efforts of his colleagues and employees.

Ivan brought commitment and energy to every activity undertaken. He took up distance running in mid-life, with stunningly successful results. Throughout his life, he sustained intense interests in music, literature and art – in each sphere he was an accomplished appreciator and ardent practitioner. But at the heart of his intellectual life is the study of mathematics and its effective application. Several qualities permeate the mathematical and organizational aspects of his professional work.

First, Ivan always emphasized the importance of historical context. Read his preface to the proceedings of the first Banff symposium for his understanding of that meeting in the development of order and lattice theory. And see the first issue of *Order* for his description of the genesis of order theory and its promise as an emerging mathematical discipline.

Second, Ivan was dedicated to effective communication, in his written mathematics, his lectures, and talks. He was devoted to the craft of writing. His essay with Merv Henwood, "Eponymy in Mathematical Nomenclature", which appeared in the *Mathematical Intelligencer*, was motivated by strongly held opinions about the importance of connotative terminology in mathematical writing. He was a polished expositor who prized the use of diagrams and pictorial reasoning – one of his dreams was to give a talk devoid of printed words or symbols, relying solely on pictures and verbal exposition. Read his essay "Picture Puzzling", originally published in *The Sciences*, to understand his views on the essential role of pictures and visualization in mathematical discovery.

Finally, he loved ideas – mathematical, musical, literary, political. Indeed, there often seemed a tension between the scholar deeply involved in the historical undertaking that is mathematical research, and the entrepreneur and organizer who saw the final proving of ideas in their use. In both the scholarly and entrepreneurial spheres, Ivan's most important contributions hinged on his ability to define an agenda and excite the participation of colleagues, and on the boundless energy and drive that brought projects to completion and opened the next phase of inquiry.

A full description of Professor Rival's professional life can be found at http://www.ivanrival.com.

DWIGHT DUFFUS
Atlanta, October 2003

The publications of Ivan Rival

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