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Life after life. Remembering Tomasz Schreiber

Abstract. Tomasz Franciszek Schreiber, a young Polish mathematician, passed away on December 1, 2010. Since 2009 he was a professor at the Department of Probability Theory and Stochastic Analysis at the Faculty of Mathematics and Computer Science at the Nicolaus Copernicus University (NCU) in Toruń.

Almost five years later, *The Annals of Probablity* published the paper *Branching random tessellations with interaction: a thermodynamic view* [3] , in which the authors, Hans-Otto Georgii and Christoph Thäle wrote:

> This work has been initiated by the second author, Tomasz Schreiber. Shortly before his untimely death of cancer at the age of 35, he entrusted to the first author a draft manuscript that introduced the general setup of this paper and proposed a study of relative entropy densities for BRTs. To keep his memory, we have tried to realise his intentions with suitable modifications of concepts and results.

This is not the only paper of this kind. When Tomasz was dying, he had published thirty five papers. Today the full list of his publications contains fifty one items[1]. Who was the mathematician who had one third of his rich creative output published *post mortem*?

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[1] Accessible at Tomasz Schreiber's Memorial Session

Tomasz Schreiber was born on June 25, 1975 in Toruń in a family linked to the local academic community. His mother, Dr. Maria Berndt-Schreiber, is a physicist, but it was education in the area of information technologies that became the passion of her life. In the years 2003-2014 she was the head of the Regional ICT Education Centre, a unique institution affiliated at the Faculty of Mathematics and Computer Science of the Nicolaus Copernicus University. Tomasz's father, Professor Roman Schreiber, is an astrophysicist working at the Space Research Centre of the Polish Academy of Sciences. Tomasz had two siblings. The younger brother, Paweł, has a PhD degree in English and works at Kazimierz Wielki University in Bydgoszcz. The youngest sister, Ewa, is a doctor of musicology and works at Adam Mickiewicz University in Poznań. Maria Berndt-Schreiber often joked that she had three special needs kids, referring to the extraordinary effort necessary to satisfy their intellectual appetites[2].

The stimulating atmosphere at home helped Tomasz to form a personality full of curiosity, easily grasping the essence of things and open in relationships with others. All these features were reinforced during the time he spent in the mathematical class supervised by the University at the Tadeusz Kościuszko secondary school number 4 in Toruń. He was taught mathematics by Zbigniew Bobiński and Mirosław Uscki, former students and co-workers of Professor Leon Jeśmanowicz. They were outstanding teachers who educated open-minded youth, not narrowly specialised achievers. While in secondary school, Tomasz reached the Polish finals of the Mathematical Olympiad four times and went on to be a laureate three times. His greatest success, however, came in 1994, when he won the gold medal at the XXXV International Mathematical Olympiad in Hong Kong. It is worth noting that in the same year he also qualified for the International Physics Olympiad, but could not participate because of his departure to Hong Kong.

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In 1994 Tomasz Schreiber began his studies at the Faculty of Mathematics and Computer Science at NCU. Several other excellent students came to the faculty at the same time: Grzegorz Bobiński, who also won a gold medal in Hong Kong, Aleksander Ćwiszewski, Joanna Karłowska-Pik, Jerzy Białkowski, and Rafał Bocian, all of whom are now working

[2]A reminiscence of Tomasz's brother, describing their adventures with the computer games in the 1980s [6] can give an idea of the stimulating home atmosphere of his childhood,; accessible at http://jawnesny.pl/2011/11/gry-ktorych-juz-nie-ma/.

at the faculty. Facing such a large group of very talented youth, the authorities of the faculty at that time decided to provide them with a customized curriculum, offering them special lectures, scholarships abroad within the framework of the TEMPUS program, and supporting their individual projects. During his studies, Tomasz went to scholarships at Oxford University, Rennes University and Paderborn University. He received the Polish Ministry of Education scholarship three times and was recognized as the best student at the NCU in 1998.

In 1997, Tomasz Schreiber decided to continue his mathematical vocation at the Department of Probability Theory and Stochastic Analysis, NCU. He started his co-operation with Professor Alexander Nagaev, a well-known probabilist and expert in applied mathematics, who moved from Tashkent to Toruń in 1994. Under his supervision Tomasz prepared his master's thesis *Estimation for the support of a multidimensional uniform distribution by the maximal likelihood method*, which was awarded the first prize in the 1999 competition organized by the Wrocław division of the Polish Mathematical Society, dedicated to best theses on probability and applied mathematics.

On October 1, 1999 Tomasz Schreiber was formally employed at the Nicolaus Copernicus University. He was loyal to his home university to the end of his life, in spite of various attractive offers from abroad.

Less then two years later, in September 2001, Tomasz Schreiber defended his PhD thesis on *Random closed sets: limit theorems, large deviations and statistical applications*, which was a somewhat eclectic combination of different problems within statistics, linked to the interests of the supervisor, prof. Nagaev, but also with a visible strand of the young researcher's passion – asymptotic properties of random geometrical structures. The thesis, which was extensive, multifaceted and rich in results, was awarded an individual prize of the National Ministry of Education and Sport in 2002. In the same year, Tomasz Schreiber was invited to deliver a lecture during the 7th Probabilistic Conference in Będlewo, Poland. In the years 2003-2004, due to an impressive number of publications and international research contacts, Tomasz Schreiber received the Foundation for Polish Science scholarship for young Polish researchers.

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Exceptionally talented individuals reach academic maturity very early, without the need to complete their habilitation procedure. This has been the case of Tomasz Schreiber. After his doctorate, his contacts with foreign research partners became fruitful and his research focused



Figure 1: Tomasz Schreiber (home archive)

on difficult and cutting-edge problems. The international position of Tomasz Schreiber increased, as evidenced by the more and more prestigious journals which published his work, as well as invited lectures at important conferences (for instance, he was an invited speaker at the Stochastic Processes and their Applications conference in Paris in 2006 and a special invited speaker at the 28th European Meeting of Statisticians in Pireus in 2010) or tasking him with organising invited lecture sessions (for example the Stochastic Geometry special invited session at the Stochastic Processes and their Applications conference in Berlin, 2009). In 2005, he received the Kazimierz Kuratowski prize for young mathematicians (together with Grzegorz Bobiński). The most important achievements of Tomasz Schreiber in this period may be divided into three main areas: polygonal Markov fields and their applications in image processing, asymptotic properties of distributions of random geometrical structures, and problems of self-organization in neural networks.

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The idea of polygonal Markov fields comes up from Arak's paper published in 1982. The theory has been developed in the works of Arak, Sur-

gailis and Clifford and it is commonly known to be very difficult on the technical level. Polygonal Markov fields are families of random polygonal contour lines in the plane, with interactions excluding contour- and self-intersections. Binary colouring (e.g. in black and white) of contours and interpretation of a monochromatic contour as an area with identical magnetization exhibits a graphical similarity between a typical realization of the random polygonal Markov field and images obtained for the Ising model on a two-dimensional lattice. However, contrary to the Ising model, polygonal Markov fields have a continuous (non-lattice) nature and are isometrically invariant.

Perhaps the most interesting result of Tomasz Schreiber's research in this field is a theorem on phase separation [7], which characterises the geometry of interphase curves in microcanonical ensembles imposing the domination of a chosen phase (it leads to an aggregation of the dominating phase and the formation of the so-called Wulff's body, whose geometry has also been described). It is a Dobrushin-Kotecký-Shlosman-type theorem, referring to the behaviour of two-dimensional Ising models in low temperatures, one of the deepest results of rigorous statistical mechanics. However, in the analysis of polygonal Markov fields, the most basic techniques linked to the Ising model (such as cluster series, random walk methods or correlation inequalities) are inaccessible. Instead of these classic methods, Tomasz Schreiber has proposed a geometric approach, consisting in a very ingenious adaptation of the processes of the birth and death of contours, introduced and developed in a series of papers by Fernández, Ferrari and Garcia. In his later works, Tomasz Schreiber also gave a full description of higher-order correlation functions in terms of duality with polygonal webs [8, 10].

It is worth noting that the algorithmic approach to the construction of polygonal Markov fields may be successfully applied to sophisticated problems of digital image segmentation. This fact has been widely exploited in a series of publications by Tomasz Schreiber with Marie-Collette van Lieshout from CWI in Amsterdam, as well as Rafał Kluszczyński and Michał Matuszak from NCU in Toruń.

The theory of polygonal Markov fields and related applications were the most important contents of Tomasz Schreiber's habilitation dissertation, *Laws of large deviations and limit theorems in stochastic geometry and for geometrical models of statistical mechanics*, officially presented on February 28, 2007.

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Random geometrical structures and the asymptotics of their quantita-

tive characteristics fascinated Tomasz Schreiber since the beginning of his research career (see his PhD thesis). However, it was his involvement in solving a series of classic problems of asymptotic theory for convex hulls of point processes in smooth convex bodies that brought him broad international recognition. A series of papers devoted to this problem (among others, articles [1, 13]), written in collaboration with Joseph Yukich and Pierre Calka and using the technique of the so-called stabilising functionals in a novel way, is among the most widely quoted in Tomasz Schreiber's output.

Tomasz Schreiber's research was often inspired by other sciences. It happened in the case of the notion of Iteration Stable Tesselations (or STIT Tesselations), modelling natural fracture patterns in stones etc. STIT Tessellations were extensively researched by Schreiber and his younger collaborator, Christoph Thäle (now a professor in Bochum) in paper [12] published in 2010 and in a series of five other papers, finished by Thäle after the death of his co-author. In a sense, the paper on branching random tessellations mentioned at the beginning could also be included in the series.

Tomasz Schreiber's achievements in the field of asymptotic theory of stochastic geometry models were honoured by making him responsible for the chapter [9] "Limit Theorems in Stochastic Geometry", part of the monograph *New Perspectives in Stochastic Geometry*, edited by Wilfred S. Kendall and Ilya Molchanov, and published in 2010.

In November 2010, the council of the NCU Faculty of Mathematics and Computer Science began the procedure of granting dr hab. Tomasz Schreiber an official presidential nomination for the title of professor of mathematical sciences. Unfortunately, it was interrupted by Schreiber's death.

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Tomasz Schreiber's studies at NCU covered two specializations: theoretical mathematics and computer science. He even represented the NCU in the national competition in team programming. Therefore, it should not be surprising that he became a charismatic leader for a group of young programmers working on theses in computer science under his supervision.

Only one PhD thesis was finished under Tomasz Schreiber's direct supervision. In April, 2009, Filip Piękniewski defended his thesis *Spontaneous Scale-Free Structures in Spike Flow Graphs for Recurrent Neural Networks* at the University of Warsaw. It was inspired by empirical

data from magnetic resonance images of the human brain. After his doctorate, Piękniewski was employed at Brain Corporation, a company operating in San Diego. Similar research was conducted by other students of Tomasz Schreiber: Maja Czoków, Michał Matuszak, Jarosław Piersa. Ultimately, Michał Matuszak and Jarosław Piersa received their PhD titles from the University of Warsaw; Michał Matuszak under the supervision of Professor Jacek Miękisz from the University of Warsaw and Jarosław Piersa under the supervision of Professor Piotr Bała from the Nicolaus Copernicus University.

Tomasz Schreiber supervised fifteen MA theses. One of them, written by Natalia Soja, was awarded the second prize in the 2010 competition for the best thesis in probability theory and applied mathematics, organised by the Wrocław division of the Polish Mathematical Society [11]. Natalia Soja-Kukieła finished her PhD thesis in mathematics in June 2015 – it was written under my supervision, but the subject was different.

There is another interesting aspect of Tomasz Schreiber's academic career – his involvement in workshops which he organized together with the Polish Children's Fund, a programme supporting exceptionally gifted youth. The workshops took place regularly in the years 1999-2009 at the Faculty of Mathematics and Computer Science, in co-operation with the Juliusz Schauder Center for Nonlinear Studies. Tomasz Schreiber also taught at numerous summer and winter science camps organised by the Fund in different locations all over Poland (i.a. in Świder, Jadwisin and Kartuzy). In total, he conducted or organized over 100 hours of lectures and workshops in mathematics and computer science[3].

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After the news of Tomasz Schreiber's passing I and his family received condolences from mathematicians from Poland, the USA, the Netherlands, the Czech Republic, France, Switzerland, and even Australia, although Tomasz had never been there. Hanna Döring, Peter Eichelsbacher and Marie-Collette van Lieshout dedicated their papers [2], [14] to his memory. The conference Stochastic Geometry Days organized by the Lille University I on March 30, 2011 was also dedicated to his memory.

On June 10, 2013 Tomasz Schreiber's Memorial Session was held in Toruń. The session preceded the international conference 17th Work-

[3]Speech by Maria Mach, head of the office of the Polish Children's Fund, available at http://tsms.umk.pl/?q=node/20.

shop on Stochastic Geometry, Stereology and Image Processing. The participants of this cycle of conferences had been officially invited to Toruń in 2009 by Tomasz Schreiber and Bartłomiej Błaszczyszyn (INRIA/ENS, Paris), and the local NCU community took over the effort of organising the conference in 2013. The academic part of the conference took place at the Faculty of Mathematics and Computer Science NCU and was organized and headed by Joseph Yukich. The lectures were devoted to the research carried on by Tomasz Schreiber and were delivered by Pierre Calka, University of Rouen (France), Roberto Fernández, Utrecht University (the Netherlands), Hans-Otto Georgii, Ludwig-Maximilians-Universität in Munich (Germany), Eva B. Vedel Jensen, Aarhus University (Denmark), Günter Last, Karlsruhe Institute of Technology (Germany), Marie-Colette van Lieshout, Centrum Wiskunde & Informatica (the Netherlands), Matthew Penrose, University of Bath (England).

There were more than one hundred participants in the session. All of them received an almost complete collection of Tomasz Schreiber's papers (except one published after 2013) in the form of an extensive, 991-page-long volume - The Book of Complete Works [5], carefully prepared by Dr. Joanna Karłowska-Pik.



Figure 2: Tomasz Schreiber (right) and Joseph Yukich with wife (Photo by Agnieszka Schreiber).

The session had a special conclusion – a concert entitled *Tomasz Schreiber in Memoriam*, organized at the Old Town Hall in Toruń, in co-

operation with the local J. S. Bach Society, which Tomasz had been involved in. The concert included the first ever performance of Dobromiła Jaskot's *Bright Star*, a musical piece dedicated to the memory of Tomasz Schreiber. The programme of the session, as well as detailed information on Tomasz Schreiber's achievements, a photo gallery and a number of reminiscences on Tomasz Schreiber are available at http://tsms.umk.pl.

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Life after life. Remembering Tomasz Schreiber

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(tłum. Paweł Schreiber)

Streszczenie. Tomasz Franciszek Schreiber, młody polski matematyk, zmarł 1 grudnia 2010 r. Od 2009 roku był profesorem w Katedrze Teorii Prawdopodobieństwa i Analizy Stochastycznej Wydziału Matematyki i Informatyki Uniwersytetu Mikołaja Kopernika w Toruniu.

Gdy Tomasz Schreiber umierał, opublikowanych było trzydzieści pięć jego prac. Pełna lista jego publikacji liczy pięćdziesiąt jeden pozycji. Kim był matematyk, którego blisko jedna trzecia bogatej twórczości została opublikowana po śmierci?

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Słowa kluczowe: Tomasz Schreiber, historia matematyki w Polsce, biografie, Uniwersytet Mikołaja Kopernika, Toruń.

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