Branko Grünbaum, Geometer

Branko Grünbaum passed away on September 14, 2018, just a few weeks short of his 89th birthday. Dr. Grünbaum was an early contributor to this journal, and was a major influence on a lot of the people who have been involved with it over the years. He contributed an article [6] that appeared in its second issue that remains one of the most cited papers to have appeared here, helping raise the profile of AMC, and his most recent contribution is currently available online and will appear in 2019 [1].

Branko was a prodigious author. Over the course of his career he published over 250 articles and several books. Probably the most influential was his book *Convex Polytopes* [2], which first appeared in 1967. This was an indispensable reference for mathematicians working in the theory of convex polytopes, linear programming, and related combinatorial problems in geometry for at least the next two decades. Its value came not only from the thoroughness of his treatment, but the care and skill he applied in presenting some of the latest ideas and techniques in the study of convex polytopes, and the wealth of material he had collected from sometimes obscure references and then presented in an approachable and clear style. It introduced the world to Micha Perles’ theory of Gale diagrams and included Branko’s easy to follow proof of Steinitz’s Theorem on convex polyhedra. The text also included numerous open problems and spurred much subsequent activity. The text was so esteemed as a reference that a second addition was assembled and prepared by Volkert Kaibel, Victor Klee and Günter Ziegler, and released in 2003 [5]. In the new edition the original text was presented in its entirety and supplemented with commentaries at the end of each section, these provide insight into more recent developments and discuss the status of open problems discussed in the original text. There was a long period prior to the publication of the second edition when copies were incredibly hard to obtain, and I was once told it was the most stolen book in mathematics as a consequence.

His volume *Tilings and Patterns*, with Geoffrey C. Shephard [9], was also very influential from the moment of its publication in 1987. It is filled with beautiful diagrams and interesting mathematical results and it inspired many researchers. It also functioned very well as a coffee table book!
To give you a sense of the scope of the reach of his work, these two texts alone have over 1000 citations on MathSciNet, involving 1209 distinct authors!

In addition to his work on convex polytopes and tilings, he also inspired many mathematicians to take up the study of configurations and arrangements of points and lines. His 1972 monograph *Arrangements and Spreads* was based on a series of keynote lectures he gave at the *Conference on Convexity and Combinatorial Geometry* at the University of Oklahoma [10]. To help set the stage he began his lectures by reading part of *McElligot's Pool* by Dr. Seuss [11], a book he had read to his sons when they were small, enjoining his audience to join him in the unexpected adventures that awaited in this subject area if only they would use their imaginations. His fascination with arrangements and configurations continued into his retirement, resulting in the publication of the graduate text *Configurations of Points and Lines* in 2009 [7]. This text is an essential reference on the subject, covering the key developments in the study of configurations since their introduction in 1876 and presenting many open problems that have inspired a new generation of mathematicians to take up their investigation. At least seventeen different articles in this journal alone have listed it as a reference.

Branko was also well known for having an encyclopedic knowledge about the state of the field for a wide variety of topics in discrete geometry. His office had rows of cases filled with note cards with bibliographic information and notes on the many articles he had read over the years. People were always writing him to ask what might be known about questions they were interested in, and he often had excellent references to point them to (this was especially true before MathSciNet became popular). He was equally well known for disseminating open problems in geometry, a testimony to which are the 58 articles he wrote for Geombinatorics, a journal devoted to the discussion of open problems in combinatorial and discrete geometry.

Branko also had a talent for spotting mistakes. Many of his articles contain corrections to the literature, and he often used finding such mistakes as a springboard for reopening and exploring old questions from a new perspective. Probably the most famous mistake he ever caught was in the logo of the Mathematical Association of America. From the period from 1971-1985, the official logo of the MAA — a drawing of a supposedly regular icosahedron — was drawn in such a way that it could not have been the product of any geometric projection onto the plane, a point Branko made in the pages of Mathematics Magazine [4]. The MAA, much to its credit, immediately revised its logo and started using one with greater respect for geometry. Unfortunately, Branko caught them using the bad one again a few years later, but a follow up letter from him on the question seems to have permanently resolved the issue.

A recurring theme in Branko’s writing was the importance of teaching geometry, and not as some highly refined and abstract activity, but through teaching the study of geometry as an area of applied mathematics. Tied closely to this was his concern that as mathematicians we have a responsibility to communicate our ideas and our proofs in a manner that not only achieves the desired result — such as proving a theorem — but doing so in a way that preserves the inherent beauty of the objects under investigation and provides genuine insight into what motivates their study [3]. He was deeply concerned by the approach of the Bourbaki to geometric subjects, and Dieudonné’s famous slogan “Euclid must go!” epitomized a movement to treat geometry as a purely formal and abstract subject (so much so that the only diagram in any of the texts on geometry published by the Bourbaki is of a
Coxeter-Dynkin diagram).

Now that you know something of the mathematician, I’d like to say something about the history of the man. Branko was born on October 2, 1929 in the small city of Osijek, in what was then the Kingdom of Yugoslavia and is now Croatia; Zdenka Bienenstock was born there a year later. Zdenka’s family, and all of the family on Branko’s father’s side were Jewish. When World War II came to Yugoslavia in 1941 it uprooted their lives. Zdenka survived the war hidden in a Catholic convent, but the rest of her entire extended family was killed, many in Auschwitz. Branko’s mother was Catholic, and his family survived the war by moving to live with his maternal grandmother, benefitting from protections given to families in mixed marriages in Croatia. Branko and Zdenka met after the war while high school students, and soon fell in love. Branko was admitted to the university in Zagreb, but quickly realized that he might not be able to demonstrate sufficient ardor for Marxism-Leninism and could be potentially denied a degree or future employment. This, combined with his father’s experience of having been forced to “donate” his share in a successful business to the local government soured him on the idea of staying in Yugoslavia. In 1948, the Communist regime arranged for Jews wishing to emigrate from Yugoslavia to register for transport to Israel. When it turned out that a ship really did arrive and it was announced that there would be a second opportunity to emigrate the following year, Branko convinced his family and Zdenka to seize the opportunity, arriving in Haifa, Israel in July 1949.

As was the case for many immigrants to Israel at the time, conditions were very difficult, but both Branko and Zdenka were determined to resume their studies. In the fall of 1950, Branko quit a job in Tel Aviv to go to Jerusalem to study mathematics. In 1954 he received his M.Sc., and he and Zdenka married on June 30, 1954. In the fall of 1955 Branko was called to active duty in the Israeli Air Force, where he worked in the Operations Research unit; meanwhile Zdenka earned her M.Sc. in Chemistry. Their first son, Rami, was born in 1956. Branko completed his Ph.D. in 1957 and in 1958 he was discharged from the military. Soon afterward he was awarded a scholarship to the Institute for Advanced Study in Princeton, NJ, where he and his family spent two years. In the fall of 1960 he obtained a visiting appointment at the University of Washington in Seattle, where their second son Daniel was born in November. While they were planning their return to Israel where Branko had accepted a position as a lecturer at Hebrew University, they learned his marriage to Zdenka was annulled because he was not legally Jewish according to Orthodox interpretation (his mother having not been a Jew), so he and Zdenka remarried at the City Hall in Seattle before moving to Jerusalem. Within three years Branko had been promoted to Associate Professor. He spent the summer of 1963 in Seattle as a visitor at the University of Washington, and he spent a sabbatical in 1965-66 at Michigan State University as a visiting professor.

The story in the news that another Israeli immigrant from a mixed marriage had her passport and citizenship revoked in 1966 for reasons similar to those used to annul Branko and Zdenka’s marriage resulted in them deciding not to return to Israel, even though this meant Zdenka would be unable to complete her Ph.D. in Chemistry. Branko joined the faculty at the University of Washington as a full professor in 1966. He retired in 2001, but continued to teach and work with graduate students as an emeritus professor (Leah Berman and I were his last two doctoral students at the University of Washington, completing our degrees in 2002).

I would like to close by saying a bit about what it was like being his student. I moved to
Seattle in 1997 at the suggestion of Marjorie Senechal. I was immediately welcomed into a vibrant and generous community of discrete geometers. At the core of this community were Vic Klee and Branko Grünbaum, both of whom provided me with much valuable advice and guidance during my time there, and both of whom were unfaillingly kind to me.

As a mathematics graduate student, a visit to Branko’s office was like a visit to the candy store. His office was filled with models he had built over the years to help him think through geometric problems. They covered shelves and hung from the ceiling tiles on bits of string (which I’m sure caused the fire marshal fits of apoplexy), and they were colorful and intriguing. It seemed like every time I went into his office I noticed something new, and he was always happy to explain the math behind the model and pull a copy of a preprint from his filing cabinet of the paper that had provided the need for the model in the first place. Questions I brought to Branko were often answered by him pulling a model from a shelf to illustrate a point, and would lead us into a discussion of other questions the model helped to illuminate. One of my most prized possessions is a model he built, and I was immensely proud when he asked me to contribute a copy of a model I had built for my own research into his collection. The garage at his house was equally a treasure trove of mathematical models, and interesting examples often made their way from his home to lecture halls at the university. In this way I learned the importance of visualization and model building as tools to gain deeper insight into geometric questions, and as an important step in verifying my understanding of mathematical ideas (if I couldn’t build it, I clearly didn’t understand it).

When I began preparing my first paper for publication, I got invaluable advice from Branko about what I should be trying to achieve in my writing. He believed strongly that an article should be written as an invitation to engage in a conversation with the author(s). This means making sure it has the necessary background, trying to make the writing as clear and engaging as possible, and asking thought provoking questions. Because a paper is a conversation between the author and the reader, even solo authored papers should use “we”. He encouraged the inclusion of conjectures, because they excited the reader to a challenge. He enjoyed and fostered collaboration at every turn. The slight exception to this was co-authoring papers with his students (especially while they were his students), because he wanted to make sure readers gave us the credit instead of assuming the significant contributions were his. This was a little frustrating to me because I wanted to lower my Erdős number and get my Grünbaum number down to 1, so I’ve always been a bit envious of my wife Leah Berman, who was a student of his at the same time, who co-authored a paper with him a few years after we graduated.

After completing my Ph.D., Branko continued to be a significant presence and influence on my life and career. His signature graces our marriage contract, and he and Zdenka welcomed us into their home when we would visit Seattle. He and Zdenka always made us feel welcome and cherished, and they doted on our children. I was always a little in awe of how much in love they seemed, even after 61 years of marriage. Zdenka sadly passed away in her sleep on December 28, 2015.

Having been his student has been a constant source of open doors for me. Anywhere I go in the world of discrete geometry, I am always greeted with warmth and delight when someone learns I was his student. One of my favorite interactions along these lines was when I first met János Pach while he was at MSRI; when he learned I was Branko’s student he said that Branko “always had great taste in problems.” That always struck me as very
high praise indeed. It was also clear that many mathematicians I met not only respected him for his achievements and contributions to the field, but also treasured his company, hospitality and generosity — that they held in high esteem not just the mathematician but the man.

There is an old Jewish tradition that no one is truly gone as long as their memory and name survive. I will treasure his memory and the influence he has had on the course of my life for the remainder of my days. May his name be a blessing to you as well.

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References


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