

Marcel Neuts Lecture

Some memories of Marcel

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It was a great joy and honor for me to be invited to give the inaugural Marcel Neuts Lecture at the Kellogg School of Business of Northwestern University. This is a biannual event in Marcel’s honor, organized under the auspices of the Statistics Department at Purdue University. The invitation came seventeen years after I had left Purdue’s Industrial Engineering department to work in finance. In preparation for the lecture, I devoted several months of weekends to resuscitating my long-dormant knowledge of stochastic modeling, and, in doing so, recalled with pleasure and gratitude many interactions with Marcel over the course of my academic career, a few of which I recounted in my talk. This note presents those personal recollections. In the process of committing them to paper, I came to better appreciate the extent of Marcel’s influence on me.

My connection with Marcel goes back to 1978, when Peter Purdue, a 1972 Purdue University PhD and Marcel advisee, visited University College Cork and spoke to the Mathematical Sciences Masters students, of whom I was one. Peter, who is now Professor Emeritus of the Naval Postgraduate School, was on the statistics faculty at the University of Kentucky at the time, and his visit led to a Teaching Assistantship for me there. Before long, I was working under Peter’s guidance on things related to Matrix-Analytic Methods, the framework for stochastic modeling pioneered by Marcel. I remember sending Marcel a dense eight-page letter written in pencil in about 1981, detailing an alternative approach to proving a key result in Matrix-Analytic Methods. The moment I put it in the mail, I felt a pang of regret because it suddenly seemed that my letter revealed a shallow understanding of Marcel’s work. I remember my relief at the encouraging letter he sent in response. I first met Marcel at the ORSA/TIMS Joint National Meeting in Chicago in 1983. He was a beacon of friendliness and approachability to young academics like myself. His sense of humor, which was always looking for an outlet, was immediately disarming.

After finishing my PhD, I began to see phase-type distributions – a key building block of Matrix-Analytic Methods – as mathematically interesting in and of themselves. I was inspired by the geometric ideas of a 1982 paper by Michel Dehon and Guy Latouch and the algebraic insights of a paper by Aldo Cumani of about the same time. I began to work energetically on the topic at the University of Arkansas’s Department of Mathematical Science. After I had

published a few papers on phase-type distributions, I approached Marcel about spending a sabbatical semester in the Department of Systems and Industrial Engineering (SIE) at Tucson. Before long, Marcel had found funding to allow me to stay for the full 1988-89 academic year.

In the summer before my sabbatical, I had an idea about how to prove a characterization theorem for phase-type distributions. I arrived in Tucson full of confidence and told Marcel about my great result. He responded with a hint of doubt: "That would be wonderful." I slogged away for months and finally produced a sixty-page paper, full of tedious youthful meticulousness. Marcel treated it as a gift from the gods. He had it reviewed by no fewer than eight referees. Their reports were positive. Some encouraged me not to belabor the basics of convexity, linear algebra, and Laplace transforms. The thought of implementing this excellent advice was almost unbearable to me, exhausted as I was after months of intense labor. Marcel accepted the paper more or less without change, and afforded it pride of place as the first paper in the 1990 volume of *Stochastic Models*, the journal that he had founded in 1985.

Marcel ran a weekly seminar that attracted mathematically-minded people from across the Tucson campus. He asked me to give a talk about my ongoing work on phase-type distributions. Robert Maier of the Mathematics and Physics departments attended my talk. In the following months, Robert developed the connection between phase-type distributions and the "structure-generating functions" of regular languages in theoretical computer science. In particular, he showed that the characterization of phase-type distributions was closely related to a 1976 theorem of Matti Soittola. Although Robert's work greatly enriched the conversation about phase-type distributions, it also took some of the wind out of my sails by showing that a key component of my long paper had been discovered more than a decade earlier. In my Marcel Neuts Lecture, I gave the topic of regular languages a central place. In addition to seminar speakers, Marcel had a steady flow of longer-term visitors who contributed to an exciting research atmosphere. I later wrote papers with Robert Maier and with my fellow visitor in Tucson, Thomas Bruss. I became one of the many beneficiaries of the intellectual culture Marcel fostered in Tucson.

Before I arrived in Tucson, I had assumed Marcel to be a slave to his work. That was far from the truth. He read widely and relished good conversation. I recall that in his lighter moments he enjoyed reading detective novels and playing the solitaire game *Canfield*. I recall that he was reading English translations of the detective novels that my wife Kumi was reading in the original Japanese. Marcel spoke many languages, but his only advice to me as I struggled to learn a little Japanese was "Your third language will be easier." He enjoyed taking walks. I remember walks with him at the Pima County Fair in Tucson and in Turkey Run when he visited Indiana after I had moved to Purdue. On these walks, we would constantly fall into conversation with whomever happened to be nearby. Marcel always projected personal warmth and empathy, and there was often a twinkle in his eye as he formulated something funny to say. His humor was often quite uncomplicated and had the effect of putting everyone at ease. He used to circulate a weekly email of humor to perhaps seventy people.

I always looked forward to those emails and would share whatever I found most delightful with friends or family.

I recall a conversation in Tucson in which Marcel said that he had been reading Galois theory, a topic in abstract algebra. He said that a colleague had asked why he would spend time on a topic so unrelated to his research. Marcel's reply, "for the beauty of it," was, to this colleague, an implausible explanation. Marcel loved mathematics. There is a special magic in Galois theory for young mathematicians, and I think Marcel was drawn to the topic in part for this reason. A budding high school mathematician who is intrigued by the quadratic formula may be inspired to seek analogous formulas for cubic and higher-order equations. But the fact that there is no such formula for the quintic, and that this can be *proved*, through Galois theory, is more astounding than any formula. To understand that such a thing can be known at all has inspired many students to study advanced mathematics. What better topic to have in your back pocket if there is an opportunity to proselytize about mathematics to the next generation?

Soon after my year in Tucson, I became an associated editor of Stochastic Models. I kept that role until I moved to finance in 2000 and the pressures of my new job made it impossible for me to contribute. Throughout the 1990s, I was in regular contact with Marcel because of my editorial work. Although he was the founding editor, he considered himself as merely "the first among equals" on the editorial board.

When I decided to move to finance, Marcel had a word of wisdom. He noted that several colleagues had made the same transition in the previous few years. He was puzzled that these experts in applied mathematics could six months later be experts in finance. With that puzzle in mind, I entered my new field with the humility appropriate for a novice.

Marcel advised twenty-one PhD students and has over 200 academic descendants, of whom I am one. I benefitted from Marcel's wisdom and good nature in the big steps of my professional life, at first indirectly through my advisor, Peter Purdue, and later as his colleague and friend.