FACES OF MASS SPECTROMETRY / Pavel Bondarenko

Anne Brenner and J.D. Brookbank are science writers at Technica Editorial Services.

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To Overcome and Discover

Pavel Bondarenko first pursued a PhD in analytical chemistry at Texas A&M. While there, he had the opportunity to build a mass spectrometer and use it to profile human serum apolipoproteins as part of a study that aimed to better understand the risk of early coronary heart disease. After this rewarding experience, it became clear to Pavel that he wanted a career in industry that allowed him to build analytical instruments and apply them in a similar way. This path ultimately led him to Amgen, where he has worked for 22 years, leading different areas of analytical and mass spectrometry studies relating to therapeutic protein drug development.

For Pavel, an essential quality of an effective leader is the ability to overcome the obstacles that prevent people from coming together and acting collectively—whether in the context of science, industry, or beyond. It's clear from the description of his involvement with various groups and organizations that he is adept at doing exactly this—bringing people together.

Pavel notes that the Faces of Mass Spectrometry series is a good opportunity to acknowledge and thank the people who have contributed to the careers of many in the mass spec field. Pavel believes his success is about teamwork; from instrument development, to collaborations, scientific immigration, adaptation to cultural changes, and the lifelong friendships he has made in the world of mass spectrometry.

How did your interest in mass spec first get started prior to coming to the United States?

I obtained my Master of Science in Applied Physics and Electrical Engineering degree from Moscow Engineering Physics Institute (MIFI) in Russia, which was good preparation for those interested in engineering careers in analytical instrumentation, including mass spectrometry. Several MIFI graduates are known to the ASMS community, including Dr. Alexander Makarov, Professor Roman Zubarev, Dr. Viatcheslav Artaev, and Dr. Mikhail Belov, just to name a few. Studying at MIFI was very tough—only one out of four were accepted, and only half of my classmates graduated. I'm very thankful to my parents, who always stressed the importance of education and pushed me to obtain high grades.

In college, I was trained to design accelerators of charge particles, which included ion sources, electric and magnetic fields, as well as vacuum and ion detectors. All these elements are used in mass spectrometers. In college, I had a chance to listen to the talks of Nikolay Basov who won the 1964 Nobel Prize in Physics for the development of lasers and Pavel Cherenkov who won the 1958 Nobel Prize in physics for the discovery of Cherenkov radiation.

After I finished college, my college classmate, Roman Zubarev, invited me to join a group that had just started a new project: development of a ^{252}Cf Plasma Desorption Time-of-Flight Mass Spectrometer (PDMS TOF) in the company Electron (SELMI) in Sumy, Ukraine. Roman has been a good friend, a strong collaborator, and a bright scientific mind.

What first brought you to the United States, and specifically the PhD program at Texas A&M?

In 1992, after commercializing the PDMS TOF, the sample preparation device and coauthoring half a dozen related peer-reviewed articles, I wrote a letter to Professor Ronald D. Macfarlane expressing interest in enrolling in the graduate school at Texas A&M and performing research in his laboratory. Professor Macfarlane was the recipient of the Inaugural ASMS Award for Distinguished Contribution to Mass Spectrometry. The 1990 ASMS Award was presented to him for his "work on the conception, development, and application of 252Cf Plasma Desorption Mass Spectrometry." Taking my previous experience in PDMS TOF into account, Professor Macfarlane invited me to continue research in mass spectrometry at Texas A&M. During my graduate studies, I built an ESI TOF MS with a mass resolution of 1800. At that time, at the beginning and middle of the 1990s, Dr. Anatoly Verenchikov was developing commercial ESI TOF Mariner at Vestec/PerSeptive Biosystems/ABI in Houston, Texas. Anatoly provided valuable

Fishing near city Sumy, Ukraine, while developing the commercial PDMS TOF. Five o'clock in the morning in the summer of 1988. Pavel, his wife Natasha, and Roman Zubarev. (Bottom) The same people 25 years later in Thousand Oaks, California. (Photos courtesy of Pavel Bondarenko.)

suggestions for design of the orthogonal accelerator and nanosecond high-voltage pulse generator enabling construction of the instrument.

After building the instrument, I applied it to profiling human serum apolipoproteins by mass spectrometry. More than 20 different isoforms of A and C apolipoproteins had been identified in HDL fractions of donors. This included several new human serum isoforms, to establish a link between the isoforms of A and C apolipoproteins related to the risk of early coronary heart disease. It was exciting to see that the in-house built mass spectrometer allowed measuring the human serum apolipoprotein more quickly and with greater detail than previously utilized 2D gel electrophoresis.

I would like to express my sincere appreciation to the people who made the Texas A&M project possible. This includes Professor Macfarlane for his ideas, guidance, and support, along with members of his research group. The human serum apolipoproteins part of the Texas A&M studies made an impact on the future shift in my career from instrument development to proteomics applications at Thermo Scientific, and then to protein drug development at Amgen.

We understand you have attended every ASMS conference since 1993. How has attending these conferences helped you to grow as a scientist?

When I attended my first ASMS conference in 1993, it was amazing to see the people whose scientific papers I had read before. I really enjoyed listening and talking to them and learning from those conversations. There is not enough time to read everything related to mass spec throughout the year. So, one week of the annual ASMS conference provides an opportunity to catch up and learn about the latest instrument and software developments from instrument manufacturers, new methods, and new findings.

We also understand you were the founding president of the Russia Mass Spectrometry Interest Group (RMSIG) and served as president for three years, beginning in the late 1990s. Could you tell us about that group's goals and your role as its leader?

The group was described in detail in the 2019 JASMS article entitled *The Russian Mass Spectrometry Interest Group at ASMS: Over 20 Years of Science and Water Polo*. After the collapse of

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At the 48th ASMS Conference (Long Beach, CA, June 2000). The early days of the Russian MS Interest Group. Top row standing from left: Raznikov, Mamyrin, Shainskaya, Gusev, Doroshenko, Mirgorodskaya, Aksyonov, Artaev, a colleague, Mordehai, Tolmachev, Berkut, a colleague, Makarov. Second row sitting on chairs from left: a colleague, Podtelejnikov, Kiselar, Taranenko, Loboda, Dodonov. Bottom row sitting on the ground from left: Moskovets, Shevchenko, Bondarenko, Chernushevich, Laiko, Nesaty, Kovtoun, Fishman. (Adapted from Tsybin, Y.O, Bondarenko, P.V., Artaev, V.B., Zubarev, R.A. Catherine E. Costello, C.E.: The Russian Mass Spectrometry Interest Group at ASMS: Over 20 Years of Science and Water Polo, *J. Am. Soc. Mass Spectrom.* **30**, 2178 (2019), DOI: 10.1007/s13361-019-02281-9)

the Soviet Union in 1991, funding for science and technology development decreased dramatically, including in the field of mass spectrometry. This steered a wave of scientists from the former Soviet Union to seek new opportunities abroad, if they wanted to stay in science. This was a big change for the scientists, and some of them experienced cultural shock, anxiety, and the feeling of uncertainty for the present, and especially for their future situation and their families.

All of this led to the creation of the self-organized Russian Mass Spectrometry Interest Group (RMSIG). The purpose was to facilitate a smooth transition for the newcomers and maintain communications among the members on the various topics related to mass spectrometry and everyday life. The group was created rather spontaneously at ASMS 1998 in Orlando, Florida. At the last night of the meeting, a dozen of people were singing around a piano in a lobby of the hotel. After all of the songs had been sung, eleven white business cards lay on the black piano, and somebody said: "Pavel, could you create a mailing list and maintain this connection?" That year, I became the first president of the group, and then had a chance to serve several times after that. The group quickly increased in number, and the mailing list currently exceeds 200 people.

It is interesting that I have served as president of the Russian group for several years, although I am actually a Ukrainian. It is great to experience diversity and inclusion in science, including ASMS and the mass spec community. This leads to better results, outcomes, benefits society as a whole, and makes this world a better place.

After your PhD studies, what first brought you to your past position at Thermo Scientific and current position with Amgen?

After my graduate studies, I knew that I liked to work in industry, build analytical instruments, and apply them in protein sciences, biology, and human health. After Texas A&M, I found a position at Thermo BioAnalysis Corporation in Santa Fe, New Mexico. There, a small Thermo BioAnalysis MALDI group was created, and it managed to manufacture and sell a dozen DYNAMO MALDI TOF instruments during a two-year period. The same group in Santa Fe also manufactured the Crystal 600 Series capillary electrophoresis (CE) system with conductivity detector. I was a chief engineer overseeing the MALDI, and CE manufacturing, testing, and applications. After two years, Thermo Electron decided to discontinue MALDI and CE manufacturing, as resources were needed for the ion trap and then Orbitrap development.

After Thermo BioAnalysis, I stayed in the Thermo family and joined Thermo Finnigan/Thermo Quest/Thermo Scientific in San Jose, California. There in collaboration with Dr Dirk Chelius and Dr. Thomas A. Shaler, my research focused on the development of label-free quantitation method for shotgun LC/MS/MS proteomics.

In 2002, when I left Thermo Scientific for Amgen, my manager at that time, Dr George Stafford, arranged a big celebration with two large cakes. Over 100 people came to say goodbye. They most likely came because of the cakes, of course! But maybe some also came because I was not leaving to work for a competitor, but to a customer, Amgen. We all had a lot of fun working together and playing sand volleyball at the court at the back of the building in San Jose.

Believe in yourself and your data, because if you do not believe it, nobody else will.

Pavel's group at Amgen in 2005 (Above) and in 2007 (Right) with mass sepctrometry on their minds. (Top) From left to right: Himanshu Gadgil, John Le, Da Ren, Jill Beierle, Gary Pipes, Dirk Chelius, Pavel Bondarenko. (Bottom) Top row, from left: Pavel Bondarenko, Da Ren. Bottom row, from left: Dirk Chelius, Drew Nichols, Gary Pipes. Not shown on the photos: Tom Dillon, Gang Xiao. The group was providing analytical, mass spectrometry support of formulation development (2002–2007). (Photo courtesy of Pavel Bondarenko.)

What have been some of your accomplishments in mass spec during your 22 years at Amgen?

My career at Amgen has included development of mass spectrometric and other analytical methods and their applications to overcome challenges in biotechnology and protein drug development. This involved analytical support of translational sciences and process and product development. This included optimization of upstream cell line and cell feeding, downstream purification, formulation, commercial manufacturing, quality, and regulatory filings of therapeutic proteins. I have also established and managed analytical groups, and labs, while recruiting and developing scientific talent, and building productive collaborations in the complex matrix environment of a large corporation.

My scientific and technical innovations are described in 80 peer-reviewed journal publications, 12 issued patent families, and 7 pending patent applications, the majority of which came from Amgen.

I would like to thank my group members and the multiple collaborators, with whom we have made several discoveries over the years at Amgen.

What are some qualities you consider important for a successful team leader in your field?

A successful team leader should be able to create an environment in which scientists are willing to share their knowledge and experience, brainstorm, and resolve problems quickly and efficiently. I believe in the high value of the collective mind. Also, in leading people, try to be honest and fair in seeing/evaluating oneself and others in the surrounding world.

In leading science, it is important to define the problem, design the experiment, and then patiently execute it to reveal a result with statistical significance. Some problems are quite challenging, and may not be resolved for a long time, if at all. A large organization includes dozens and even hundreds of scientists from different schools and with different backgrounds. It is my opinion that any problem that can be resolved in this world can potentially be resolved in a large organization.

When you're not working, and you are outside of the lab, do your other interests include any kind of travel?

I enjoy spending time with my children and grandson. I like to cook, go to the beach, and watch movies. When I was younger,

Talking about mass spectrometry and having fun in the lab at Amgen with Pavel in 2024. From left: Gloria Cho (sitting), Pavel Bondarenko, Andrew Dykstra, Daniel Woodall, Prashant Jethva, and Tom Dillon. (Photo courtesy of Pavel Bondarenko.)

Pavel and colleagues at Amgen in 2024, from left to right in the back row standing: Jason Richardson, Zhongqi Zhang (ZZ), Bhavana Shah, Prashant Jethva. From left to right in the front row, sitting are Daniel Woodall, Pavel Bondarenko, and Andrew Dykstra. (Photo courtesy of Pavel Bondarenko.)

I was involved in karate, volleyball, and soccer. These days, I am mainly playing pickleball.

I would like to thank my family for being patient with my long working hours and supportive during job-related relocations.

What advice would you offer to younger scientists beginning their careers in mass spec?

A positive, active attitude and initiative are important, but with initiative comes responsibility. My first boss at Amgen, Dr. Michael Treuheit, used to say, half-jokingly, "Pavel, if your initiative is successful, we will always have your back, but if you screw up and waste everybody's time and money, you are on your own."

Another piece of advice: believe in yourself and your data, because if you do not believe it, nobody else will. A discovery often contradicts previous data and postulates, and your new findings may be met with doubt and criticism, which need to be overcome.

Professor Roman Zubarev once said that "science can be a lonely place." If you want to be a professional scientist, be prepared for that. And yet, in my experience, science is also an exciting place of discoveries, teamwork, collaborations, lifelong friendships, and diversity. I am thankful to Mike and my other managers at Amgen for their support, trust, and freedom to operate.