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INTERVIEW

Professor Jörg Feldmann kindly granted an interview to BrJAC

Professor Jörg Feldmann was educated in Germany. After 25 years in Canada and Scotland working on the development of novel elemental speciation methods for unraveling biological and environmental pathways of trace elements, he moved to Austria. At the University of Graz, he became Head of the Analytical Chemistry Department and was recently appointed Head of the Institute of Chemistry. Currently, he is focusing mainly on the development of new platforms for fluorine and per- and polyfluoroalkyl substance (PFAS) analysis and is additionally investigating arsenic and mercury transformations and bioaccumulation pathways in the marine environment and in rice cultivation. Professor Feldmann has published more than 350 papers (h-index of 76), given over 180 invited lectures, and educated more than 50 PhD students.
He has also received many awards, including the 2015 European Plasma Spectrochemistry Award, the 2016 RSC Interdisciplinary Award and Medal, the 2020 Award for Industrial Engagement, and the 2023 Award for Excellence in Teaching, and was elected a Fellow of the Royal Society of Edinburgh in 2018.

BrJAC: What was your childhood like?
Prof. Feldmann: I grew up in a working-class environment in Germany and left school at 15 when I embarked on an apprenticeship in the chemical industry. I hated my job and I realized that I needed to get my life and a job in my own hands. I went back to school to get my qualifications to go to university and study chemistry.

BrJAC: What early influences encouraged you to study chemistry? Did you have any influencers, such as a teacher?
Prof. Feldmann: In my early years I did chemical experiments at home and in the garden. I carried out explosions and was fascinated about the science of this. In school I had to give a full lesson to the class, since I was always annoying the teacher. “Stop talking or I’ll do choke chemistry (that meant no experiments), and if you know it better, you do the next lesion,” she said, and I accepted it. I hated school but I loved chemistry and wanted to see the world.

BrJAC: What was the beginning of your career in chemistry like?
Prof. Feldmann: I realized that I was interested in environmental chemistry, which was not taught in Germany at the time, but I studied geology on the side and I did my Master project in geochemistry in South Africa, already doing some elemental speciation in gold solubilities under hypothetical Precambrian atmospheres. This is all I wanted: chemistry of the environment and in a faraway country with a different culture. But I did not continue with a PhD, although most people did this back in Germany. I decided to work for a city

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council as environmental officer to assess contaminated land in the city. But my work was shallow and I could not travel the world. Then I got a phone call from Alfred Hirner, who had founded a new institute of environmental analytical chemistry at the University of Essen, and he had heard that I was a chemist and interested in environmental and analytical chemistry. He offered me a PhD position (and a part-time lecturer position). I developed the first coupling of gas chromatography to ICP-MS in 1991 to analyze volatile metal species in landfill gas and I loved it. When on the matrix printer the numbers were coming out, we knew that we had discovered something novel—this was exiting.

BrJAC: What has changed in your profile, ambitions, and performance since the time you started your career?

Prof. Feldmann: When I was about to finish my PhD, I did not want to stay in Germany, otherwise I had no plans. But I realized that with a PhD the world opens up, and I applied to the Alexander von Humboldt Foundation, who send out the best-qualified PhD to the world in order to return to Germany. I received a scholarship and went to Bill Cullen at the University of British Columbia in Vancouver, Canada. I worked there on hot springs and volcanic exhalations, trying to develop new skills such as microbiology and working in a hot lab with radioactive material. Even at that point I had no idea what I wanted to do later in life. I never planned anything but I was determined not to go back with my new family to Germany and I decided to go to Aberdeen in Scotland. I loved Scotland when I visited this wonderful country for one month, climbing the hills on the west coast, during my undergraduate years in Germany. At the same time, I had the opportunity to go to large, successful groups in elemental speciation (to Alfredo Sanz-Medel in Spain or Olivier Donard in France), but I wanted to build up my own lab from scratch and that is what I did. I was lucky—I specialized in elemental speciation and that was hip at the time, so I received a lot of funding and attracted great people to work with me as PhDs and postdocs.

BrJAC: Could you comment briefly on the recent evolution of analytical chemistry, bearing in mind your contributions?

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Prof. Feldmann: When I started with elemental analysis, I moved from AAS to ICP-MS very quickly. Plasma spectrochemistry was always at the heart of my research in speciation analysis. I always wanted to explain environmental and biological processes in which metals and metalloids were centerpieces, but I found out that the right tools and methods were not available to characterize these processes. Hence, my team needed to develop first of all new analytical methods and then they could apply those to answer environmental or biological scientific questions. This has always been my focus and still is. We were the first to do elemental mapping in soft tissues using laser ablation ICP-MS and coupled HPLC simultaneously to electrospray mass spectrometry and elemental mass spectrometry (ICP-MS) to identify and quantify novel elemental species such as arsenolipids and mercury phytochelatins. But using only one type of analytical technique is not enough in most cases, and we should use the entire toolbox of analytical chemistry to analyze environmental samples. Hence, synchrotron techniques such as XANES/EXAFS or Raman and electrochemical methods are often needed. Thus, I tried to team up with the best in the world for those techniques and this has been very successful. But the most important collaborations have been with life scientists (soil scientists, geneticists, marine biologists, archaeologists, geologists, epidemiologists, etc.) in working on grand environmental questions. Without these collaborations I would not have been able to answer any of those interesting questions or prove or disprove sometimes outrageous hypotheses. I guess if you work in analytical science, you have to do a good job, and if you come with interesting questions like "why do sheep not die when they eat more than 13 g of arsenic per year?" or "why are whale strandings increasing?" people will flock to you.

BrJAC: What are your lines of research? You have published many scientific papers—would you highlight any?
Prof. Feldmann: Most of my research has focused on arsenic from biovolatilization, to arsenic metabolism in sheep and humans, to arsenic in rice. The latter gave me the most satisfaction. Then our work in Aberdeen together with Andy Meharg was instrumental in setting guideline values for a maximum legal limit of inorganic arsenic in rice worldwide, and in particular in the EU.
Then, of course, there is the mercury work I did together with Eva Krupp on mercury in plants and in whales in forming mercury nanoparticles, and recently in the decommissioning of offshore oil and gas.

BrJAC: What is your opinion about the current progress of chemistry research in Word? What are the recent advances and challenges in scientific research?
Prof. Feldmann: Our latest endeavor is fluorine speciation with an emphasis on using mass balance approaches in PFAS analysis. I realized 15 years ago that the approach we use in elemental speciation would be very beneficial for PFAS analysis, since we have more than 12,000 different PFAS and only up to 50 are routinely measured with target analysis using LC-MS/MS. Using elemental analysis like atomic spectrometry (AAS and ICP-MS) can help with monitoring the PFAS. But we are only at the beginning right now. I would compare the current situation with arsenic speciation in the 1990s. So, the challenges are to get a sensitive and robust fluorine detector like we have for metals and metalloids, which can be coupled to chromatography, flow field fractionation for particulates, or to laser ablation for fluorine mapping, and to do reliable total fluorine analysis at the ultra-trace level. If you have any ideas, please contact me.

BrJAC: For you, what have been the most important recent achievements in analytical chemistry research? What are the landmarks? What has changed in this scenario with the COVID-19 pandemic?

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Prof. Feldmann: I think classical environmental analytical chemistry has to move to automation, i.e., not only for measurements but for sample preparation and for data analysis. Here, fully automated systems are needed that have been developed in proteomics and other disciplines. AI-guided approaches for data analysis are becoming more and more important since we often get gigabyte data and use only a fraction in nontargeted analysis. We neglect most of our data. What COVID-19 has shown us is that we cannot stop developing sophisticated analytical methods for well-funded labs, but we need to simplify the methods so that our methodologies can be used in less developed economies. We developed, for example, a field-deployable method for inorganic arsenic in rice where an untrained rice farmer can do the analysis and get an answer in one hour as to whether his or her rice can be exported to countries with legal maximum limits for this carcinogenic compound. Recently we even replaced nitric acid with Coca-Cola in the extraction step to make it applicable in rural countries—so, a traffic light system like we have had with the COVID-19 quick tests; that is where we have a social impact and this fits well to the SDGs (Sustainable Development Goals).

BrJAC: There are, in Brazil and across the world, several conferences on chemistry. To you, how important are these meetings to the chemistry scientific community?
Prof. Feldmann: We have experienced extraordinary times of lookdowns and no in-person conferences. This has resulted in a communication breakdown between scientists, despite the fact that we have all had the technology to listen to lectures all around the world without traveling. The most important parts of those conferences are the breaks and evenings. This is the time science comes alive and new ideas for new projects are born. This is not happening if you sit alone in front of a computer. Hence, scientists in Brazil

keep going and organizing conferences and workshops at which, in a relaxed atmosphere, networking opportunities are generated. I am thankful for those conferences in Brazil.

BrJAC: What is the importance of awards for the development of science and new technologies?
Prof. Feldmann: Awards are a great tool for all ages but mostly for young researchers. These awards are an acknowledgment of all the hard work from a research community. This helps young researchers especially who are still on the brink of getting a permanent position to get a job or to secure funding to develop new technologies.

BrJAC: What advice would you give to a young scientist who wants to pursue a career in chemistry?
Prof. Feldmann: As I mentioned before, I did not have a career plan myself, and I hated school and university at first, but my eyes were always open for opportunities. You can have a career in chemistry in industry or in government organizations. You do not have to decide early on what you want to do, there will always be time to change. You will find out during your Master or PhD if academia or industry or working for legislators is for you. All have their pros and cons. If you like training people and you are thrilled by developing new ideas without borders, then academia is the place for you. But you need to be prepared to work some extra hours (unpaid but maybe rewarded with prizes). If you want to earn money and have a brilliant idea, go down the entrepreneur route, but here you need to hunt more for funding than in academia, but it can be rewarding. A nine to five job, if something like that exists, is best found in a large chemical or pharmaceutical company. But you do not have to decide during your Master or PhD and you may get opportunities during this time. Go to conferences and meetings; these are the places where opportunities are.

BrJAC: For what would you like to be remembered?
Prof. Feldmann: No idea. I am not retired yet and I have still some exciting projects ahead of me. No idea if they work but this is research. If this fails, remember me as a crazy Germanic Scottish guy who likes to come to South America and likes to work with those wonderful Brazilians on interesting projects in environmental chemistry.