FACES OF MASS SPECTROMETRY / Catherine Fenselau

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Wrapping Up a Life's Passion

On July 1st, after 51 years of pharmacological and proteomics research using mass spectrometry, ***Catherine Fenselau*** *(Cotter) is closing her lab and taking emeritus status as Distinguished University Professor at the University of Maryland.*

"I am sending my last two post docs off to very good jobs and will now spend more time in Silicon Valley with my two sons and grandchildren," says Fenselau, whose academic progeny include over 150 graduate students and postdocs. "I am so pleased that one of my granddaughters has decided to be a chemist; neither of my sons would go near science because they felt both of their parents cared too much about it."

When Fenselau speaks about her life's passion and work, she chooses her words precisely and laughs frequently. Her first faculty position was at the Johns Hopkins School of Medicine in 1967 where she was one of the first formally trained mass spectrometrists in a medical school. After 20 years of research in pharmacology and disease, she switched to the University of Maryland.

"Rather than be in a clinical setting, I wanted to be more involved in training new chemists," says Fenselau. "I wanted to be in a chemical environment where I would hear people talking about chemistry and biochemistry."

A fellow of the American Association for the Advancement of Science, Fenselau received numerous awards for her work, including the Distinguished Contribution Award from the American Society for Mass Spectrometry and both the Garvan Medal and Field & Franklin Award from the American Chemical Society. She was the first female president of the American Society for Mass Spectrometry, and she has published more than 400 academic papers.

As Fenselau laughs, "We were busy!"

What drew you to science?

My first exposure to science was really through archaeology. I grew up in Nebraska, and we would often vacation at Mesa Verde National Park when you could still get close to the ruins. I've been curious all my life and enamored with how scientists think: by asking a question and designing an experiment to get the answer. So, when I got to Bryn Mawr College, I declared as a chemistry major and worked for two summers training in NSF-funded research labs. This was the late 1950s, just after Sputnik, when the government decided to put a lot of money into training scientists.

How did you get introduced to the field of mass spectrometry?

I went into graduate school at Stanford and ended up in the laboratory of Carl Djerassi who, along with Fred McLafferty and Klaus Biemann, really opened the field of organic mass spectrometry in this country. After a post doc at Berkeley, I joined the faculty at Hopkins where I was encouraged to exploit mass spectrometry in support of biomedical research. It was delightful! Everything that we tried was new and interesting because so little had yet been done with mass spectrometry in biomedical research.

It was a very collaborative environment where samples and problems were brought to me by colleagues from many disciplines. A pathologist asked me to look at bacteria. We were surprised that different bacteria gave different spectra, and we eventually had great success characterizing bacteria [Anhalt, J.P., Fenselau, C.: *Anal. Chem*. **47**, 219-225 (1975)]. The Army supported our work because they thought it could be a rapid way to detect bacteria on the battlefield [Fenselau, C., Demirev, P.A.: *Mass Spectrom. Rev.* **20**, 157-171 (2001)].

Prof. Catherine Fenselau talks with post docs Dr. Fabio Gomes and Dr. Dapeng Chen in the lab (May 2018.)

What research have you found most exciting?

One of the things I am proudest of is the measurement of the proton affinity of the amino acid arginine [Wu, Z., Fenselau, C.: *Rapid Comm. Mass Spectom.* **6**, 403-405 (1992)]. Arginine turned out to be—by a considerable amount—the most basic of the amino acids, so the measurements turned out to be useful to other people who were developing peptide analysis.

My most cited paper is a contribution to the development of proteomics, a high through-put workflow for analyzing peptides. We proposed and demonstrated a method [Yao, X., *et al.: Anal. Chem.* **73**, 2836-2842 (2001)] of isotope labeling with ^{18}O to allow relative quantitation of peptides and proteins in different systems. We were interested in the changes in proteins in cells that are resistant versus susceptible to anti-tumor agents.

What is your lab working on right now?

We've just come off a four-year grant to look at little vesicles called exosomes that carry messages between cells and help control the resistance of tumors to antibodies. This was my last NIH grant, and so far we've published 15 papers based on it [Burke, M., *et al.; J. Proteome Res.:* **13**, 836-843 (2014)].

Scientists always think that what they are doing right now is the most interesting thing, and right now we are developing a method for characterizing branched proteins [Lee, AE., *et al.*: *J. Mass Spectrom.* **51**, 315-321 (2016); Chen, D., *et al.: Anal. Chem.,* **90**, 4032-4038 (2018)]. When proteins are conjugated with ubiquitin and other messenger proteins, their function and location in the cell changes, and I want to know the structures of the polyubiquitins that change the fate of the proteins. I like this kind of research in part because it is hard – the state of the art in mass spectrometry – and because it will be useful to cell biologists.

What do you like to do outside of the lab?

I always enjoy trying new recipes, I like contemporary expressionism in art, and I like to travel—I'm especially enamored with the south of France, northern Italy, and the Four Corners Area. My husband recently passed away, but we did a lot of hiking and biking, especially bicycling in Maryland, because you can move faster and cover more distance. Our favorite trail was along the C&O Canal: it is flat, and you see lots of porcupines, turtles, deer, and flowers in the spring.

What challenges did you face over your career?

I am really a positive person, so I cannot think of lot of problems. But I've been very pleased with the progress that women have made in science over my arc of 50 years. When I started, I was often the only woman in the room. I was the first female president of the American Society for Mass Spectrometry. There are still fields that need to diversify, but our field now has a relatively high percentage of women. Some have suggested that mass spectrometry opened up to women in part because I performed reasonably well in my own science, and, if true, this is a wonderful tribute. I've taken every opportunity to mentor women scientists and more broadly to support women.