ACS central science

CENTER STAGE
In collaboration with C&EN

A Conversation with Helen Sharman

Sarah Everts

The chemist talks about being Britain's first astronaut 25 years ago.

Credit: Mary Turner/Newscom

Helen Sharman was driving around London in her car in 1989 when she first heard a radio advertisement asking for applicants for a project to send the first British national to space, specifically to the Soviet Union's *Mir* space station.

A few years out from receiving her chemistry degree, Sharman was working as a food technologist at Mars, the confectionery company, on a chocolate research project. Little did she know that she would be selected from 13,000 applicants to spend 8 days in space as the first British astronaut. During her mission training, Sharman lived for 18 months near Moscow, just as the Soviet Union was collapsing.

After her trip to the *Mir* space station in May 1991, Sharman spent years touring around the U.K., speaking about her space experience, and advocating for science. Then she took a long break, reevaluated her career goals, and came back to chemistry as an administrator: She is now operations manager at Imperial College London's chemistry department, where she manages staff and budgets. In May, *C&EN* spoke with Sharman shortly after she feted the 25th anniversary of her groundbreaking mission at Imperial and London's Science Museum alongside three former members of the Soviet crew.

Given the competition's 13,000 contenders, your odds of winning were incredibly slim. What did you think your chances were?

As soon as I heard the advert, it sounded like an amazing opportunity. Like many people, I satisfied the basic criteria: I was between 25 and 40 years old, I had some sort of technical degree, I understood at least one foreign language, and I was physically fit. I thought, "I've got all those, why not?"

At each stage of the selection process, I genuinely expected to be told, "Okay, that's it, thanks but no thanks." I decided I would just enjoy each particular stage—like being spun around in a centrifuge for the first time ever. I thought, "When am I ever going to get this opportunity again?"

So why do you think you were chosen?

Part of the selection criteria was based on good team-working abilities and personalities. We were a tight, gregarious, don't-take-each-other-too-seriously team but also not overly excitable or depressive. They wanted fairly regular types of people.

And I don't get motion sick at all. They spun us around and around in chairs, then jostled us up and down. I had never experienced g-force before—that's when we were centrifuged—but never had a problem with it. I could do all the tests for the maximum period of time and not be fussed.

Tim Peake is just home from the International Space Station as the second British national in space. You were the first—not just the first woman, but the first U.K. national. What is a typical reaction to this?

In Britain, when you say you were the first astronaut, often the immediate response or subtext is, "Oh ... you were the first woman, but who was the first *one*?" People assume there must have been a man first. It is very odd.

My mission was a business agreement between a British company and the Soviet space agency. It was not a U.K.-government-funded mission. There wasn't a huge amount of hype in the U.K., and I'll never know whether that was a gender thing or if it was because there wasn't a U.K. space

Published: August 11, 2016

DOI: 10.1021/acscentsci.6b00212
ACS Cent. Sci. 2016, 2, 486−488

agency like there is now to give me a load of hype. It was what it was. I am what I am. I am very much aware that a lot of people assume that it must have been a man first. It's a shame.

Tell me about the toilets on *Mir*. Is it true you breathed your own recycled pee?

The toilet that the Russians designed for *Mir* was a brilliant contraption. It's very similar to the one on the International Space Station. It's flushed with air rather than water. The urine is collected and put through a series of filters, reverse osmosis, and temperature changes. Then they add silver ions to ensure bugs do not grow. In the end, the water is clean enough to drink. But space psychologists prefer astronauts not to drink water that's come from the toilet. So if there is enough drinking water on the space station, then the water is electrolyzed with solar energy to separate the oxygen from the hydrogen. Then they mix the oxygen with the air that you are breathing.

What kinds of experiments did you do on *Mir*?

We did a lot of agricultural experiments. They were very interested in growing food in space. And in the way magnetic fields affect plant growth. So how potato roots can be pulled in a certain direction if you have a strong enough magnetic field around them. We also had a miniature lemon tree. We wanted to see if we could keep it alive by supplying all the right gases. It was at the space station for three years but died eventually. We were also growing crystals of the protein luciferase.

The experiments were fairly foolproof—I'd call us space technicians not scientists. Astronauts don't invent the experiments. We don't analyze the data, and by and large, we don't make conclusions. We send the data down to Earth. But at least when we were carrying out the experiments, my chemistry degree made it easy for me to understand what was going on inside the boxes and what to do if there were problems.

Can you explain why protein crystals grow better in space?

Imagine crystallizing something on Earth. As bits of the solute move from the solution into the crystal, that local bit of solution becomes less dense—only very marginally. But it's enough to effect convection currents in the solution. For strongly ionic solutions, convection doesn't matter: The ionic bonds are so strong that convection currents don't get in the way of forming nice ionic crystals. But proteins are big, floppy molecules, often with very weak interactions between the molecules that make up the crystal. Even very small convection currents create dislocations within protein crystals. Bits that aren't quite right.

In an orbiting space station, warm air doesn't rise—you don't get convection in anything. So there are no convection currents in a solution as crystals are crystallizing. You can grow protein crystals of a much higher quality at an orbiting space station, and you can grow them much bigger.

You were also responsible for taking the blood of the four other astronauts on *Mir* as part of research to understand some of the strange phenomena experienced by astronauts. What happens to your body in space?

When you start to feel weightless, your body fluids no longer pool downward by gravity. They tend to migrate toward your face and head. It's why astronauts tend to get skinny legs and fat, puffy heads. Then your brain senses that there is too much water in the cells around it, and it tells your kidneys to excrete more urine. Over the course of a few days, you lose about two extra liters of urine than you would normally excrete. This has a knock-on effect to your whole body. So that's one of the reasons we lose a lot of potassium from muscles and calcium from bones.

However long you are in space, you continue to lose bone mass no matter how much exercise you continue to do. There are many other physiological and hormonal changes too—for example, there's concern about intracranial pressure on the optic nerve. Nobody has lost sight in space yet, but it's something people are concerned about.

Training near Moscow in 1990 and 1991 must have been surreal because the Berlin Wall had already fallen and the Soviet Union was dissolving around you. What was it like?

It was tremendously interesting. I was working on a military base northeast of Moscow called Star City with soldiers and air force people. It was very much in their interest to have not a lot of change. They were among the more privileged people in the Soviet Union. But nonetheless it was at a time when there was nothing in the shops in Moscow. They very much wanted to share what they had with me—they were proud of their culture—but they couldn't buy ingredients to make food at their parties. It was a sad time for them.

Were you constrained in your movements in Russia? Did you have a KGB minder?

The local KGB person assigned to us was not introduced as such. He was introduced as the person in charge of communications in the library. I'm sure he felt it would have been better if we could have just seen the good stuff. But

DOI: 10.1021/acscentsci.6b00212
ACS Cent. Sci. 2016, 2, 486−488

clearly we were seeing the city as it was. I had freedom to go into Moscow. My Russian teacher lived in Moscow and so did some of the cosmonaut engineers. I had gotten used to living in London on my own, and I found it quite stifling just living in Star City. So every couple of weeks on a Saturday, I'd make a little escape to Moscow and go into the city and enjoy myself. I'd go in and see art galleries and theater. Moscow has a very rich cultural life. Even though there was little stuff in the shops.

They did try to keep control of me a bit, though. I mean if I had gotten lost in Moscow or had an accident or had something bad happen, it wouldn't look good for those who were supposed to be looking after me and advising me. I think they were concerned about me on a number of levels.

What was the most unexpected part about being in space?

That the *Mir* space station was like any old laboratory in the world—where you go in and think, "Oh my God, why did they keep this? Surely they could clear out that drawer." They started bringing equipment in 1986 when the first module went up. I went in 1991. Instead of getting rid of stuff, they just left it up there. A lot of things were attached to walls in nets. It took me 2 days to find an experiment because they had just shoved it away. The extra toilet was stocked full of equipment and cameras. Had we needed it in an emergency, it would have taken ages to get stuff out. I don't know how the International Space Station is, but I expect it's pretty much the same.

What was the most wonderful part about being in space?

The weightlessness, the views, and the camaraderie. Weightlessness is pure freedom. You forget what it's like to stand up or sit down. All you do is float. And nobody ever gets tired of the views. At the end of the day, we'd gather around the largest window we had and talk about what we could see and about our families and friends we had left behind. When you go through a tough time—we had a problem docking, for instance—you feel like you'd do anything for each other. It's a lovely feeling.

Were you ever scared?

I had such good training there were no unknowns left. But the day after we arrived, all the lights, all the power went off. The fans circulating the air also stopped whirling, so it became completely silent—the station is quite noisy normally. Addition of a module to the space station had shielded solar panels from the sun. In fact, we had brought up a computer to correct the problem. And so we settled down and just waited until we got back into the sunlight, and then, presto, everything went back on.

What are you doing now?

I'm at Imperial College London doing operations for the chemistry department. So it's managing all the technical and support staff, the admin, and the budget—essentially making sure the research and teaching happens as it should. I do operations while the head of the department does the strategic side. It's great fun. I've not been there a year yet. I'm still learning, but it's great to be in that sort of environment, where things are changing all the time.

Sarah Everts is a senior editor at Chemical & Engineering News, the weekly newsmagazine of the American Chemical Society. This interview first appeared in C&EN.

DOI: 10.1021/acscentsci.6b00212
ACS Cent. Sci. 2016, 2, 486−488