Silent Chemistry

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The obstacles for deaf students to become molecular scientists are shrinking, but it's still hard

Ivan Amato

When Australian-born John W. Cornforth of the University of Sussex, in England, traveled to Oslo in late 1975 to receive a Nobel Prize in Chemistry for work that helped clarify how enzymatic reactions control stereochemistry, he couldn't hear a word that was said during the awards ceremony.

"I amused myself by looking around at the audience," Cornforth later told an interviewer with Vega Science Trust, a U.K.-based science communication organization. "I could see in the darkness of the auditorium, these flashes of bright light ... and I couldn't make out what they were. And finally, I realized all the women were wearing their jewels and that was what was causing the flashes of light. And that is what I remember most of all from the ceremony."

The hall's acoustics were fine. Cornforth began losing his hearing in the late 1920s at the age of 10 and had become profoundly deaf within a decade. And in winning the Nobel Prize, Cornforth showed the world that deafness is no barrier to reaching the pinnacle in chemistry.

Aside from the signing, the near absence of spoken words, and the small size of the group, the scene looked like any other chemistry class.

According to the latest workforce data available from the National Science Foundation's Division of Science Resources Statistics, 2.6%, or 3,256 of those 124,235 technical professionals in the database who call themselves chemists also describe themselves as deaf, or at least moderately hard-of-hearing. Of 74,643 chemical engineers in this 2003 database, 2,325, or about 3.1%, report having the same hearing disabilities.

For those with the most dramatic hearing deficits, the road to becoming a professional chemist is riddled with extra obstacles. For many of them, even reading high school textbooks can be a challenge.

"By the time deaf students are 18 or 19 years of age, their measured reading ability is generally no better than an average eight- or nine-year-old normally hearing student," says Harry Lang of the National Technical Institute for the Deaf (NTID) at Rochester Institute of Technology. Lang investigates the cognitive features of learning for deaf students in an effort to identify, develop, and promote effective teaching practices. At most universities, which are not nearly as culturally and technologically attuned to the needs of deaf learners as Rochester Institute, the graduation rate at the baccalaureate level for deaf students is about half that of hearing students. At Rochester Institute, Lang notes, the rate is above 60%, which makes it at least on par with the national average.

As it turns out, of the 30,000 deaf students in postsecondary programs, only a small number each year now choose to follow Cornforth's pathway into chemistry. Keeping this trickle of students moving through academic programs and into the chemical professions-even at places like NTID and Gallaudet University in Washington, D.C., one of the country's premier institutions of higher learning explicitly founded and designed for deaf and hard-of-hearing students-takes devotion and persistence on the part of students, teachers, and employers.

Courtsey of Nat. Technical Inst. for the Deaf

Getting Dirty Pagano (right) discusses soil sampling and analysis with recent graduate Lori Poole and student Steve Janosi in the Laboratory Science Technology program at Rochester Institute of Technology's National Technical Institute for the Deaf.

With about 15 majors in its chemistry program this year, "we have a bumper crop," says Walter E. Trafton Jr., chair of Gallaudet's chemistry and physics program. In a normal year, three or four students will graduate with a chemistry degree. When Trafton, who is

not deaf, applied with some trepidation for an opening in the department of physics and chemistry 31 years ago, the same year Cornforth won his Nobel Prize, he couldn't sign a word. A crash course in signing got him partly up to speed, but he says it took a few years to become proficient. "I feel sorry for those students in my first year," he says. Now he signs like the seasoned pro he has become, and he teaches his students with a supply of enthusiasm, devotion, and energy that science teachers know it often takes to keep their students on task.

In his organic chemistry class one day last month, he simultaneously signed and spoke to about a dozen students. Because it's impossible for his students to engage in a heads-up signing conversation while also taking notes with heads-down concentration, Trafton frequently flicked the classroom lights on and off or waved to get everyone's attention as he worked through the interpretation of a half-dozen infrared and NMR spectra that he flashed onto a screen with an overhead projector. Now and again, a student would raise a hand, point to a band in an IR spectrum or a set of peaks in an NMR spectrum, and then sign out the molecular fragment that each corresponds to. In one explanatory bout, Trafton gave the hand sign for C, quickly followed by the sign for O, and then a pair fingers drawn horizontally across the air to indicate a double bond.

SAY AGAIN?

When among fellow signers, students and teachers now and again invent signs together, especially for frequently used technical terms or names. Some years ago, recalls Walter E. Trafton Jr., chair of Gallaudet University's chemistry and physics program in Washington, D.C., "I was spelling out benzene so many times that one student just said 'Make the letter B and put it in a circle.' " Now instead of always handspelling out b-e-n-z-e-n-e, which he can do in a matter of a second anyway, he merely makes the sign for B and sweeps it in a circular gesture.

Todd Pagano, head of the Laboratory Science Technology program at the National Technical Institute for the Deaf at Rochester Institute of Technology, also has invented a few signs. For "spectroscopy," he flashes the sign for the letter S and it merges it into the sign for spectrum. For titration, a longish word for handspelling, he invented a sign that essentially mimics the action of twisting a titration tube's stopcock.

Like words in a dictionary, however, such lingual inventions only work if an entire community agrees to use them in a specified way. Working with native signers in science and others, another NTID professor, Harry Lang, is helping to assemble and evaluate a growing lexicon of technical signs. A website with many of the signs viewable in short video snippets is available at www.rit.edu/~comets.

Aside from the signing, the near absence of spoken words, and the small size of the group, the scene in Trafton's class looked like any other chemistry class anywhere else. Some students were engaged; some weren't. One or two students asked most of the questions. One student baldly tapped away on an instant-messaging (IM) device with who-knows-whom.

Chemistry professor Charlene Sorensen's class had a similar mix of students. During a "review game" session a few weeks ago in her general chemistry class, clusters of three to five students fielded questions that Sorensen signed, spoke, and projected onto a screen. The teams, which earned points for correct answers, were careful to keep the other team from seeing their signing hands for fear of giving away hard-won answers to their competitors.

Most notable in her "smart classroom" was a projection system that included a screen onto which she projected her questions in written form as well as images relevant to the problems. She also could effectively write notes directly onto the screen with a "marker." Although her marker left no actual marks on the screen, the system converted her writing motions into a form that could be instantly projected onto the screen.

Sorensen, a hearing, 10-year veteran at Gallaudet, was moved to learn to sign and become a teacher of deaf students by an all-too-familiar experience of a deaf student at her former professional home, the University of Tennessee. There, the student, who had the services of an interpreter, nonetheless was extremely frustrated by communications difficulties and was falling seriously behind in class. Ever since the 1990 passing of the Americans with Disabilities Act, interpreter service for the deaf and hard of hearing has become more widely available. Even so, Sorensen notes, interpreters rarely have the scientific background they need to interpret chemical language as fully as possible. That's why Sorensen took it upon herself to master sign language. She joined the faculty at Gallaudet in 1996.

Photo by Ivan Amato

Hands on For would-be chemists who are deaf or hard-of-hearing, learning to communicate chemical ideas and information in sign language goes hand in hand with learning chemistry's structural and word-based languages.

Even when all available communications resources are brought to bear, the task can be daunting for deaf students. "A deaf student watching a lecture by a professor using media, a sign language interpreter standing nearby, and a computer terminal on the desk must cope with multiple visual demands," Lang says. "Looking away from the media to see the interpreter makes it difficult to see where an instructor is pointing on a graph. Looking away from the interpreter to see the data point on a computer screen may mean missing an explanation in sign language."

"These students operate on a very visual language in a very visual culture," says professor Todd Pagano, who for the past four years has been directing NTID's Laboratory Science Technology (LST) program.

Despite the many pitfalls, Gallaudet's chemistry program over the years has sent its graduates into more than a dozen molecular science fields, among them biochemistry, geochemistry, chemical oceanography, and environmental science. One former student works for the Secret Service doing anticounterfeiting work. For these placements to work, Trafton and Pagano note, it takes an enlightened employer willing to make a few accommodations.

"Deaf and hard-of-hearing people are capable of doing research," remarks longtime Gallaudet chemistry professor Michael L. Moore, who is himself profoundly deaf and a 1968 graduate of Gallaudet. "At the same time, we often face attitudes from employers," he says, referring to reluctance on the part of managers to provide reasonable accommodation for deaf would-be employees. "Most of the time, it's just access to e-mail that's needed," he notes.

Moore earned his M.S. and Ph.D. in the 1970s at schools in Texas. Like Cornforth and other deaf chemists of his and earlier generations, Moore relied almost entirely on texts, papers, and other documents. He also leaned heavily on his classmates. "I had great friends who provided notes," he signs, with Trafton interpreting.

Now e-mail, the Internet, pagers, IM devices, and other gadgets that rely on written language are eroding communication barriers and strengthening the case for hiring deaf chemists, Moore notes. As with any powerful technologies, the relative ease of communication that comes with these devices can lead to abuses. When he teaches classes now, he prohibits IM chatter by asking his students to turn off their gadgets.

For NTID's Pagano, IM technology has been helping him expose his students to chemists in the field with an ease and frequency that might not be possible otherwise. "I might be teaching a certain concept, and it's great to have someone working in the field to illustrate in real-time what I'm talking about," Pagano says. With just a little logistics work, he says, he has set up IM discussions with working chemists who can be anywhere during the discussion.

Even though his students cannot graduate from the LST program without demonstrating competence with dozens of laboratory instruments, protocols, and methods-as well as skills that include laboratory organization, storage, and record keeping-the transition from the school setting to the work setting can be the most harrowing moment of the entire program, Pagano says.

"Employers I work with naturally wonder how they will communicate with the deaf or hard-of-hearing employee," Pagano notes, adding that employers worry about safety issues and whether lots of additional managerial oversight will be part of the deal. This is where NTID's National Center on Employment comes in. Working one-on-one with employers, NCE staff provide workshops, demonstrations, and other training tactics to help prospective employers get comfortable with a commitment to working with an LST student or graduate. "Most companies who hire our students are thrilled with the experience and many hire additional students," Pagano says.

About 30 students are now enrolled in Pagano's program, which prepares its deaf and hard-of-hearing graduates primarily for jobs as lab technicians. About a dozen students finish the program each year.

As he sees it, deafness now is less of a barrier for students to enter chemistry than a more insidious impediment that's rampant throughout society. "Perhaps the greatest challenge we face at NTID is the 'chemophobia' that often exists among high school and college students." As a consequence, he says, many deaf students come into NTID with a fear and reluctance to pursue an academic program or a career in chemistry. That's one particularly unfortunate way, he says, that deaf and hard-and-hearing people are no different from the hearing community.

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