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A Hothouse for Female Scientists

At Carleton, working closely with professors leads women to careers in science

By Robin Wilson

NORTHFIELD, MINN.

When Renee R. Frontiera was just a junior at Carleton College, her chemistry professor sent her out with a 1,000-pound spectrometer to measure particles in the atmosphere. Driving a rental truck, Ms. Frontiera took the spectrometer from Yellowstone National Park to East St. Louis, stopping in fields and farms and near a metal-smelting plant to take measurements from the air. At several stops, she worked alongside researchers from major universities.

“My professor trusted me to travel in the field with all of this nice scientific equipment and do what I could to get some data,” says Ms. Frontiera, who believes she would have been shut out of such experiences at a large university where graduate students get most of the hands-on opportunities.

The work piqued Ms. Frontiera’s interest in research and prompted her to enroll last year in the Ph.D. program in chemistry at the University of California at Berkeley.

At a time when higher education is growing more concerned about the small number of women pursuing advanced degrees and academic careers in science, Carleton is a hothouse for female chemists, geologists, and physicists.

Although Carleton’s undergraduate enrollment is minuscule compared with that at universities like Minnesota-Twin Cities, North Carolina at Chapel Hill, and Wisconsin at Madison, it produces more women who go on to earn their doctorates in the physical sciences than do any of those institutions.

Carleton has even managed to send on more women for advanced degrees in the physical sciences than either Dartmouth College or Princeton University— both of which graduate double the number of women that Carleton does.

“We don’t lose women along the B.A.-to-Ph.D. pipeline,” says Mary Savina, a professor of geology at Carleton. “Our women carry on. We show them what real work in the profession is like.”

‘Ph.D. Prone’

Data from the federal Survey of Earned Doctorates show that 32 women who earned their bachelor’s degrees from Carleton went on to receive Ph.D.’s in the physical sciences between 1999 and 2003. That makes Carleton one of the top 20 producers in the country of women who earned doctorates in the physical sciences. (In the survey, the physical sciences is a broad category that includes astronomy, chemistry, computer science, geology, mathematics, and physics.)

Higher-education officials have been particularly interested in encouraging women to pursue those fields because, compared with the life sciences, they are unpopular with female students. Even at Carleton, twice as many men as women go on to earn doctorates in the physical sciences. And nationwide, faculty members in those disciplines are overwhelmingly male.

Carleton clearly has a head start when it comes to encouraging women to pursue advanced degrees of any kind. The college attracts high-achieving women and men with an average SAT score of 1397, compared with the national average of 1028. And 33 percent of Carleton’s first-year female students indicate an interest in majoring in mathematics or science, compared with just 25 percent of female freshmen at other highly selective institutions, including those in the Ivy League.

“These are really high-achieving kids, and they come in Ph.D.-prone,” says David Davis-Van Atta, director of institutional research and analysis at Carleton.

How They Do It

Still, exactly how does the college manage to inspire more than its share of female scientists? Even administrators at the liberal-arts college don’t have a simple answer. But conversations with students, professors, and alumni here show that Carleton hooks students early on by involving them in real scientific research— outdoors and in the laboratory.

Professors treat students as collaborators, taking the time to counsel and sometimes even cajole them into considering scientific careers. And undergraduates here cheer each other on, holing up in science labs until after midnight to work on homework or research projects with a television blaring and popcorn flowing.

Carleton's atmosphere encourages all students, regardless of gender. But professors say the close contact they have with undergraduates seems particularly welcome to women.

Of course, it doesn't hurt that female students here who want to become scientists have more role models than they would at most places: Fifty-six percent of Carleton's chemistry professors— five out of nine— are female, a proportion that is practically unheard of. And 43 percent of its physics and astronomy professors are women, compared with a national average of less than 15 percent, according to the American Institute of Physics.

Over all, nearly half of Carleton's science and mathematics majors are women. And in some departments, the proportions are even higher. Last year, seven of the 10 graduates in geology were female, compared with just four out of 10 nationwide, according to the American Geological Institute. Geology seems to have set the gold standard here for attracting female students.

Cameron Davidson is one of the geology department's most popular professors. On the second week of classes this spring, Mr. Davidson headed out to a commercial gravel pit 10 miles west of the campus with 17 students from his introductory geology course, 14 of whom are female.

The students donned yellow and blue hard hats and used shovels and picks to dig into the gravel and dirt. Their assignment: to examine a section of the pit up close and draw the rock and soil profile in a notebook.

In all, Mr. Davidson will take the class on eight field trips during the 10-week quarter. His own experience as an undergraduate at the University of Wisconsin at Madison was completely different, he says. "We had 150 people in my intro class, and one field trip— which was optional," he recalls. "The professor stood outside with a bullhorn."

At the gravel pit, students scaled the 25-foot walls to examine the rocks from top to bottom. Mr. Davidson treats them more like graduate students than freshmen. "I say, I may be more experienced, but you're just as smart," he says. "I will ask: What do you think? You're the next generation, and we may not know everything yet."

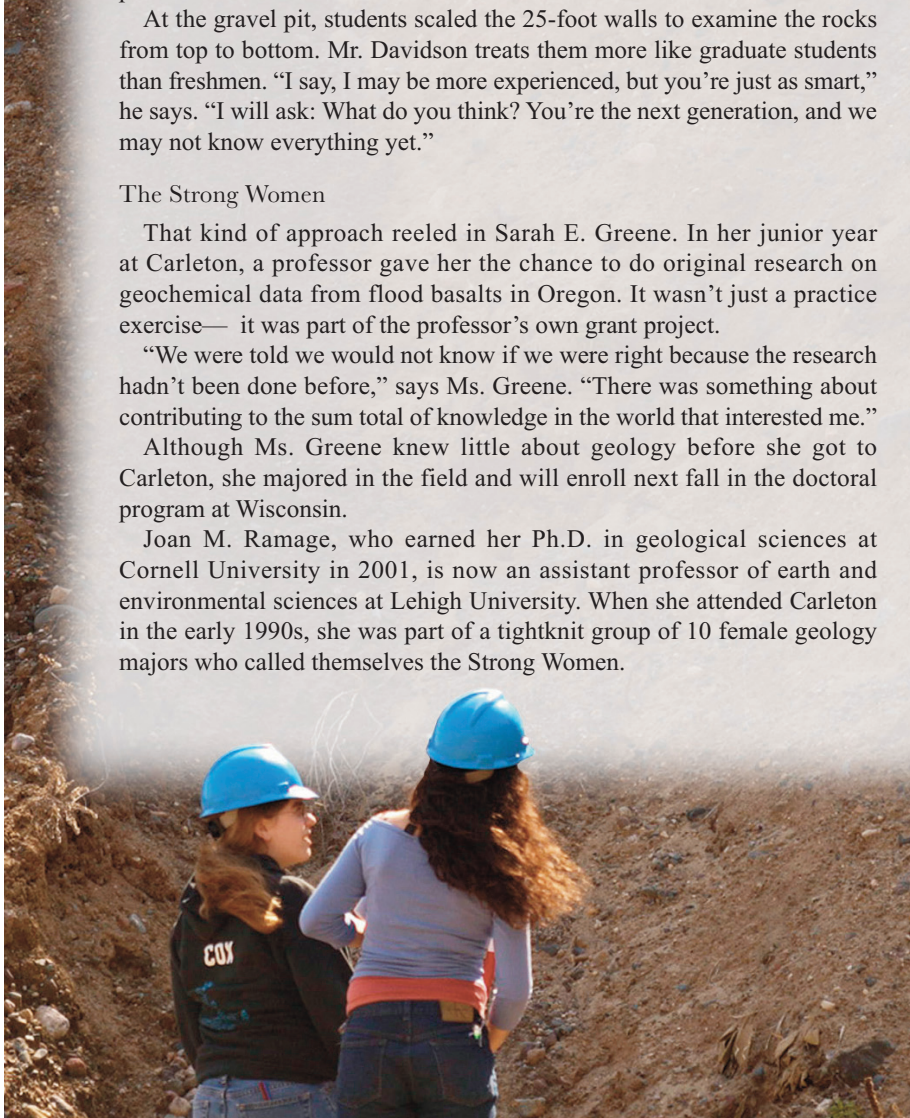
The Strong Women

That kind of approach reeled in Sarah E. Greene. In her junior year at Carleton, a professor gave her the chance to do original research on geochemical data from flood basalts in Oregon. It wasn't just a practice exercise— it was part of the professor's own grant project.

"We were told we would not know if we were right because the research hadn't been done before," says Ms. Greene. "There was something about contributing to the sum total of knowledge in the world that interested me."

Although Ms. Greene knew little about geology before she got to Carleton, she majored in the field and will enroll next fall in the doctoral program at Wisconsin.

Joan M. Ramage, who earned her Ph.D. in geological sciences at Cornell University in 2001, is now an assistant professor of earth and environmental sciences at Lehigh University. When she attended Carleton in the early 1990s, she was part of a tightknit group of 10 female geology majors who called themselves the Strong Women.



They lived together, studied together, and generally supported one another. Four of them earned Ph.D.'s, and of those, three are now geology professors. Five others have master's degrees, says Ms. Ramage. The women still get together at least once a year for camping trips—and weddings.

“At Carleton, we never got told exactly what to do,” she says. Instead of stuffing students with facts, Carleton professors encouraged curiosity. “Carleton students do well in grad school because of their research and independent-thinking skills,” she says. “My students at other universities always want to be told exactly what to do.”

Still a Minority

Perhaps because they are surrounded by so many female professors and science majors, undergraduate women at Carleton don't think much about what it would be like to be in a distinct minority. But if they become professors of science themselves, they will be.

“When you come here, you don't think, I'm a girl, these are the boys,” says Erin Addison, a junior majoring in chemistry. “You're put on an equal playing field.”

Neither Ms. Addison nor any of the more than a dozen young women who spoke to THE CHRONICLE reported experiencing gender discrimination at Carleton. In fact, some of them were concerned about exactly the opposite: being handed special opportunities precisely because the federal government and college leaders are so interested in encouraging women to pursue science.

“You want to feel like you're awesome, and that's why they picked you,” says Melina K. Blees, a junior majoring in physics. She sees a lot of glamour in an academic job. “There are a lot of professors I'd like to be one day,” she says. “Their lives are so cool.”

Susan N. Coppersmith, who teaches physics at the University of Wisconsin at Madison, says her female undergraduates get an entirely different impression after they see the grueling schedules that some of their professors keep. And that may

be one reason Madison, with 13 times as many female undergraduates, sends fewer of them on for doctoral degrees in the physical sciences—30 compared with Carleton's 32 in the time period measured by the Survey of Earned Doctorates.

But Ms. Coppersmith and other science professors at Madison say one reason the university does not send more students on to doctoral programs is that the number of science majors is relatively small.

For example, although undergraduate enrollment at Madison is more than 10 times greater than at Carleton, Madison graduates on average only about 25 physics majors a year— just double the number that Carleton does.

Still, students at Madison soon learn that “academic life is very female unfriendly,” Ms. Coppersmith acknowledges. “Female students here have a better view of what it means to be in the academic rat race: the fighting for tenure, working eleveny-seven hours throughout your 30s. I enjoy what I do, but I know it looks harried.”

Jean M. Bahr, who leads the geology-and-geophysics department at Madison, says professors' chock-full lives leave them little time to spend with undergraduates.

“Our department has programs to encourage undergraduate research, but in terms of faculty time, it is an overload on an already busy schedule,” she says. “At an undergraduate institution, professors are given a lot more credit and incentive to participate on work with undergraduates.”

Back on Carleton's campus, Gretchen F. Hofmeister bustles around her organic-chemistry laboratory, helping one student plot experimental data on a computer and then observing three other students who are preparing a chemical sample.

Ms. Hofmeister, an associate professor, takes two or three chemistry majors to the American Chemical Society's annual meeting each year, on her department's dime.

“This is what it's like in graduate school,” Ms. Hofmeister says of her students' experience. The difference between professors at large universities and those at Carleton, she says, is that “here, we need the results of what students are working on to write papers and get research money. My research is with students. We're depending on them.” ■

