Women in Marine Science...Good Girls Don’t?

It Was a Man’s World

As the tiny submersible descends into the undersea gloom, an experienced pilot intently watches the actions of a pilot-in-training. Deep in concentration, eyes riveted to the instrument panel, the trainee carefully maneuvers Alvin in its slow trip to the bottom of the Atlantic. A scientist, the third member of the team, peers through the small porthole, unaware of the drama unfolding within the titanium sphere itself. What makes this dive different from the more than 2,000 others in Alvin’s history? The pilot-in-training is Cindy Lee Van Dover, the sub’s first female pilot.

Van Dover has a goal. “I want to be the best deep-sea biologist I can be,” she states, “and the best way to do that is to see as much of the ocean floor as possible.” Van Dover has never been one to let gender stand in her way. She enrolled at Rutgers University the first year the college became coeducational, and she was the first female undergraduate to work at one of the university’s field stations. Now, after many years of experience and earning a Ph.D. in oceanography and oceanographic engineering, she has recently completed a rigorous one-year training course to qualify as an Alvin pilot. Her accomplishment follows many years after Ruth Turner, Harvard biologist and adjunct scientist at Woods Hole Oceanographic Institution, became the first woman scientist to dive in Alvin for deep-sea research.

But women like Van Dover and Turner are rare. Though women have succeeded in breaking into many previously male-dominated fields in recent years, it is still unusual to find them in science and technology careers. Betty M. Vetter, executive director of the Commission on Professionals in Science and Technology in Washington, D.C., wrote in 1987 that “women now earn half of all bachelor’s and master’s degrees awarded in the United States and more than one-third of the doctorates. In science they earn 45 percent of the bachelor’s, 39 percent of the master’s, and 27 percent of the doctoral degrees.” Vetter notes that most women who earn advanced degrees in science do so in the social and life sciences such as biology, health, psychology, and sociology. Moreover, a National Science Foundation (NSF) study found that female interest in science and engineering seems to have plateaued since the early 1980s, and that women now earn only 16 percent of the doctorates in physical sciences, 10 percent in computer science, and 7 percent in engineering.

A 1990 report by the 10 Joint Oceanographic Institutions in the U.S. shows an increase in the number of women applying to JOI schools between 1987 and 1990, although actual attendance figures have leveled out at about 30 percent. Ten years ago, women made up only 20 percent of the student body at the JOI schools. And women still constitute only a small fraction of the faculty: of 487 JOI faculty positions, just 46 are held by women.

Why should we be concerned with the success rates of women in the sciences? One reason is the impending shortage of scientists this country faces. The NSF expects a shortfall of about half a million scientists and engineers by the end of the century. This is partly due to changing demographics: retirements among the present pool of scientists are increasing simultaneously with a dip in the college-age population in the 1990s. The NSF reports that, while white males now make up 47 percent of the total work force and 80 percent of the science and engineering pool, they will represent only 15 percent of the net number of people entering the work force at the end of this century. Most science administrators agree that a greater push for women and minority students to enter science and technology fields may be the only way to fill the gap and maintain our country’s global competitiveness.

Adding to the challenge is the realization that science education in the United States is in trouble. American students are rated low in science and technology compared to stu-

Opposite page: Photo courtesy of Peter Wieke, Woods Hole Oceanographic Institution.
Some of the old stereotypes have been successfully shattered. Women, once barred from research vessels, now go to sea on equal terms with men.
students in other major industrial countries. U.S. students are losing interest in math and science as early as elementary school. Because they are often not required nor encouraged to take advanced math and science, students may drop these subjects at a very young age, then find it much harder to catch up if they later decide to pursue scientific careers.

Many federal programs are in place to improve the status of science education in the U.S. and to further encourage young girls as well as graduate-level and professional-level women in the sciences. As time passes and the shift toward women in the work force continues, no doubt more and more women will successfully seek careers in marine science and technology. Some of the old stereotypes have been successfully shattered, and there are more role models now for young women to emulate. Women, once barred from research vessels, now go to sea on equal terms with men. The National Oceanic and Atmospheric Administration - the National Sea Grant College Program's parent organization - has several women in upper management and has recently appointed well-known marine biologist Sylvia Earle to the position of chief scientist.

The Formative Years

Shortages of women in science and technology can be traced back to early childhood. Pressure to conform to traditional gender roles infiltrates our educational system, and subconscious societal attitudes may blur the thinking of even the best teachers. Unlike boys, girls may not be encouraged to think independently and solve problems; rather, they are often guided toward the concrete and factual subjects. This may explain why more of the women who do go forward in science pursue the more factual biological and life sciences instead of engineering, math, and the physical sciences. Uninformed school guidance counselors may reinforce the attitude that girls are unable to compete with boys in math and science by discouraging female students from pursuing a particular course of study. "I wanted to be a pediatrician," explains Shelley Lauzon, publications and information manager at WHOI, "but my high school guidance counselor convinced me that, as a woman, I would never be accepted into medical school."

Young women's general lack of confidence concerning math and science stems from attitudes and biases presented by teachers, administrators, and parents, according to Beth Schwarzman, a geologist with the U.S. Geological Survey in Woods Hole. In her work as an outreach educator with USGS, Schwarzman focuses on attracting women and minorities into the sciences. During a recent workshop for science educators she matter-of-factly instructed all the participants to "take out your pocket knives." Noting the absence of pocket knives among the women compared to the men, she explained that girls are not usually encouraged or taught to use tools. "This," she observed, "can be a handicap in both science classes and technical careers."

Next, Schwarzman handed each participant a stack of 3-by-5-inch cards and asked everyone to "build the tallest structure you can with these cards." Few of the women educators bent the cards to make better use of them for building. During the ensuing discussion, most of the women said they had assumed that altering the cards was "breaking the rules," even though no rules were given.

Elizabeth S. Ivey, chairman of the physics department at Smith College, has studied the success rates of women who attended women's colleges and those whose background was coeducational. She claims that more of the women who earn science degrees from women's universities go on to earn a Ph.D. than those who attend coed institutions. The generally larger proportion of female faculty members and the absence of competition between women and men at the women's schools are among the possible reasons why.

Do parents tend to give more encouragement to boys than girls to excel at math and science and to enroll in computer or science camps and classes? Do teachers unconsciously encourage boys to call out answers in class while expecting girls to raise their hands and wait their turns? Are there ways of teaching that provide positive reinforcement for both boys and girls equally? Schwarzman and education researchers answer "yes," but it will take work to change the negative patterns.

Graduate School Daze

More than half of the current University of New Hampshire graduate students in environmental engineering are women, though there are few faculty women in that subject, according to Nancy Kinne. Kinne, a civil engineer, teaches and pursues research on water and waste treatment systems at UNH. Although she remembers no real obstacles during her training in this field, there were no women role models. Like other women in science today, Kinne has helped pave the way for new generations of young women and, by her very presence on the UNH faculty, proves to them that it can be done.

What are some of the problems Kinne's female students face? While there are many points along the science path from elementary school through the advanced degree where girls tend to "fall out of the educational pipeline," graduate school may be one of the most critical times for women.

Adequate funding for graduate school is a problem for male and female science students alike. But, according to a 1983 NSF study, women Ph.D. candidates are less likely to receive federal and institutional
support than men and more likely to be self-supporting. They are often expected to work with foreign (as well as American) students and faculty whose cultural biases concerning women in science careers may pose difficulties. Women must deal with the feeling, valid or not, of being a “token” representative of their institution’s compliance with affirmative action and equal opportunity laws. All of these factors combined tend to create the often-cited “chilly climate” for women on campus.

At the 1988 annual meeting of the American Association for the Advancement of Science, Sheila E. Widnall, then president of the AAAS, addressed the problem of women in science. She cited studies indicating that women enter graduate school at the same rate as men relative to their presence in the B.S. pool, but their participation in science drops off significantly after attainment of the M.S. degree. In addition to the factors mentioned above, Widnall noted differences in modes of communication between men and women and examples of inappropriate treatment of women (any treatment that emphasizes the student as a woman first and a student second) as further contributing to a cool atmosphere. The resulting loss of self-esteem, she suggested, may lead directly to the decline of women in doctoral programs along the educational continuum.

Working 9 to 5

Attracting women is one important step; keeping them in the sciences is another. In a 1989 article in Science, Constance Holden claims women scientists still suffer from higher unemployment, lower pay, and fewer opportunities for promotion at every degree level. Once in the work force, women in science may be isolated and may feel that they have more to prove than their male counterparts. “If your science is good enough, you can make your gender work for you, since people tend to remember you,” says Susan Humphris, dean of the Sea Education Association (SEA) in Woods Hole. “But it can also work against you. A male scientist can give a poor talk at a scientific meeting and colleagues will just think it was a bad talk; but if a female scientist gives a poor talk, it may be perceived as a result of poor science.”

Humphris is responsible for SEA’s academic programs for college undergraduates and secondary teachers. The school offers semester-long courses combining oceanography, marine affairs, and seamanship in both shore-based and shipboard classrooms. An adjunct scientist in the chemistry department at WHOI as well, Humphris has studied hydrothermal vents in the deep sea and is a veteran of many oceanographic cruises. She is aware of the superstition maintained by some older male crew members that bad luck befalls ships that carry women to sea, although she feels she has suffered no ill effects from it. She’s quick to point out that SEA employs a woman captain on one of its two sailing research vessels. Humphris’ advice to young women interested in marine research is, “Go for it; the problems can be overcome.”

For men and women alike, given the nature of funding and the pressures of grant-writing, science careers require a more than full-time commitment. Kinner points out that issues surrounding doctorate-level occupations are not unique to women. “People who pursue a Ph.D. must make some decisions about the life they will lead; they’ll never have a 9-to-5 job.”

“I love my job,” says Jennifer Specker, an associate professor of zoology at the University of Rhode Island. While pursuing research in the physiological and chemical basis of animal behavior, Specker teaches physiology to URI undergraduates and endocrinology to graduate students. Despite the long hours and the competitive nature of her work, she is happy with her career choice. Perhaps that, above all else, is what has most helped her move ahead in a difficult and highly competitive field. “I did what I wanted to do — what I enjoyed doing the most,” said Specker. Kinner echoes this view, encouraging her students to “Do what you like to do, since you’ll be spending a great deal of time at it.”

What about those women who want to have a family as well as a science career? Is it possible to be a wife, mother, and research scientist? Cindy Schramm, a Ph.D. candidate in geological oceanography at the University of Rhode Island and mother of a young child, notes that it is possible to juggle a career in science and a family, but it requires tight organization and an extensive support system. Traditionally, male graduate students and scientists are able to start families and still meet their time commitment to science. But women students or scientists who choose to have families often find less time available for their research. “As a result,” Schramm states, “most of the premier female scientists that I know do not have children.”

While this career vs. family issue affects women more than men in any given profession, the demands of marine science-going to sea, keeping unusual hours during laboratory experiments, traveling to scientific meetings, and strict time frames for attaining tenure-make this an especially tough issue. Many of the women who have succeeded depend on live-in nannies or stay-at-home husbands. The dilemma is especially difficult for couples with dual careers in science.

Ellen Druffel, a tenured associate scientist in the chemistry department at WHOI, has recently returned to work after having her second child. “You learn to become more efficient at time management,” she says. Now she must think about child care and family schedules concurrently with her work using radiocarbon isotopes as tracers of carbon in the atmosphere and ocean. Druffel dispels the old notion that women who have families are not as serious about their science careers by stating emphatically, “I became more creative and did better-quality work after my first child was born.” Her advice to other women is, “Be true to what you want to do; don’t settle for what other people say you can have. The rules are changing slowly—but they are changing.”

Jennifer Specker is an associate professor of zoology at the University of Rhode Island. URI Sea Grant is helping to support her work raising striped bass and Atlantic salmon in hatcheries for the stocking of waterways throughout the Atlantic states. Photo courtesy of Kenneth Davignon, University of Rhode Island.
The Importance of Mentoring

Specker, Van Dover, Kinner, Druffel, and Humphris all have at least one thing in common: each sought out and received the help and encouragement of a mentor who took the time to teach her science, take her seriously, and encourage her to go on. Because women in marine science have been sparse, most of these advisors were men. But the value of mentors—whether male or female—in providing these women with self-confidence and perseverance, cannot be overstated. In large high schools or universities where dedicated students often find themselves feeling alone in the crowd, a few encouraging words from a supportive teacher can mean the difference between forging ahead or falling behind.

More women are needed to act as marine scientist role models. Ivey writes that “career options appear more viable to someone who sees a person like herself as a science or engineering professor.” Perhaps even more crucial, young women need the reassurance that a technical career can be mixed with family responsibilities, but, as yet, few such role models exist.

Since mentors do not usually go out looking for students, young women (and men) must actively seek their own opportunities. Specker, who has high school students working in her URI laboratory, would appreciate the efforts of Tammy Jackson, a junior at Falmouth High School in Falmouth, Mass. Jackson’s interest in marine science led her to the laboratory of Scott Gallager, a research associate at WHOI, whose aquaculture research is partially supported by WHOI Sea Grant. Under Gallager’s supervision, and using his lab space and equipment, Jackson has developed a project entitled “An Analysis of Particle Retention in the Sea Squirt Ciona intestinalis.” Her work has earned accolades in a regional school science fair, the Massachusetts State Science Fair, and the International Science and Engineering Fair held in Tulsa this past spring. Her prizes included a trip to Japan last summer and a cruise aboard a research vessel this coming winter. Jackson says of arranging to work with a researcher in his laboratory, “I guess you have to be a little outgoing to approach a scientist and ask for help, since they usually don’t have much extra time.”

Jackson does not see her accomplishments nor her scientific pursuits as unusual. There are more girls than boys in her honors science class, and she was one of three girls and one boy chosen to represent Massachusetts at the International Science Fair. She is a well-rounded, down-to-earth young woman, who is active in various sports and clubs at school, maintains a part-time job, and likes to have fun with her friends. Yet she has done what Specker recommends to any young woman looking to enter the marine science field: “Have the courage to go out and find people who are working on what you would like to study, and then participate.”

Hands-on Science

Participation, especially at an early age, is a key to success in the marine sciences. M. Tundi Agardy, a postdoctoral investigator in the Marine Policy Center at WHOI, credits the field course she took in the ninth grade with putting her on the right career track. The three-week marine science course, held in the Virgin Islands, was sponsored by the American Museum of Natural History in New York City. Agardy returned in later summers as a staff member and based her career choice on the field work that the experience provided.

Today Agardy is a biologist working with resource managers, economists, lawyers, and policy-makers to find practical solutions to environmental problems. She sees her work as “providing the science that is needed to formulate good policy.” Her research on endangered sea turtles takes her throughout Central America and the Caribbean. Agardy encourages high school and college students to accompany her on research internships there in order to “try out” this line of work.

Participation in extracurricular, hands-on programs may lead to a complete change of focus for some young women. Kinner knows this well. She was an undergraduate ecology major at Cornell University when she first went to the Shoals Marine Laboratory (SML). Located on the Isles of Shoals, 10 miles out to sea off the Maine-New Hampshire border, SML is an educational center operated jointly by Cornell and UNH. After her first summer there, Kinner wanted to return to study amphipods—small shrimplike creatures of the rocky tidepools—but it seemed that financial limitations would prevent further island study.

The SML director at that time, John Kingsbury, offered Kinner free room and board in exchange for her help with the island’s sewage treatment problem. “I realized that waste treatment involves the biological techniques I had studied in college, and I liked the practical application of the knowledge,” she says. The experience led her to backtrack briefly for some additional courses in math, physics, and engineering, and then to pursue her master’s and Ph.D. degrees in environmental engineering at UNH.

Recognizing the need for more hands-on opportunities in science education, the Sea Grant Program at the University of New Hampshire has developed a successful summer course for high school students called the UNH Mathematics and Marine Science Program. It is an intensive three-week program attended by about 25 post-ninth grade students who have demonstrated academic achievement, but are not necessarily oriented toward math and science.

Sharon Meeker, UNH Sea Grant marine educator, explains, “The program is designed to give kids an integrated experience that teaches them the importance of all areas of science and math, including computers, and how they are interconnected. The way sciences are taught tends to be too compartmentalized, and it is
not until the graduate level that students have an opportunity to make connections between them." Meeker notes that more girls than boys attended the program this past summer. She observes no real difference between them in abilities and success rates, saying "the girls wade right in."

Jamie Anderson, an enthusiastic young woman just beginning her second year in robotic engineering with the MIT/WHOI Joint Program in Oceanography and Oceanographic Engineering, recalls the day, as an undergraduate at the University of California at San Diego, when she first reported for her job at the nearby Naval Oceans System Center. Because she had been hired without a personal interview, but based on her resume qualifications (which included years of life-guarding), her new supervisor was quite shocked to discover that she was a woman. "He said, 'Oh! I was expecting a tall, blond guy with a tan,'" Anderson says with a chuckle. It didn't take long for her to demonstrate her competence in computer-aided engineering design and to develop a good working relationship with her boss.

Since then, Anderson says she has been continually encouraged by her teachers, parents, advisors, and both male and female colleagues in her graduate program. She sums it up this way: "This is the 1990s. These days there are very few obstacles to prevent academically qualified women from achieving their potential in science."

The Long Road

It would seem that the future looks brighter for women in marine science. Some universities, research institutions, and private companies are improving benefits for professional women, offering both maternity and paternity leave, helping families obtain affordable child care, providing flextime or work-at-home options, and

altering old rules that prohibited the hiring of dual-science-career couples. Some institutions that require that tenure be attained by a certain point now have "stop-the-clock" programs for women who request maternity leaves. Still relatively uncommon, these progressive attitudes need to be encouraged and made more widely available in the workplace.

But, despite the progress, there are still difficulties. Now, more than ever, women scientists face the added responsibility of being role models while also trying to maintain their laboratories, their funding, and their personal and family lives. Judith McDowell Capuzzo, a tenured senior scientist at WHOI, successfully juggles family, laboratory and field research, teaching, writing, travel, and advising students. In addition, she finds herself continually pursued by national, regional, and local groups asking her to serve as an advisor, committee or board member, consultant, public speaker, teacher trainer, or high school career counselor. Like other women in her field who realize the importance of this type of guidance, she tries to accommodate as many of these requests as possible but admits that it can become overwhelming at times.

"There is no doubt that the women who have paved the way in marine science have not had an easy road," according to John Farrington, recently appointed associate director for education at WHOI. "During the last 20 or so years, as society has become more sensitive to women's issues, WHOI and other institutions of higher learning have seen tremendous changes. But the danger is in allowing complacency to slow the momentum. We need to keep at it; we cannot relax the standards that have been set, and we must remain sensitive to the added pressure placed on the women who have made it in the sciences."

The personal stories presented here illustrate the wide variety of marine science careers that exist and the uniqueness of the women who pursue them. These women all stress the importance of getting a broad-based background encompassing math, computers, engineering, all the sciences, and a foreign language. And they encourage young students to learn to read, write, and think critically, thereby keeping all possible career options open. After all, if Anderson had not taken (on a whim) that one undergraduate engineering course that prompted her to change her major from biology to mechanical engineering, she might never have known the excitement of deep-sea robotics!

Moreover, the women interviewed agree that it is not necessary to attend a college that offers undergraduate majors in marine science; in fact, they discourage it. It simply does not pay to specialize too early; graduate school is time enough. In keeping with the idea of being true to herself and happy in her pursuits, a young woman should be encouraged to attend the college where she expects to be happy and successful. If she has an opportunity to attend a hands-on marine science program, so much the better. Later, if she decides that the research career she'd been dreaming of is no longer her first choice, she is well qualified to pursue one of the countless other marine-related careers available today.

A positive attitude is all-important. These successful women all agree that a young woman must decide what she wants and go after it. The road to a marine science research career is long and demands perseverance. A woman traveling that road must believe in herself and in her abilities. She must find the courage to seek out mentors, male or female, who can provide her with support and encouragement. Whenever possible, she should take advantage of opportunities for hands-on experience. "She must be a little stubborn," admits Druelle. But the rewards, they all say, are worth the effort.

Marine science: women can, they should, and they do!

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