

Science with a passion

As the longest-serving female member of the Corporation, biochemist Maxine Singer looks back on solid gains for Yale science and Yale women

by Sharon Elder

When Bill Moyers was looking for someone to discuss science as part of his "World of Ideas" television series just over a year ago, it was no surprise that he called on Maxine Singer. A renowned molecular biologist and president of the Carnegie Institution of Washington, Singer, who earned a PhD from Yale in 1957 and has been a member of the Yale Corporation since 1975, is among the nation's leading authorities on genetics.

One of the first questions Moyers put to Singer during their interview was why scientists are so often suspected by the public at large of being "mad," if not downright diabolical. Having suffered from that scientific stigma on any number of social occasions when the mere mention of her profession seemed to "drive people to the far end of the room," Singer could answer from experience. "I suppose they're frightened," she said. "They think that I live in a world apart, without the same kind of human concerns they have."

In Singer's case, nothing could be further from the truth. Besides heading the Carnegie Institution, which is one of the most respected private scientific



Life in the lab: Times have changed.

research organizations in America, and pursuing her own research in genetics at the National Institutes of Health, Singer, 58, is a wife and the mother of four grown children. She successfully combined career and family long before the media latched onto the professional woman's lament about the burdens of "having it all."

But the casual encounters Singer described to Moyers continue to bother her, if only because they highlight how pervasive scientific illiteracy is, and how prejudiced some Americans still

are against science. If Singer had her way, science would be an integral part of everybody's education, and people might begin to see it as she does, as "one of the grand human activities." Science, she insists, "uses the same kind of talent and creativity as painting pictures and making sculptures. It's not very different except that you do it from a base of technical knowledge."

Singer's conviction about the importance of scientific literacy has had a considerable impact at Yale. Appointed by Kingman Brewster in 1974 to head the University Council's Committee on the Biological Sciences, Singer joined the Corporation as a successor trustee the following year. She has since been a strong advocate of the University's efforts to strengthen science requirements for undergraduates, all of whom are now required to complete two natural science courses in order to graduate. "In a world that is largely driven by technological change, and where social and ethical decisions hinge on science," she says, "it's extremely important that everybody learn something about it. Yale is doing better than most places in this regard."

Singer has also been a staunch supporter of Yale's campaign to improve

the standing of its science faculty. Singer's service on the Corporation coincided with the late President A. Bartlett Giamatti's initiative to bring the science departments to the same high level as those in the humanities. That effort, according to Singer, has been continued with "great verve" by President Schmidt. Now in her final year as a corporation member (she is the longest-serving woman trustee in Yale history), Singer is pleased with the University's progress. "Yale has become great in the sciences," she says, and insists that she is not overstating the case. "Across the board, from Science Hill to the Medical School, Yale's science efforts are first-rank. I'm not saying that this is coming; I'm saying it's here. It takes images a while to catch up with reality."

But as she prepares to leave the Corporation, Singer is not about to declare the battle won. She remains deeply concerned about the shrinking number of Yale students who are actually preparing for careers in science and about the high percentage of science majors who switch to other majors before graduation. And as a scientist who happens to be a woman, Singer is also concerned about the slow progress female faculty members are making in obtaining tenure at the University and, in general, the increasingly heavy demands being made on the community of professional women Yale's current female undergraduates will eventually join.

Singer's perspective on such issues, at Yale and elsewhere, is informed by her own professional and personal experience. Growing up in the Flatbush section of Brooklyn, the young Maxine Frank attended Midwood High School, where a gifted (female) chemistry teacher introduced her to the excitement of science. "She was a marvelous teacher," Singer recalls, "and she was demanding." As an undergraduate at Swarthmore, Singer majored in chemistry, was elected to Phi Beta Kappa and Sigma Xi, and graduated in 1952 with high honors.

Married just one week later to Daniel M. Singer, a Yale law student whom she had been dating since she was 17 (and with whom she recently celebrated her thirty-seventh wedding anniversary), Singer came to New Haven that fall in the dual role of bride and graduate student in biochemistry. By 1957, she had completed her doctorate and begun a thirty-three year association with the

National Institutes of Health in Bethesda, Maryland. By 1980, Singer had risen to chief of the Laboratory of Biochemistry of the National Cancer Institute, one of NIH's largest laboratories.

Endowed with abundant energy (until recently, she rarely slept more than five hours a night), Singer has managed, without compromising her career, to raise four children, all of whom have taken diverse professional paths. Stephanie Singer, '85, majored in mathematics and is now a graduate student at New York University. David Singer,

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'84, went on to Stanford Business School, where he earned an MBA. Two of her daughters attended their mother's alma mater, Swarthmore College: Ellen Singer went on to earn a master's at Tufts and is now a veterinarian; Amy Singer holds a doctorate in Near Eastern history from Princeton and is an assistant professor at the University of Tel Aviv.

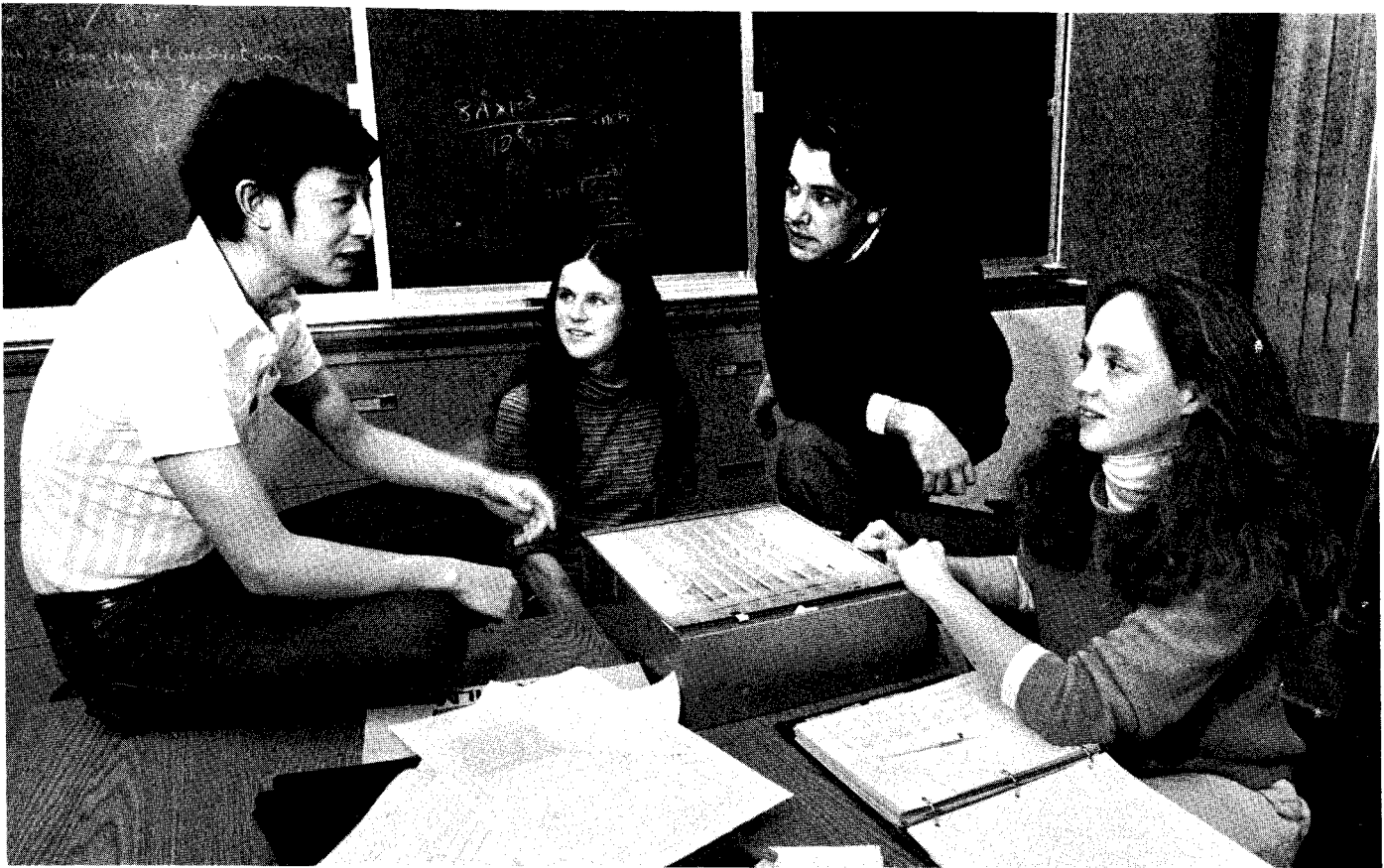
Over the years, their mother's considerable professional accomplishments have brought her numerous awards and honorary degrees, including membership in the National Academy of Sciences and the Pontifical Academy of the Sciences. In 1988, she received a Distinguished Presidential Rank Award, the nation's highest civil-service prize. A member of the governing board of the Weizmann Institute of Science in Israel and the Whitehead Institute, she is also known for her work on behalf of civil rights, human rights, and scientific causes. In the 1980s, Singer assisted in the development of Yale College's Judaic Studies program and established the Henrietta and Hyman Frank Book Fund at the University Library in honor of her parents. She also served on the School of Medicine's National Volunteer Committee during its recent, and

highly successful, capital campaign.

One of the causes about which Singer has cared the longest is science education. Without some drastic improvements in the teaching of science, it has been predicted by the National Science Foundation that by the year 2010, the U.S. will face a shortfall of between 500,000 and 750,000 scientists. According to Singer, increasing numbers of American students are disqualified from careers in science by the time they finish high school, having given up on mathematics long before. A recent article in *Time* magazine reported that one of the earliest decisions school children make, often by the fourth grade, is that science is not for them. Singer feels one important reason is the teaching. "Children probably haven't changed," she says. "They're curious about the world around them and always have been. But the teaching of science in elementary and high schools fails to capture that curiosity and sustain it."

Although it has long been true that relatively few high school students went on to careers in science, what was once, in Singer's view, a "reasonable pool" of potential science majors is steadily evaporating. And of the few who do become science majors in college, a significant number switch to other disciplines before graduation.

The phenomenon is readily apparent at Yale. Continuing a trend of recent years, biology is the most popular prospective major listed by this year's Yale freshman class, and, according to Dean of Admissions Worth David, growing numbers of applicants indicate that they plan to major in molecular biophysics and biochemistry, engineering, or physics. Some soon discover, however, that getting an "A" in a humanities course is a safer bet than in a science course, and if their sights are set on grades that will get them into graduate school, the incentive to drop science is high. Undergraduates also argue that the science faculty's top-flight research skills don't always guarantee comparable teaching ability. Singer concedes that there is room for some improvement on that score. "I suppose it's nice to say that it would be good if excellence in teaching counts more in getting tenure," she says, "but in a way, that's almost unrealistic because of the whole grants picture." As things now stand, professors are forced to spend a disproportionate amount of their time applying for



As good as Yale's research teams are, holding onto more science majors may call for some revamping of teaching methods.

grants critical to continuing their research. Without a national effort to change the current two- or three-year funding cycle to five or more years, she contends, those requirements make it unlikely that professors can devote any additional time to designing and teaching undergraduate courses.

Even so, Singer would like to see the University do more to nurture science majors. "Special programs are needed," she says. "People get lost because they discover that it's a lot of hard work, and there are social pressures to do other kinds of things. At Yale, even the geography is a problem, because students have to do much of their work way up on Science Hill, which makes it harder to be part of the community during the day."

Singer remains heartened by Yale's continuing efforts at encouraging the study of science. But she is alarmed by the situation in the nation as a whole. Turning American students on to science, as Singer sees it, is going to require taking into account a complicated set of social and economic issues outside the classroom, including the fact that so many teenagers work after school. The

United States leads the nations of the world in the percentage of 16- to 18-year-olds who both go to school and work. Singer shares the concerns expressed last summer in a report by the Connecticut Academy of Science and Engineering warning that the state faces a scarcity of scientists and engineers, and that the entire U.S. risks turning into a nation of "hamburger flippers." The evidence is close to home. "In most middle-class suburbs, the staffing of shopping malls depends on having young people work," Singer says. "They work to buy cars, to buy clothes, and in the worst case, to buy drugs. They're in school until they can leave and go to work. They don't see their lives as defined by the fact that they're getting an education the way many of us did when I was a student."

Singer's education has led her to a point where she has had to do considerable juggling of her own just to stay up to date in her chosen field. The presidency of the Carnegie Institution is a halftime position, an arrangement that has allowed her to continue her laboratory work at NIH (with the title of scientist emeritus). She confesses that her passion for research is such that she can begin to

feel bored if her administrative duties keep her away from the lab too long.

Her current work concentrates on what she describes as "some odd and poorly understood aspects of the way human genetic information is organized" within DNA. A significant proportion of DNA—perhaps as much as 80 percent—is not made up of genes. Within that still mysterious segment (sometimes referred to as "nonsense" or "junk" DNA) are many repeated sequences. One such sequence appears almost a million times and constitutes about five percent of the total.

The sequence Singer is concentrating on, known as Line-1, exists in all mammals, suggesting that it has an as yet undiscovered function. (Otherwise, Singer notes, evolution would have eliminated it long ago.) Although nobody knows yet what purpose such sequences serve, Singer and her colleagues have discovered that Line-1 is a "movable element," a piece of DNA that can shift from one place to another and create illness. For example, hemophilia can be caused by the migration of such a sequence into a gene required for blood clotting. The next step for Singer and her team is to figure out the chemistry of

just how such elements move and how they can be controlled.

In addition to being a respected researcher, Singer has continued to play a leadership role in the international scientific community. In the mid-1970s, what the public now refers to as “genetic engineering” was just getting started. In 1975, Singer was among a group of concerned scientists who organized the Asilomar Conference, a gathering sponsored by the National Academy of Sciences of the United States to develop safety guidelines for what was perceived at the time to be a highly risky enterprise. “People were concerned that by introducing unknown genes into bacteria, you might so alter the properties of the bacteria that they would become hazardous,” says Singer. Almost fifteen years later, she is able to report that “most of the speculation about the risks, even in the scientific community, have turned out to be essentially wrong.” The groundwork laid at Asilomar became the basis for what Singer describes as a “very extensive and public process” of overseeing genetic experimentation. “Many of the concerns people had were addressed,” she says. “This situation has been monitored and regulated from the start because the scientific community raised the issue and started the regulation itself.”

While struggling with public misconceptions about science, Singer has also had to weather the storms surrounding the fact that she is not just a scientist but a female scientist. In some ways, the experience was made easier by the fact that she was somewhat out of step with her own generation. During the mid-1950s, while she was working toward her doctorate, the conventional role for women was to stay close to home. But Singer saw no conflict between her desire to go to graduate school and to be a wife and mother. “I was naïve,” she says, “and extraordinarily lucky.” At Swarthmore, her closest female friends had all been science majors. Arriving at Yale to study in the Department of Biochemistry (now the Department of Molecular Biochemistry and Biophysics), she found herself working with Professor Joseph Fruton, whose wife, Professor Sofia Simmonds, was also a gifted biochemist. “It didn’t matter to him that I was a woman,” Singer says of that early professional relationship. “If things happened that had to do with discrimination, I was unaware of

them. I tend to think they really didn’t happen, and I suspect that made a very big difference for the future in my attitude about myself.”

Not that she remained a Pollyanna about the condition of professional women. Until the late 1960s, women were rarely asked to serve on professional committees. Singer vividly remembers the day when that started to change. Less than twenty-four hours after President Lyndon B. Johnson ordered that all federal committees should have female representation, Singer was asked to serve on one at the National Institutes of Health. “I had never been asked before,” she recalls. “Nothing had happened to my status overnight, but all of a sudden they were calling me. It was so transparent that I just said to them, ‘No, I won’t do that. If you didn’t want me yesterday, you’re not getting me today.’”

One invitation from a heavily male preserve Singer did not turn down was the one to join the Yale Corporation. Service on it has given her a close look at how both professional women and female students are faring at Yale. For all the progress made in recent years, Singer remains concerned about Yale’s

“Young women know that they can’t have career and family without the right kind of partner, but they’re not finding supportive young men.”

relatively slow pace at tenuring more women faculty members, particularly in science. At present, fewer than 10 percent of full professors on the Arts and Science faculty are women. Although the University recently met the goal it had set five years ago of doubling the number of tenured women faculty members, Singer hopes that the special efforts made by the Advisory Committee on the Education of Women will be continued.

But for women undergraduates, at least, Yale strikes Singer as an especially welcoming place. “Yale is theirs, just as

much as it is for the male students,” she says. “They are energized, original, enormously talented and enormously attractive in every way, and their expectations for what they will be able to do are limitless.”

For all that, Singer sees difficult times ahead for these undergraduate women in future relationships with their male counterparts. “There is a tremendous disparity between what the young women see as the world ahead of them and what the young men see,” she says. “The expectations of young men are still very similar to those of their fathers. In looking for spouses, young women recognize that they can’t have both career and family without the right kind of partner, and they aren’t finding suitable partners because we haven’t raised young men to appreciate the reality of what young women want. My husband was a rare person for his time and men like him are just as rare now. This is a serious problem and I think it is a big challenge for a university community like Yale.”

As an example, she again cites her own experience. “I don’t think anybody knows completely what it takes to raise great kids,” she says. “Obviously it has mostly to do with the parents’ attitude and the importance of family. But the fact that I went to work didn’t mean that I thought family wasn’t important.” As it turned out, some of the same people who had criticized Singer for “sacrificing” her children in favor of her career, turned out to have very troubled children. “I have four great kids,” Singer says, “so there’s a lesson in that. They’re constructive, they’re original, they’re motivated, they’re loving—they’re everything wonderful and they know the importance of family. It’s not that I can pontificate—all I know is that it didn’t have to do with whether I went to work or not. I think it’s important for men to hear that.”

With her own children off on their own, Singer’s retirement from the Yale Corporation next summer will mean more time for the laboratory work she loves. “I don’t think there’s anything more interesting,” she says. “Wondering about things you don’t understand, and then searching for the explanations is exhilarating. The natural world is an extraordinarily beautiful place—nothing equals it in complexity and elegance. Man-made things simply can’t come close.” □