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ABSTRACT

This publication contains highlights from a report on the participation of women in scientific research which was prepared by the Office of Opportunities in Science (OOS), American Association for the Advancement of Science (AAAS) with the support of the National Science Foundation (NSF). The report, issued March 1978, includes both the findings of the AAAS research study project and perspectives gained from interaction of women participants at the conference held October 1977, in Washington, D.C. The publication provides information on: (1) Progress of women in science; (2) Women in the National Academy of Sciences; (3) NSF and women; and (4) Recommendations to NSF. Abstracts of some materials which are related to the participation of women in scientific research are also included. (SM)

Increasing

The Participation of Women in Scientific Research

Summary of Conference Proceedings, October 1977, and Research Study Project Report, March 1978

National Science Foundation

Cover Photo: Dr. Margaret A. LeMone and Dr. William Pennell are atmospheric scientists at the National Center for Atmospheric Research in Boulder, Colorado. They are debriefing the crew of a flight on an instrumented aircraft through a line of precipitating cumulus clouds off the coast of Senegal, West Africa. The data collecting flight was part of the international Global Atmospheric Research Program/Atlantic Tropical Experiment, in part supported by the National Science Foundation.

Increasing

The Participation of Women in Scientific Research

Summary of Conference Proceedings, October 1977, and Research Study Project Report, March 1978

Spurred by signs that "there are valid indicators of progress as well as tough remaining problems" related to the role of women in science, the Office of Opportunities in Science (OOS), American Association for the Advancement of Science (AAAS), last year sought a better understanding of the situation through a research study project. Its purpose was to yield "depth and detail" on the participation of women in scientific research, to identify "otherwise elusive factors and possible patterns of change," and to illuminate what barriers persist and determine if they are "unyielding."

As responses from the study began to be received and analyzed, a series of questions emerged. Some were expected and even solicited, such as those on the difficultics of balancing one's career and personal life. Others were unsolicited and unexpected, such as the disparity between how male and female students allege professorial bias in grading or the incidence of reported sexual pressures on women. It appeared that a number of topics required further discussion as an integral part of the study. This took place at a working conference attended by the women participants only.

This publication contains highlights from The Participation of Women in Scientific Research, *a report prepared by Janet Welsh Brown, program head, Michele L. Aldrich, project director, and Paula Quick Hall, research associate, OOS, AAAS, under contract number PRM-7700343 for the Office of Planning and Policy Analysis, National Science Foundation. The report, issued March 1978, covers both the findings of the study and perspectives gained from the interaction of women participants at the conference held October 17-20, 1977, in Washington, D.C.*

James Campbell, aero engineer, and Janet Campbell, space scientist—two of the 120 participants in the AAAS research study project—are both employed at the National Aeronautics and Space Administration (NASA) Langley Research Center, Hampton, Virginia. They are husband and wife.

"The men see the situation in terms of how far women have come, and the women see the exact same set of facts, developments, or changes in terms of how far they have still to go."

Report on *The Participation of Women in Scientific Research*

The Bitter with the Sweet

Highlights of AAAS Research Study Project

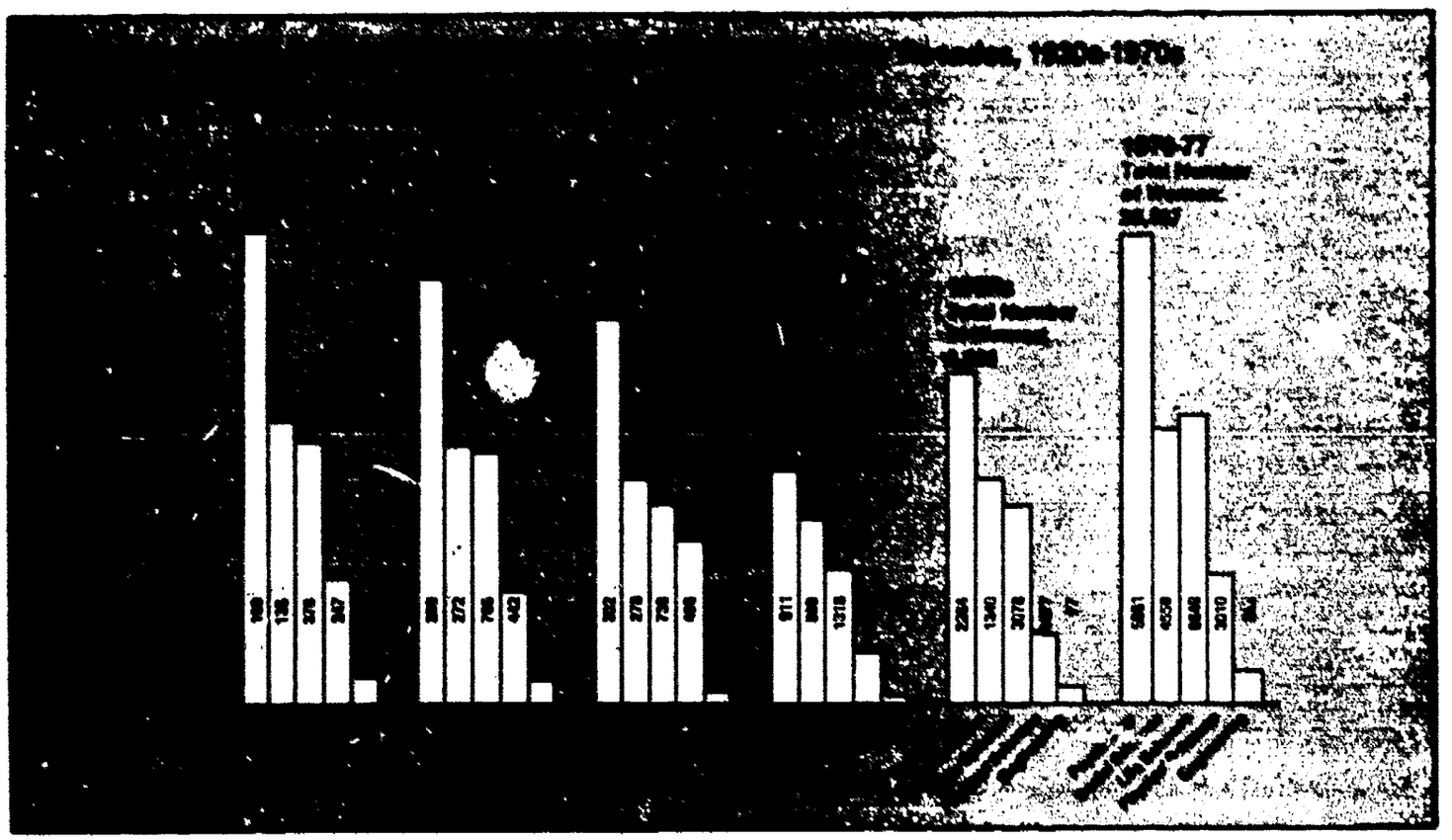
The rewards of a career in science still outweigh the difficulties for most women in the field, even though the difficulties remain substantial. As a percentage of Ph.D.'s granted, women have just now, in the 1970s, achieved the same level they enjoyed in the 1920s (see chart below)—just when the market for their skills is limited. Employment possibilities for all scientists, women and men, are constrained by economic retrenchment. Affirmative action with its perceived corollary, "reverse discrimination," is widely misunderstood, mistrusted, and misused. The young scientists in the AAAS study project "write of their anxiety and fear, and sometimes of their resentment and bitterness," states the report. "Everywhere . . . there is the concern for jobs. Even the most breezy and confident in the study sample face some undesirable choices. The real cloud hangs especially heavy in academia."

Science has long held a prejudice against people who receive their degrees after age 30 and who have interrupted their education or careers by switching fields or taking time out. Findings in *The Participation of Women in Scientific Research* challenge that bias. More women than men in this study had discontinuous patterns, but the results in both cases were felt to be salutary. ". . . it is almost as if the time taken out has given these people an added perspective, an opportunity to assess and reevaluate their goals, their choice of field, or their kind of work or type of research." "Instead of perpetuating the myths about the dangers of interrupting a career or switching between fields," the report continues, "we perhaps should counsel young scientists to think about alternative patterns, and to weigh the value of different schedules of preparation and changes of pace."

Different Workplaces

Only a few scientists in this study had experience in industry, reflecting the generally low numbers of women employed in the private sector. At the conference, however, representatives from industry and those women so employed made it clear that "corporations that have formerly been reluctant to hire and promote women scientists are now quite willing to do so, especially to take them in at the beginning level. Industry is feeling pressure from the government for equal opportunity and is on the whole responding." Data are seriously needed. Existing research on women in business trends to concentrate on management rather than professional and technical staff.

More information was obtained about women and men scientists doing research in government agencies and national laboratories around the country. A striking finding was the nearly universal feeling of satisfaction with this type of work because of its social usefulness. Other advantages include being able to combine education with their employment and having good relationships with their senior colleagues. Nevertheless, many barriers for women are still evident: veteran's



preference discriminates against women in getting jobs; jobs are often already "wired" for a specific candidate, usually male; and outright prejudice in interviewing by potential employers is common.

Government jobs often involve supervision of other employees. While recognizing the importance of women assuming managerial roles, many of the women scientists said they did not like administrative work. The report speculates that this attitude may disappear "as enhanced stature offers them positions of greater authority." On the question of supervising men, all agreed that women must learn to be comfortable in this capacity if they wish to advance in their careers.

A larger proportion of scientists employed in academia express disappointment with their workplaces than their colleagues in industry and government. The reality is too far a cry from the ideal. For every plus, there are several minuses. The benefits of more flexible hours and freedom from supervision of their research are more than offset by the discouragements of job hunting, lowered expectations, appointments being made on factors other than merit, the competition between teaching and research, the necessity of finding funding to do research, the irrationality of how some projects get funded, and a feeling that younger faculty must meet more rigorous standards than older, entrenched colleagues.

No Special Favors

Regardless of where they stand on women's issues or the degree to which they see discrimination operating against them, the women in this study request for themselves, their women colleagues, and the young women coming behind them "simply an equal chance . . . and equal opportunity to choose, to prove and to accomplish."

"We would conclude that essential at the precollegiate level are equal preparation in science courses, bias-free counseling, and information on the full range of options open to both men and women. Second, equal admissions not only to institutions but to programs are absolutely necessary. Thirdly, they need an equal education at the college and graduate level . . . equal access to fellowships, equal research opportunities while in graduate school, an end to unfair sexual pressures, and adequate numbers of role models and good mentors."

Other Findings

The Participation of Women in Scientific Research is organized around the scientist's life cycle. From the importance of the early years of childhood and adolescence, it progresses to undergraduate and graduate education, the early stages of young scientists' careers in three work settings, and the accommodation of professional and personal lives. Following are additional highlights of the report:

• In elementary and high school, girls and boys interested in science were treated differently by parents, teachers, and friends. Girls found ambivalence, lack of encouragement, and messages that what they were doing was inappropriate, impractical, or unacceptable. Encouragement for girls took the form of learning for its own sake or facilitating a good marriage. Boys encountered much wider acceptance of their intentions as appropriate and admirable, particularly in terms of future economic status and a successful career.

• Girls and boys were about equally well-prepared academically, but ". . . girls in advanced mathematics and sciences courses were nearly always in the minority—often the only girl," states the report. "The question of whether there is actually such a disproportionately low number of girls interested in science subjects or whether there are other reasons that girls did not choose science must be answered."

* * * * *

• At the undergraduate level, more men than women attended colleges and universities with a

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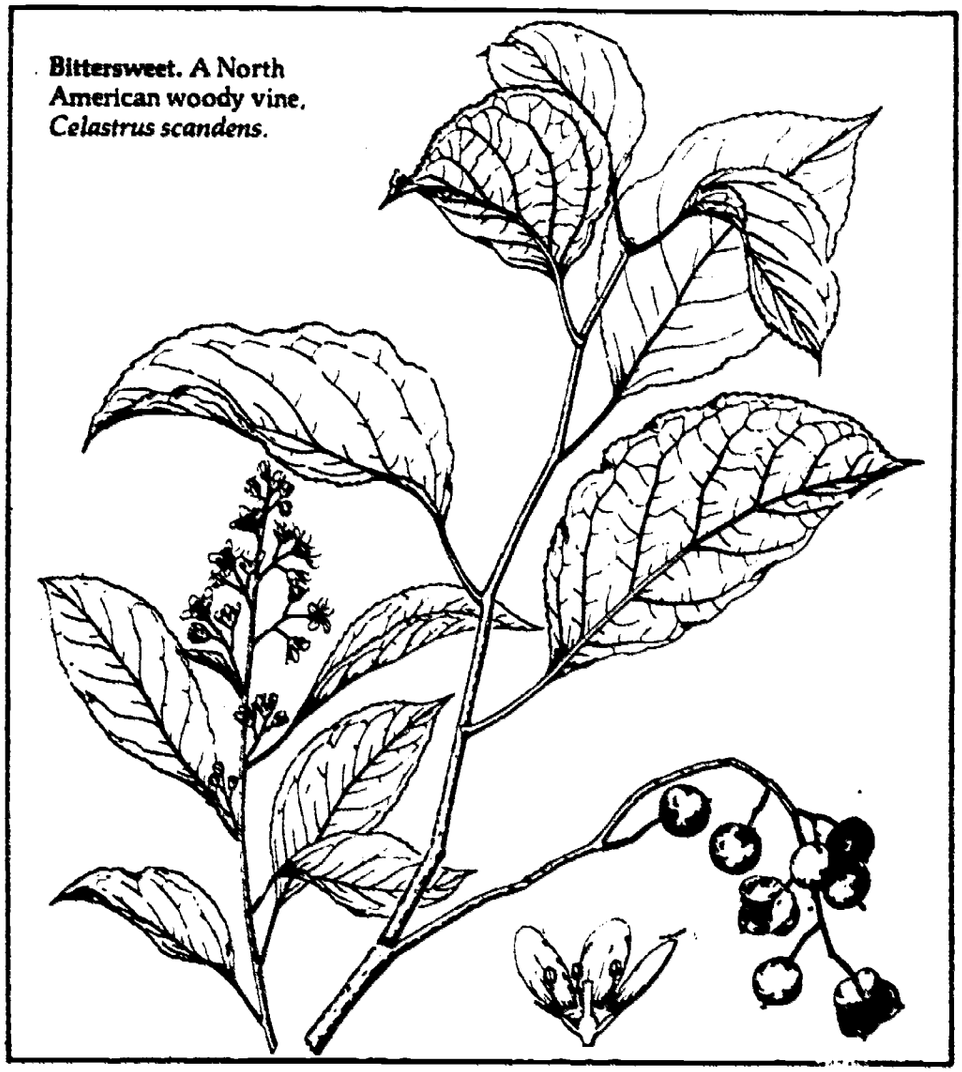
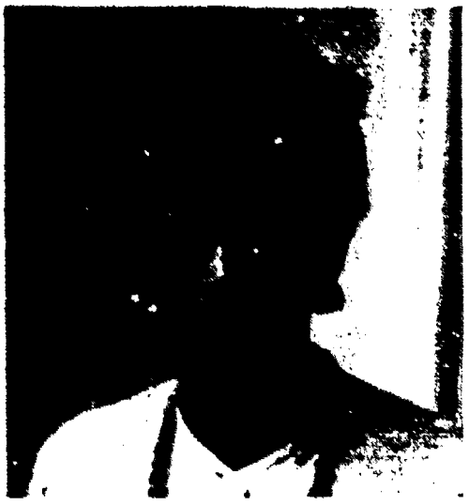


Bittersweet. A North American woody vine, *Celastrus scandens.*



We are honored and pleased, indeed, to convene this conference of young women scientists, an important group in our future scientific community. You, as young scientists, are the result of 20 years of persistence, commitment, downright stubbornness, and all the survival processes it took to reach the peak that you now enjoy. It is precisely because of your struggle that we want to learn from you what factors in your lives have made this advancement possible so that we can relate to others these important findings.

We hope that your meetings this week will provide the scientific community with new ideas to correct the underrepresentation of women in science and technology. We shall be looking forward to your guidance and fresh perspectives on the road to scientific achievement for women.

Jewel Plummer Cobb, *Dean*, Douglass College,
Honorary Conference Chair and Member, National Science Board

The Conference in Microcosm

Sixty women scientists, holding doctorates in fields from anthropology to zoology, met with leaders from government, business, and the academic world at the conference on The Participation of Women in Scientific Research, October 17-20, 1977, in Washington, D.C. All had received their Ph.D.'s within the last six years. Their ages ranged from 27 to 47, with the majority being in their late 20s and early 30s.

One-half of the participants in a research study project (for details of the study, see page 13), they gathered to explore the reasons for such dramatic statstics as:

- **Men who did not complete high school earned 27 per cent more than women college graduates in 1976;**
- **Despite equal opportunity and affirmative action laws, the gap between women's and men's wages continues to widen. In 1975, women Ph.D.'s had salaries 19 per cent below men's, whereas in 1973, the difference was only 17 per cent.**
- **Women make less than men at every degree level, in every field, in every employment setting, at every age, in every activity—and the difference increases with age.**

Some conference participants were disenchanted with science when they came—and left with renewed delight in their disciplines and enthusiasm for their careers. Sharing experiences, perspectives, and information made the difference. Attendees listened to knowledgeable and renowned speakers, met in large and small groups, read background papers, compared workplaces, questioned myths, traded horror stories, challenged the system, searched for truth, and—most importantly—drafted policy recommendations to help the National Science Foundation design programs to improve the access of women to research and educational opportunities. Many of the recommendations are related to a new piece of legislation, the Women in Science and Technology Equal Opportunity Act, (S. 2550) introduced by Senator Edward M. Kennedy (D-Mass.) in the 95th Congress.

This publication presents the conference in microcosm: highlights from speeches, abstracts of research, excerpts from discussions, background stories, important data, synopsis of recommendations, and update on legislation. Topics addressed in working groups included precollegiate and undergraduate experience; graduate training; postdoctoral employment in industry, government, and academia; training and employment by disciplines; minority women's perspectives; mentors and models; and funding of research. Issues and discussion leaders not represented elsewhere in this publication included:

Research issues related to women and men—Jean Lipman-Blumen, Director, Women's Research Program, National Institute of Education (now a Fellow, Center for Advanced Study in the Behavioral Sciences, Stanford) sparked discussion on teaching and learning aspects.

Publishing of research—Philip Abelson, Editor, *Science*, outlined considerations. Participants were particularly interested in furthering the process of "double blind" review, where neither the submitter nor the reviewer are known to each other.

Research in the public sector—Joan R. Rosenblatt, Chief, Statistical Engineering Laboratory, National Bureau of Standards, summarized research opportunities for women at the federal level.

Research in the private sector—Herman L. Finkbeiner, Manager, Employee Relations Operations, General Electric Research and Development Center, covered the employment situation in industry for researchers.

Federal responsibilities and opportunities in science education—F. James Rutherford, Assistant Director for Science Education, NSF, and Peter Relic, Deputy Assistant Secretary for Education, HEW, conducted a dialogue on how the proposed separate Department of Education might affect the teaching of science.

The conference was supported by the National Science Foundation through the Office of Opportunities in Science of the American Association for the Advancement of Science. Retiring President and Chairman of the Board of Directors Emilio Q. Daddario and Executive Director William D. Carey, AAAS, presided at the opening session.

NSF—and Women

The National Science Foundation (NSF), financed by Congress, is an agency of the federal government established in 1950 to promote and advance scientific progress in the United States. It allocates scientific research funds to public and private agencies. Its budget for fiscal year 1979 is $941.3 million dollars.

NSF is divided into seven "directorates." The Directorate for Biological, Behavioral, and Social Sciences, with a 1979 budget of $156 million dollars, is one. Assistant Director Eloise Clark outlined its relevance to women in opening remarks to the conference.

The directorate for Science Education, with a 1979 budget of $80 million dollars, is another. Efforts are being made throughout its four divisions to bring more women and girls into mainstream science education. A primary focus is encouraging girls at the junior high school level to "hang in" math and science courses and participate in science activities, so that the possibility of further science education is not foreclosed at an early age.

In addition, one of the divisions of Science Education, Scientific Personnel Improvement, has a special targeted program for women in science, budgeted in 1979 at $1.3 million dollars. This program, which had been exploratory since 1974, was made official by the Congress in 1976 "to develop and test methods of increasing the flow of women into careers in science." A background paper prepared for the conference and recently updated by Program Manager M. Joan Callanan explains the current and future status of this program.

Opening remarks by Eloise Clark, Assistant Director for Biological, Behavioral, and Social Sciences, National Science Foundation

Last week when Rosalyn Yalow received a Nobel Prize, we were quickly reminded that she was only the second woman to receive the Nobel Prize in medicine. The first was Gerty Cori in 1947, a founding member of the National Science Board.* A third woman, Maria Mayer, received the Nobel Prize in physics in 1963. I'm sure that you share with me the pride in accomplishment and recognition of these women—and look forward to the day when we lose count of the number of women who are Nobel Laureates.

The National Science Foundation has a formal commitment to the participation of women and minorities in science,** which has grown steadily over the past few years. The director of the Foundation, Richard Atkinson, continues to stress this commitment, and the Congressional committees with jurisdiction over the Foundation have taken a keen interest in these programs and actively encourage the Foundation to strengthen its commitment. The National Science Board, except for a two-year hiatus, has always had women in its membership.

My own job is to supervise the annual spending of a bit over $140 million dollars [fiscal year 1978] for basic research in biological, behavioral, and social sciences. By coincidence, these are the fields in which the employment of women is most fully represented at the doctorate level. They are about 11 per cent of the social sciences, 12 per cent of the life sciences, and 20 per cent of the psychologists. In contrast, only about one-half of one per cent of the doctorates in engineering are women and less than 5 per cent in the physical sciences.

It turns out that the proportion of women who apply to the Foundation for research support tracks along the same distribution. I should like to encourage you, however, by noting that success in receiving support is significantly better than average. The problem is that we aren't getting nearly enough applications from women who are active in the field. Now that

(Continued on page 12.)

* Dr. Cori was one of the two women on the original National Science Board, 1950. The other was Sophie D. Aberle, who served until 1958; Dr. Aberle was a visitor at a recent board meeting in Colorado. The National Science Board is composed of 24 members appointed by the U.S. President. It acts as the policy making body of the National Science Foundation.

** Reinforced by a standing committee of the National Science Board on Minorities and Women in Science. Chair, Jewel Plummer Cobb; Executive Secretary, Carlos Kruytbosch.

Update by Joan Callanan on Women in Science Program

While the Congressional authorization act gave no prescription on how the stated goal of the program was to be accomplished, "the message we got was to become more action oriented," states Ms. Callanan. A plan was developed to assist three separate audiences:

1. College and university students attend Science Career Workshops at the freshman/sophomore, junior/senior, and graduate student levels to obtain factual information and practical advice regarding careers in science. Spinoffs include exposure to more women scientist role models and increased sensitivity of male faculty, who attend, to the problems women face in a traditionally male profession.

2. Women with unused bachelor's and master's science degrees participate in Science Career Facilitation Projects designed to augment their scientific knowledge in order to enter graduate school or obtain employment. These projects hinge on training or retraining in fields where women are scarcer than usual and job opportunities are good. The projects are of three main types: a) updating in a field, b) converting from one field to another, and c) updating,

(Continued on page 12.)

Point/Counterpoint

Excerpts from keynoter's exchange: **Philip Handler**, *President, National Academy of Sciences,* and **Estelle Ramey**, *Professor of Physiology, Georgetown University Medical Center*

Commenting that he undoubtedly stood before the audience as "the very embodiment of the male chauvinist scientific establishment," Dr. Handler discussed a range of issues related to the participation of women in American scientific life. "I rather suspect that we are walking up onto a plateau," he observed, "a plateau which you will not necessarily enjoy. The easy steps have already been taken. . . ." Efforts aimed at getting women beyond the first rungs of the ladder have not been particularly successful, he noted, amplifying his remarks with information from Women and Minority Ph.D.'s in the 1970s: A Data Book, *published by the National Academy of Sciences in 1977.*

*Following Dr. Handler at the lectern, Estelle Ramey provided some answers to many of the questions he had raised. "It's extremely difficult to fight prejudice that is based on an irrational premise," she stated. "How do you defend yourself against the bred-in-the-bone belief that just being a women, somehow or other, makes you intellectually and creatively inferior?" She also stressed that women who are secure must "make it their top professional priority to bring an end to the mindless discrimination that has destroyed female scientific potential. . . ."**

(Many women at the conference recalled their struggles throughout high school and college in social relationships with men—a sense of being different, of threatening the tradition of men dominating women and being smarter than women. This was reinforced by both men and women in the research study project—and by Handler and Ramey. Reminiscing about a blind date they had together many years ago, Dr. Handler remarked, "When I went to pick you up, you were reading a book and I was put off.")

Handler: Some problems of women scientists are attributed to the fact that they are older than men when they receive their Ph.D.'s. This is not because they took longer to complete graduate school, but because they took more time out between the baccalaureate and entrance into graduate school for a variety of reasons. That reduces the time they are available for employment, and it may remove them at the very age when scientists, certainly male mathematicians and theoretical scientists, are most creative and productive.

Ramey: Can the fact that women are paid less than comparably trained men and have much less upward mobility on the job be ascribed to the time given by women to family management, thus removing them from the job market for longer periods of time? I don't think so. Right after World War II, many of my male colleagues belatedly entered their training period. They got their Ph.D.'s five years later than normal. Many of the senior staff had also been out of the labor force serving their country. Upon their return, society said, "Welcome back, Joe, we have kept your place warm for you."

When a woman is out five years and wants to come back, however, society says, "Well, science moves very rapidly and you can't expect. . . ." Anything that women are doing when they are out of the labor market is considered by its very nature to be trivial. Being out reduces a woman's value, while it may well enhance a man's.

Estelle Ramey

Handler: Except for the GI Bill, which very few women could take advantage of, the relative proportions of men and women who had support from federally sponsored fellowships or training grants were about the same. The women had somewhat greater access to fellowships. They were also appointed in equivalent percentages to teaching assistantships in graduate school. Thirty-eight per cent of the men had had research assistantships, however, compared to only 27 per cent of the

*A noted endocrinologist, Dr. Ramey began speaking out on women's issues several years ago when she felt that a well-publicized reference to women's "raging hormones" as limiting their professional capabilities could not go unchallenged.

women. I do not understand this discrimination and am baffled by the extent of this discrepancy.

Romey: The answers to why more men than women receive research assistantships are not obscure. Research assistantships are invaluable. They give graduate students large blocks of time to devote to research while being subsidized. This increases the intensity of the work and hastens the completion of the Ph.D. thesis. It also brings the student into a close working relationship with the professor. Teaching assistantships, on the other hand, take away time from research.

There are seldom enough research assistantships to go around, so the question is—who gets the money? The people making the choices are almost all men and the research assistantships go to the student who will bring greater glory to the mentor. There *are* female research assistants but they are fewer, usually paid less, and not regarded as having much of a future.

Handler: A few years ago, those women who were members of the National Academy of Sciences considered whether or not they should have a "women's

Philip Handler

caucus" to develop a special nominating procedure for women to become members of the Academy; they totally rejected the idea. Meanwhile, something beneficial has been happening anyway. The next-to-last step in the Academy election process is the so-called "preference ballot," which includes 50 per cent more names than the number that can be elected. In the last eight years, no woman whose name has appeared on the preference ballot has failed of election. This is affirmative action, Academy style. You may think that rising from one trivial number to another trivial number isn't progress. Nevertheless, the total fraction of all members newly elected to the Academy who are women has been rising.

Romey: It is no surprise that the women of the National Academy of Sciences, a small handful of women, are not in the forefront of feminist ranks working to change the perception of women scientists. This small band of outstanding women are still really interlopers. They have the same trouble that other small groups of successful women have: they find themselves constantly having to fight a very subtle battle—to be women and to be taken seriously as scientists.

Handler: Sweden started down the trail of heightened consciousness of the role of women almost a decade before the United States. "Women's lib" is an instrument and article of national policy. Yet the participation of women in science and engineering there looks remarkably like it does here. After equal formal education and equal opportunity in taking the first steps up the employment ladder, some monstrous barrier seems to be operative. Very few women in Sweden rise to positions of authority in science.

Romey: Women have largely bought the idea that they are being educated not for careers but to increase their desirability as the wives of achieving men. The percentage of women in the field doesn't seem to make much difference, nor does the national philosophy. When medicine was considered a rather low-class occupation in the Soviet Union, there were far more women in medical schools. About 70 per cent of all Russian M.D.'s are women. Now that the M.D. has achieved a certain cachet in the Soviet Union, that is changing; the entry of women into medical and dental schools is being limited substantially.

Handler: Some data clearly indicate that even the first step on the ladder is somewhat harder for females than males to take. In 1976 at graduation time, 4-5 per cent more male than female Ph.D.'s said they had jobs or assured postdoctoral appointments. Nearly 9 per cent more females than males were still seeking employment. Lots of evidence and a long history tell us that only continued pressure will ease that step; it will not happen spontaneously. Only pressure and, occasionally, perhaps, wielding a legal club will make that first step easier.

Romey: We have laws to prevent overt or covert discrimination. They must be enforced and women must be aggressive about it. I'm not a great believer in saying, "How could you do this to me?" because the very fact that they are doing it means they *can* do it. Women must demand justice, not mercy, as professionals. I believe with Dr. Handler that there is only one thing that gets attention in any society—democratic or otherwise—and that is pressure, political and economic pressure.

"Every single woman in this room was born of a woman, and spent nine months in the body of a person who was like her instead of a person who was different from her. Every single man was in the body of a person who was different—endocrinologically, kinesthetically, everything else. And those are facts, not stereotypes.

Margaret Mead

What Women Bring to Research

Excerpts from a paper on "Women and Men in the Natural and Social Sciences," presented by Margaret Mead, Conference on the Participation of Women in Scientific Research, Washington, D.C., October 19, 1977.

Dr. Mead's assumption was that women "might bring something different" to research. Whether this is due to experience in women's own lifetime; the accumulated experience of human societies for thousands of years, but not built in genetically; or genuine biological differences between women's and men's minds has not been discovered. "There's an enormous overlap, also, when you say 'a feminine mind' or 'a masculine mind.' Whatever you think the differences are, you'll find some attributes among the other sex and a very wide distribution of them within each sex."

A stereotype always holds some core of truth in it, which gets exaggerated or distorted, Dr. Mead noted. In talking about what women may contribute to different kinds of science, she cautioned her audience to "please remember that there are women who have virtually completely masculine minds." But nevertheless, she said, men and women—as they exist today, having been brought up in the present world—show marked differences in the way they tackle problems. There is a good possibility that women have unique capacities, even though these capacities are only based on women's individual life experiences, that are different from those of men. The question is—"are we going to lose them, pretend they aren't there, or use them constructively?"

Growing Up

At present, most boys and girls are brought up by women. In early childhood all over the world, Dr. Mead said, boys are told, " 'You're different; don't identify with me. Get off my lap; get out there into the world.' " And boys learn that the way to understand someone is to put themselves in the other person's place, no matter whether it is your wife or your boss, without any regard for the fact that the other person is different. "This often distorts the situation quite heavily," she said.

In contrast, girls are taught, from the moment they associate with their mothers, that other people are different, that other people may be hungry, for example, when they are not. "Every women who takes care of an infant learns to observe something other than herself," said Dr. Mead. "She does not understand by putting herself in the infant's shoes." Women, because they are brought up differently than men, have an extraordinary capacity to know that other people are different.

Studying Behavior

Most men doing any kind of work that involves human beings and animals think they themselves are some kind of animal. They try to understand animals by identification, Dr. Mead said—"If I were a graylag goose, how would I feel?" Women, on the other hand, have been taught to look at animals, or babies, as different from themselves. "This is an exceedingly important dimension of research," said Dr. Mead, indicating that extreme degrees of personification and anthropomorphism in some sciences in the past have not been helpful.

"Saying that the way to understand human beings is to have no feelings or emotions involved whatsoever is equally disastrous," she continued. "We either cut people up in little pieces and study the pieces, or we call them 'human components' of some kind of machine. Resistance in the human sciences to treating the human being as a whole person is very great. Not because the human sciences are soft or easy—they are much harder—but because they call for a kind of empathy. It's not detachment; it's knowing who you are and who the other person is, watching both, and using the interaction between the two as one of your tools."

Research Teams

On the whole, the bulk of research that is done today has to be done by teams, Dr. Mead pointed out. "Thus, a question gets raised regarding the complementarity of what women bring to research and what men bring to research." A woman interviewing a man is very different from a man interviewing a man, and vice versa. The same is true cross-culturally and cross-ethnically.

If one looks at the sciences today—moving from the most technical, such as astrophysics, to the most human, such as psychology and the study of human development, passing through biology, which is where they meet—it is clear that "we have a spectrum of scientific fields which call differentially on the kinds of behavior which men and women have learned as children and while they were growing up." At the human end of the scale, said Dr. Mead, "much more involvement in introspection and of empathy is needed if we are going to understand what's happening." And it may be that women are going to make a contribution to astrophysics, such as on an observation team, that will be different from the kind they make in the human sciences.

Choosing a Field

"The older a science is, the more pickled or fossilized masculine behavior is in it," Dr. Mead observed. " 'Can a

Participants Challenge Mead's Assumptions

woman sleep on Mt. Wilson?' was a great worry in astronomy, I remember." When women enter an old science, in which there have not been women, "you find there are all sorts of styles of behavior built into it that are not intrinsic to the science at all, but are simply things like where you sleep, or whether women can go on ships, or some piece of nonsense." Dr. Mead said he had the advantage of entering a new science, anthropology, which men hadn't been practicing, and thus setting the style for, over a period of years.

Women ought to ask themselves, said Dr. Mead, "What can I do as a person, given the state of the world, better than a man?" And if they don't feel they have anything to contribute as a woman, they ought to know that, too. There are women who do exactly the same kinds of things men do.

"But by and large, the best work at present in the human sciences is done by women, and there is a great difference between the sciences that recognize that fact and those that don't," said Dr. Mead. The sciences that recognize it are anthropology, clinical psychology, and psychiatry. The social sciences that don't recognize it are sociology, social psychology, and experimental psychology.

Q. Why do you so stereotypically limit the potential contributions of women?

A. What I contribute is what I contribute, not what women contribute. That I am a woman enters into it, of course, but it's not the main thing—not any more than whether you more efficiently use your eyes or your ears to observe. What a listener contributes is different from what a visualizer contributes. It isn't everything. I am talking about whether there is anything in the experience of women, at present, which makes their scientific work different, and there is nothing stereotyping about the fact that women were born of women.

Q. Do you have any more examples of sex-related differences in physical sciences?

A. As you move from the most abstract sciences, where the largest amount of detachment is required to be a good scientist, toward biology, you find more women. When they used to have a national science talent search and they wanted to let girls do well, they put in more biological questions. If they put enough in, the girls would do as well as the boys. But very few girls were taught to do well in physics and chemistry; many more were allowed in biology and so they picked it. Biology is a crossing point, where there is room for very abstract experimental work, which traditionally has been a male field, and there's also room for people who can see something.

Q. Several older women scientists have expressed regret at the years required by a scientific career away from their families. There seem to be incredibly few happy marriages with children in the study group. Do you regret having spent little time with your children because of your science?

A. No. I don't think anything could have been worse for my child than to spend all my time with her, and she agrees with me completely. My life and my science have always been tied together but, for the most part, we don't know how to have professional marriages because we've had so few of them. The professional world has been closed to women for quite a long time. If you do have two professionals in a family and their work takes them in different directions, you cannot run a residential marriage, so that fractured marriage is one of the prices people pay. The chances of having a happy marriage are greater if one partner is more interested in what the other one does than in what he or she does. That's usually the woman. Very few women want to marry men who feel the other way around. They won't put up with men who would rather look after the house and children than have a career. That may change, or it may be biological. It may be as it is in animals, where females pick a superior male. Women have been picking good providers for millennia. The question is whether they can get over doing so.

MARGARET MEAD was a world-famous anthropologist, noted for her numerous scientific honors, research activities, lectures, and publications. *Blackberry Winter*, an autobiography, is an insightful account of the life of a woman scientist. Other related books include: *Sex and Temperament in Three Primitive Societies*, 1935; *Male and Female*, 1949; *Family* (with Ken Heyman), 1965. Most noted for her early field work: *Coming of Age in Samoa*, 1928; *Growing Up in New Guinea*, 1930. Ph.D., Columbia. Curator Emeritus, American Museum of Natural History. Member, National Academy of Science.

Progress of Women in Science

Betty M. Vetter, *Executive Director, Scientific Manpower Commission*

Women are still a relatively small proportion of all U.S. scientists and engineers (about 13% of scientists and less than 2% of engineers) but that proportion has increased significantly since 1950, with the most rapid increase occurring during the 1970s.

The proportion of women scientists earning doctoral degrees, however, is still well below their proportion of the population and is only slightly higher than it was in the 1920s, when the last great wave of the drive for women's equality took place. In the intervening decades, and particularly during the 1950s when women's proportion of doctorates in science and engineering dropped to 6.7%, women settled into the role of homemaker in record numbers, while returning World War II veterans utilized the GI Bill to complete their higher education and move into positions of authority and responsibility in science. (See chart, page 2.)

In the past six years, the proportion of women earning doctorates in science and engineering has nearly doubled (from 9.7% in 1970 to 18% in 1977), showing increases in every field. But the most spectacular change in women's participation in science education has occurred at the bachelor's level in engineering. The number of women entering engineering has risen an astonishing 763% over the last eight years! Women made up 11.4% of the 1977-78 freshman class.

A new statistical study by the Scientific Manpower Commission shows that, except in a few fields, women's increased participation in career preparation has not yet been matched by increases in job opportunities, opportunities for promotion, or salary levels relative to men.

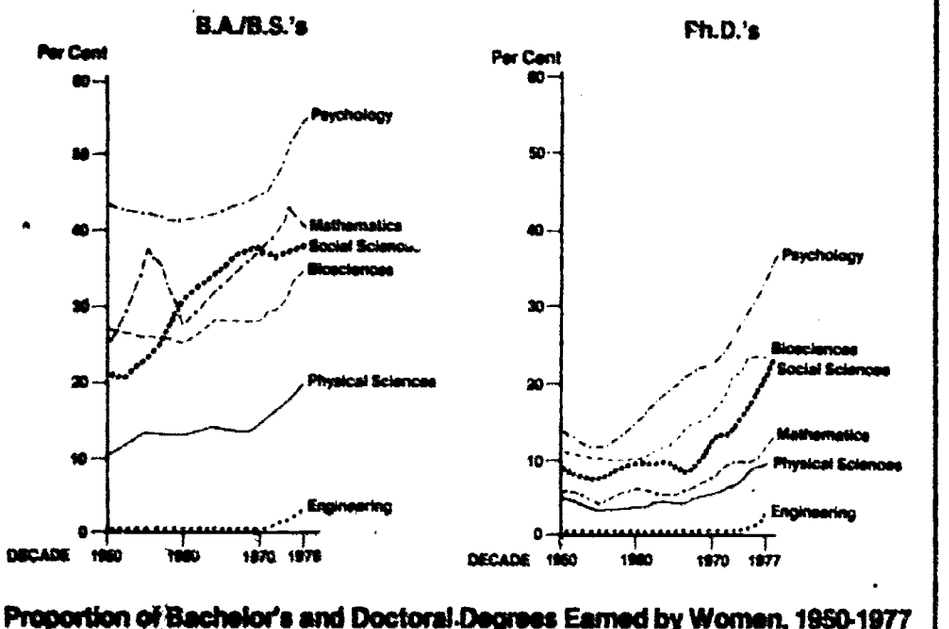
Unemployment rates of women have always been higher than those of men.* In the past, higher unemployment rates for women were accepted because it was assumed that women did not "need" to work. We know now that women and men work for the same reasons: to support themselves and their families and to seek advancement in their fields. Despite the legal mandate and moral persuasion to provide equal opportunity in employment, unemployment rates for women scientists continue to be two to five times higher than those for men.

Their increased numbers notwithstanding—to say nothing of the Equal Pay Act—women scientists still earn less than men in almost every field, at every age, and at every degree level. The salary gap between men and women increases with age and higher degree levels, and has widened over the past five years instead of narrowing. The one exception is in offers to new bachelor's graduates in engineering —a field where women are still very rare.

Some of these differences exist because women scientists are some-

*The unemployment rate is the percentage of the work force that is unemployed and seeking work. It does not include retired people or those not seeking work. The labor force is defined as people working, plus those actively seeking work.

Women are earning more of the degrees in science . . .

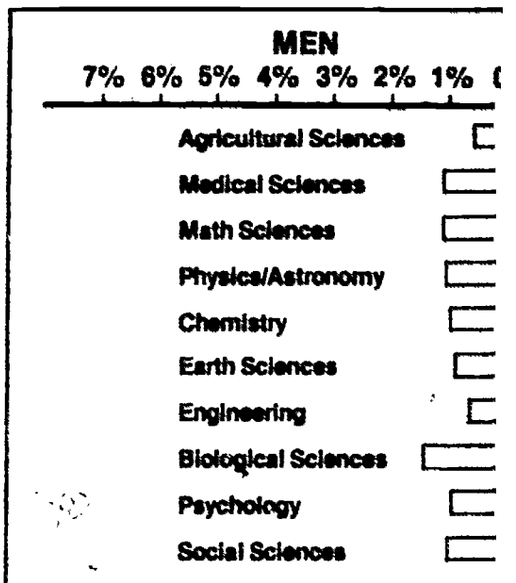


Proportion of Bachelor's and Doctoral Degrees Earned by Women, 1950-1977

SOURCE: U.S. Office of Education, series of *Earned Degrees Conferred*, 1950-1976

SOURCES: National Academy of Sciences, *Doctorates Awarded from 1920-1971*, and *Summary Report, Doctorate Recipients from United States Universities, 1971-1977*

but higher proportions of wom unsuccessfully seeking jobs.



Unemployment Rates of Doctoral Scien

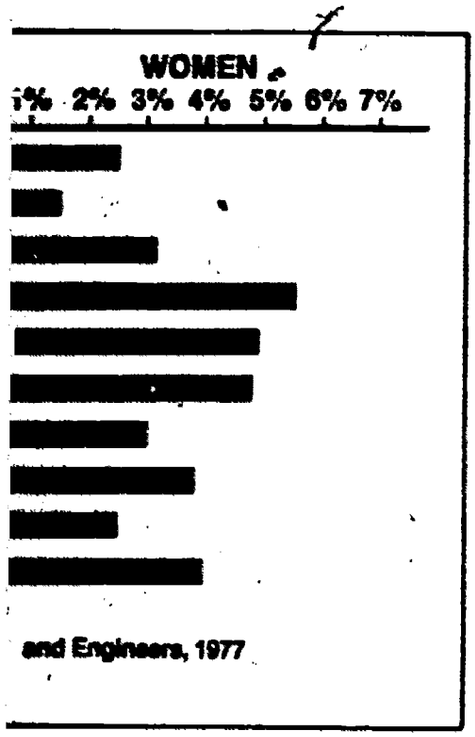
SOURCE: National Science Foundation

what less likely than men to be employed in industry, where higher salaries predominate. However, women typically earn less than similarly qualified men, whether their employment is in government, academic institutions, or industry.

Women are almost 16% of all scientists and engineers employed at colleges and universities, but they are more likely than men to be employed as junior faculty and nonfaculty research associates rather than as tenured faculty. They are also more likely to be employed in two-year and four-year colleges and less likely to be in universities than men.

Even among women who have attained faculty status, progress up the academic ladder still lags behind that

...as more doctorates are



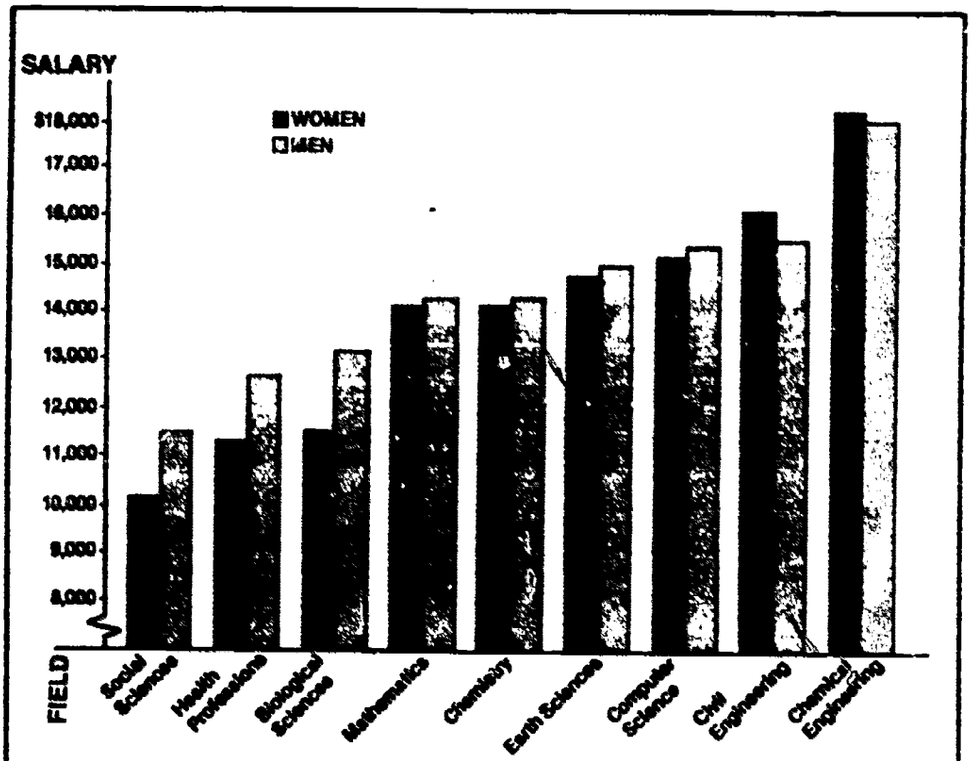
and Engineers, 1977

of men, including more recent Ph.D.'s. For example, by 1977, among Ph.D.'s who earned that degree between 1970 and 1974, standings were as follows:

Rank	Women	Men
Professor	2.0%	4.4%
Associate Professor	17.8%	29.5%
Instructor, Lecturer	18.2%	10.8%

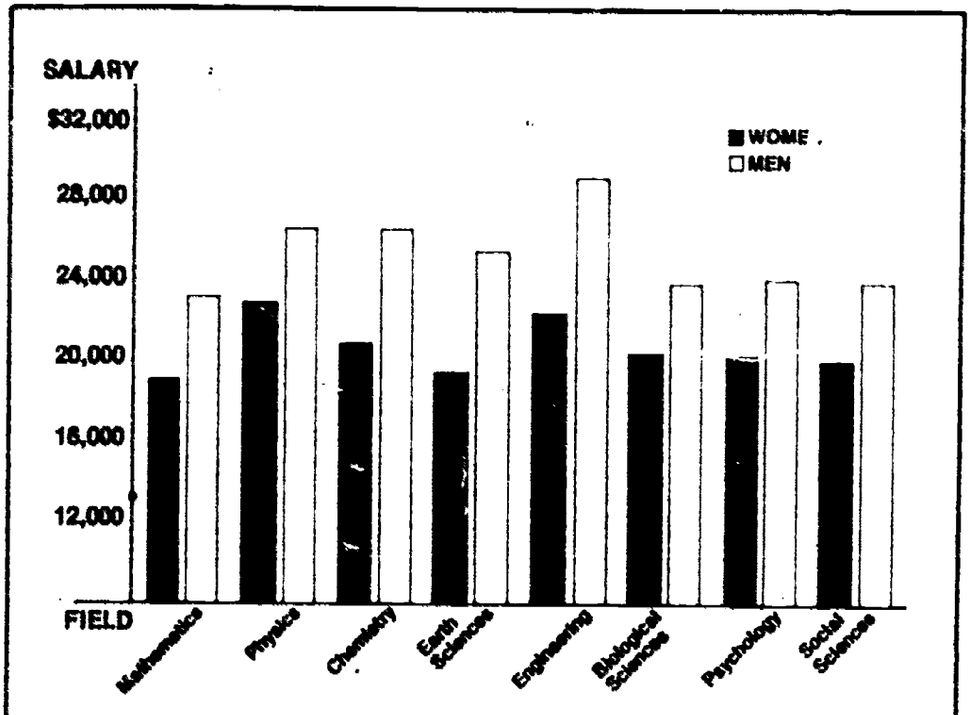
Women are more likely to be in the life sciences, psychology, and the social sciences, where salaries are generally lower, than in the physical

Women engineering graduates get higher beginning offers than men in 1978 . . .



Beginning Annual Salary Offers to Bachelor's Degree Graduates, 1977-78
SOURCE: The College Placement Council, A study of 1977-78 beginning offers by business and industry.

but women doctorates earn less than men in every field,



Salaries of Doctoral Scientists and Engineers by Field, 1977
SOURCE: National Academy of Sciences

(Story and charts continued on page 12.)

at every age . . . and the gap is widening.

1973 Salary Difference		1977 Salary Difference	
Under age 30	$1,580	Under age 30	$1,300
30-34	2,590	30-34	2,300
35-39	2,840	35-39	3,900
40-44	4,310	40-44	5,100
45-49	5,710	45-49	6,800
50-54	5,810	50-54	6,800
55-59	5,410	55-59	8,500
60-64	5,710	60-64	7,200
Over 64	5,240	Over 64	6,900
Overall gap	16.7%	Overall gap	20.5%

Dollar Amount of Men's Salaries Over Women's Salaries, Doctoral Scientists and Engineers, by Age—1973 and 1977

SOURCE: *National Academy of Science*

sciences and engineering. The salary differential between men and women also is wider in the fields with higher proportions of women.

Although most of the findings in the data compiled by the Scientific Manpower Commission regarding the progress of women in the sciences are fairly discouraging, there are bright spots:

- Increasing numbers of academically prepared women will also increase the proportion of women in the scientific workforce.
- Some indications show that salary and employment discrimination is lessening.
- Women bachelor's graduates in high-demand fields have low levels of unemployment and higher starting salaries relative to men. (Whether or not this trend continues to prevail as their careers progress bears watching.)

In the physical sciences, where unemployment is less, unemployment rates for recent graduates at the bachelor's level are about the same for men and women graduates. In the social, behavioral, and biological sciences, where more women are concentrated and more unemployment exists, unemployment rates are still significantly higher for women than for men.

Among women doctorates, the data indicate little improvement either in closing the salary gap with men or lessening the difference in unemployment rates. Nonetheless, scientists and engineers have higher earnings than many other professionals with similar amounts of education and women scientists are better off relative to men than are women in most other fields.

Charts designed by Jeanne Fisher, COMMENT

Professional Women and Minorities—A Manpower Data Resource Service is an updated and highly detailed statistical analysis of the participation of women and minorities in the professional U.S. labor force, recently published by the Scientific Manpower Commission, a participating organization of AAAS.

More than 350 tables and charts draw a comprehensive picture of enrollments, degrees, and employment in industry, government, and academic institutions.

Highlights include the findings that:

- Women and minorities are moving rapidly to obtain the education required for a professional career.
- Opportunities for employment and advancement, particularly for women, have not kept pace with their increased participation in career preparation.
- Minority men are progressing in the professional labor force at comparable rates with white men of similar credentials, while minority women are statistically comparable to majority women in their slower advancement.

Originally published in 1975, *Professional Women and Minorities* by Betty M. Vetter, Eleanor L. Babco, and Judith E. McIntire is a proven, indispensable tool for those concerned with implementing affirmative action. Available for $75.00 from the Scientific Manpower Commission, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036.

Opening Remarks

(continued from page 5)

the percentage of women doctorates seems to be increasing, I hope that we'll see a rise in applications.

The Foundation's activities that are specifically oriented toward women are:

1. A program of extramural grants and contracts to facilitate the entry and progress of women in careers of scientific research, science administration, research administration, and science education. (See Women in Science Program story.)
2. Special studies that track, monitor, and explain the condition of women in science. This conference is illustrative of this type of project. Others are carried out in the Directorate for Scientific, Technological, and International Affairs in the Division of Science Resource Studies, which gathers data for examining the utilization of women and minorities.
3. The Foundation's own internal policies as they relate to the employment of women on staff and their use in advisory and consultant roles. In the last several years, the Foundation has gradually increased the number of women at the professional and higher-grade levels and also their use in advisory boards. We're anxious to expand the pool of proposal reviewers and I invite those of you who are willing to become part of this process to send in your curriculum vitae and identify your areas of expertise.

The participation of women at the Foundation varies, reflecting their involvement, or lack of it, in different scientific fields. There are few women in the physical sciences. One-quarter of the economists at the Foundation are women, as are one-third of the biologists. Among geographers, we're 100 per cent—but that is because there's only one!

Women in Science

(continued from page 5)

plus additional training in a new field, such as computer science.

In 1978, renewal grants were made to about one-half of the projects supported in 1976, rather than funding new ones, and in 1979 about one-half of the 1977 awardees are expected to receive renewals. There are several

reasons for this method of operation: the need to wait for evaluation results to help define future directions, improvement of ongoing projects, and the hope that some of the projects might become institutionalized.

3. High school students are served by the Visiting Women Scientists Program at assemblies, classes, and meetings with students, teachers, and counselors. This program also provides career resource materials to the schools visited. Evaluation of the pilot program, in which 40 women scientists (out of 600 who volunteered) visited 110 schools nationwide indicates that "high schools are interested in such a program, that a large number of women scientists and engineers are interested in visiting high schools, and that such a program can be effective in encouraging girls to consider careers in science."

AAAS Study Method

The sample for the AAAS research study project consisted of 60 women and 60 men who had received science doctorates since 1971. This group was selected because most existing information on women's careers in science is based on the experience of women scientists who have already been successful. Data on women scientists in the launching stage of their careers were needed.

The women in the sample were drawn from three sources: nominations by women's science organizations, suggestions from science department chairs at major research-oriented universities, and lists of graduates of 10 other universities chosen for geographical balance. The men in the control sample came from these three sources, plus suggestions by the women scientists in the sample.

Three-fourths of the sample were in the natural sciences, mathematics, and engineering; one-fourth in the social sciences. The majority was pursuing research careers or combining research with teaching. Participants represented a broad range of disciplines, geographic regions, educational institutions, and work settings. They filled out a biographical profile, answered a survey on their attitudes and experiences, and wrote an essay on the rewards and difficulties of research careers in science. Forty additional women scientists were drawn upon as well.

More than enough women wanted to participate in the study, note the authors of the report on the study, but just barely enough men were found. Once found, however, they were "extraordinarily cooperative." "This behavior stands in contrast to earlier studies done in some of the scientific societies on the status of women," write the authors, "where the response from matching male samples was poor indeed and sometimes so thin as to be inadequate to provide the comparative data needed to draw definitive conclusions."

Several characteristics of the sample are noteworthy: most of these men and women grew up in the Sputnik era, when science and technology were national priorities. Most of them had white, middle-class backgrounds. Many—as the authors put it—"are in that terrible trial period between Ph.D and tenure." Among the women, there was a wide variety across the feminist/anti-feminist spectrum. The sample is too limited to have statistical significance for the entire scientific community, the report cautions; however, "the importance of the patterns that emerge . . . should not be denied because the absolute numbers are small."

Margaret Mead

Margaret Mead was the most famous person I have known well enough to call by a first name—not so unusual, because everyone called her "Margaret." That symbolizes the full extent of her accessibility to others. She was available to anyone who wrote or phoned or climbed the stairs to her attic study at the top of the American Museum of Natural History. She was mentor to students and advisor to governments. She encouraged a blind anthropology student to go off to do field work in Latin America. She shared her insights with thousands of readers through an extraordinary monthly column in *Redbook* magazine. (Her column and the story on page 8 were two of the last pieces she approved for publication.) She sat at AAAS meetings, talking with high school students about science. She sat through board meetings of the AAAS and advisory committees of women's organizations and gave us her counsel between the meetings. Her presentation at the AAAS Conference on Women in Scientific Research was squeezed in between an evening lecture in New York and another later in the day in Virginia, and she had to rise early to catch the 7 a.m. shuttle. She was indefatigable and seemed never to say "no" to a cause or request she thought worthwhile. She was the center of her own network, a network she leaves behind as part of her legacy.

Margaret Mead was also frequently the center of controversy. Some of the women at the Conference on Women in Scientific Research were angered by her address to them, disturbed by comments that seemed to them to identify as innate characteristics what they considered learned behavior, conditioned in a male-dominated world. We heard accusations that she was "anti-feminist." And indeed, Margaret was not a standard feminist any more than she was standard in anything she did or said. She celebrated the variety of human experience, even while she looked for human truths. My experience is like that which others had with Margaret. Whether terrified, angered, or delighted, one never came away from a lecture or exchange with her without some new kernel for thought. She synthesized information and generalized from her observations with a clarity and assertiveness that often violated accepted beliefs and provoked heated response. She seemed so confident, so sure of herself that she sometimes intimidated those around her, but in fact she was always open to new information, enjoyed a challenging argument, and readily changed her conclusions on the basis of new information. One did not have to agree with her to be awed, to be challenged to do one's best, and to learn from her.

We will all miss her company, but remain enriched by her presence.

Janet Welsh Brown
American Association for the Advancement of Science

Women in the National Academy of Sciences

The National Academy of Sciences is a highly selective honorary society which advises the nation on science and technology related issues. Its elected membership of 1,250 represents less than one-half of one per cent of American scientists.

One woman was elected to the National Academy of Sciences in the 20s, another in the 30s. Two women were elected in the 40s, three in the 50s, and three in the 60s. Twenty-eight women have been elected so far in the 70s.

The 32 living female members of the National Academy of Sciences represent 2.6 per cent of the current membership.

1925 **Florence Rena Sabin,** *anatomist,* Rockefeller Institute of Medical Research, New York City. Deceased 1953.

1931 **Margaret Floy Washburn,** *psychologist,* Vassar College, New York. Deceased 1939.

1944 **Barbara McClintock,** *botanist,* Cold Spring Harbor Laboratory, New York.

1948 **Gerty T. Cori,** *biochemist,* Washington University Medical School, St. Louis. Deceased 1957. Shared Nobel Prize in medicine 1947.

1956 **Maria Geoppert Mayer,** *theoretical physicist,* University of California, San Diego. Deceased 1972. Shared Nobel Prize in physics 1963.

1957 **Katherine Esau,** *plant morphologist,* University of California, Santa Barbara, Emeritus.

1958 **Chien-Shiung Wu,** *nuclear physicist,* Columbia University, New York City.

1961 **Libbie Henrietta Hyman,** *zoologist,* American Museum of Natural History, New York City. Deceased 1969.

1967 **Berta Vogel Scharrer,** *anatomist,* Albert Einstein College of Medicine, New York City.

1968 **Rita Levi-Montalcini,** *neurobiologist,* Laboratorio Di Biologia, Rome, Italy.

1970 **Ruth Patrick,** *biologist, ecologist,* Academy of Natural Sciences, Philadelphia.

1970 **Rebecca Craighill Lancefield,** *bacteriologist,* Rockefeller University, New York City.

1971 **Mildred Cohn,** *biochemist,* University of Pennsylvania School of Medicine, Philadelphia.

1971 **Eleanor Jack Gibson,** *psychologist,* Cornell University, New York.

1972 **Gertrude Scharff Goldhaber,** *physicist,* Brookhaven National Laboratory, New York.

1972 **Elizabeth Shull Russell,** *geneticist,* Jackson Laboratory, Maine.

1973 **Beatrice Mintz,** *medical geneticist,* Institute for Cancer Research, Philadelphia.

1973 **Helen M. Ranney,** *hemoglobin biologist,* University Hospital, San Diego.

1973 **Helen Brooke Taussig,** *pediatric cardiologist,* Johns Hopkins University, Baltimore, Emeritus.

1974 **Estella Bergere Leopold,** *research botanist,* University of Washington, Seattle.

1974 **Sarah Ratner,** *biochemist,* Public Health Research Institute, New York City.

1975 **Gertrude Mary Cox,** *statistician,* North Carolina State University, Raleigh, Emeritus. Deceased 1978.

1975 **Frederica Annis De Laguna,** *anthropologist,* Bryn Mawr College, Pennsylvania.

1975 **Dorothea Jameson,** *psychologist,* University of Pennsylvania, Philadelphia.

1975 **Margaret Mead,** *cultural anthropologist,* curator, American Museum of Natural History, New York City. Deceased 1978.

1975 **Rosalyn S. Yalow,** *medical physicist,* Bronx Veterans' Administration Hospital, New York City. Shared Nobel Prize in medicine 1977.

1975 **Dorothy Millicent Horstmann,** *epidemiologist, pathogenesist.* Yale University School of Medicine, Connecticut.

1976 **Charlotte Friend,** *oncologist,* Mount Sinai School of Medicine, New York City.

1976 **Julia Robinson,** *mathematician,* University of California, Berkeley.

1977 **Elizabeth Florence Colson,** *anthropologist,* University of California, Berkeley.

1977 **Elizabeth Fondal Neufeld,** *biochemist,* National Institute of Health, Maryland.

1977 **Ruth Sager,** *geneticist,* Sidney Farber Cancer Institute, Boston.

1977 **Evelyn Maisel Witkin,** *geneticist.* Rutgers University, New Jersey.

1978 **E. Margaret Burbridge,** *astronomer,* University of California, San Diego.

1978 **Mary Rosamond Haas,** *linguist.* University of California, Berkeley, Emeritus.

1978 **Isabella L. Karle,** *physical chemist,* United States Naval Research Laboratory, Washington, D.C.

1978 **Elizabeth C. Miller,** *oncologist,* University of Wisconsin, Madison.

1978 **Mary J. Osborn,** *microbiologist,* University of Connecticut, Farmington.

Mary Jo Strauss
--Research Consultant, Women's Studies

The American Association for the Advancement of Science, founded in 1848, is the world's largest federation of scientific organizations. It has 127,000 members and 280 affiliated societies. Its aims are to promote science, humaneness in science, and the well-being of scientists.

In 1973, AAAS created the Office of Opportunities in Science to develop programs, policies, information, and advocacy modes that would increase the number of women, minorities, and handicapped in the sciences and further their access, visibility, and status. A current project of the OOS is conducting a survey of programs in science and mathematics for women and girls since 1966. Programs directed to all age levels are eligible, as is work by any type of organization or agency. Projects of direct benefit to women and girls, as well as research, is included.

Anyone knowing of projects within the scope of this inventory are asked to contact Michele L. Aldrich, OOS-AAAS, 1776 Massachusetts Avenue, N.W., Washington, D.C. 20036.

Bitter with Sweet
(continued from page 3).

strong orientation toward research. Many more women than men attended liberal arts colleges, noted for their emphasis on teaching. These values may carry over into their professional lives and contribute to women's lesser positions in science.

* * * * *

• Graduate school was a high point for most women and men. "They write of the joy of discovery, of sharing with colleagues who have the same academic interests, of the excitement of being part of the research establishment."

• Women graduate students, however, soon get the message that they are different. By far the most often cited problem is the assertion that women students are not taken seriously. "Both men and women attested that the abilities and accomplishments of women were downgraded and discredited, that they have had to prove themselves over and over again, that they have had to 'do better' than their male colleagues."

• A further manifestation of not being taken seriously (as a woman, perhaps, but not as a scientist) is the surprising incidence of unwanted and improper sexual advances toward women students by male colleagues and faculty. Both unsolicited survey responses and discussions at the conference made it clear that this phenomenon "is widespread and professionally damaging to women scientists."

• A related matter is the opposite ways women and men view how women are graded by professors. Most men felt that women had it "easy," especially "if they're pretty," while the majority of women felt they were graded fairly or even more harshly than men.

• Many more women than men experience "professional isolation," being "left out of the semi-social get-togethers at which their male colleagues discussed everything from the solution to a particularly tough problem to the latest news about the availability of grants and jobs. . . ." Most scientists agree that such sessions are a very important part of professional development.

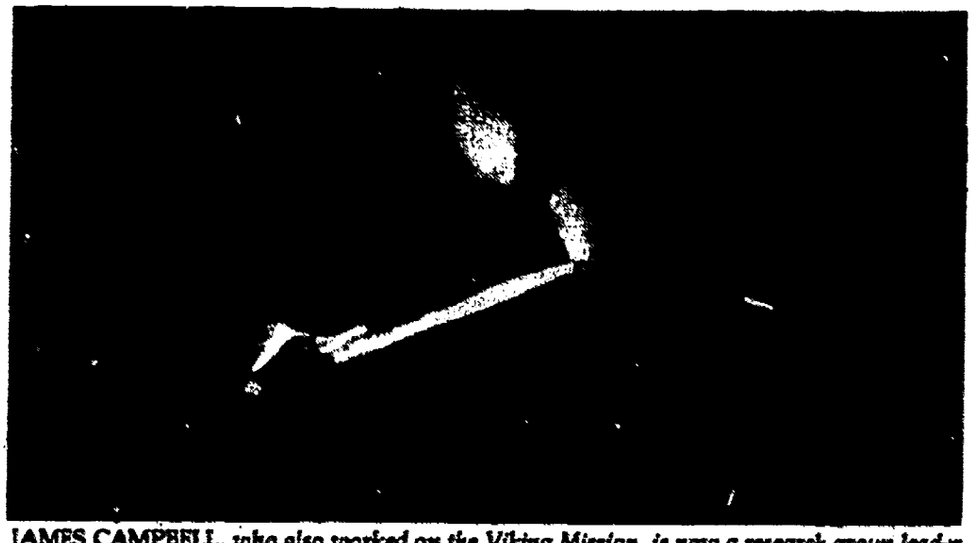
* * * * *

• Combining marriage and a career creates real tension for both men and women, but it is stronger for women and it intensifies with the decision to have children.

• Single women are at a greater disadvantage, socially and professionally, than single male scientists.

• Solutions so far to the conflict between personal and professional life are individual solutions, but they are amenable to institutional policy. Institutions need to ". . . review employment rules bearing on nepotism . . . look at flexible scheduling, part-time work and shared fellowships and employment . . . establish part-time tenure tracks and special leaves and research opportunities for productive scientists who are also parents of young children . . . re-examine the teaching loads and teaching assignments of their junior faculty and ask whether the demands made on young faculty are in fact incompatible with a healthy personal life."

JANET CAMPBELL *is a technical assistant in the Space Systems Divisions of NASA's Langley Center, where she does research on applying the remote sensing technology used in space to earth resources, such as measuring and monitoring the marine environment. As a statistician, Dr. Campbell took part in the Viking Mission to Mars, and is shown with a mockup of the lander used in those missions in 1976.*



JAMES CAMPBELL, *who also worked on the Viking Mission, is now a research group leader in the Subsonic-Transonic Aerodynamics Division at Langley, testing innovative concepts in deflecting airflow. Conducted in a wind tunnel, this experimental work is aimed at improving airplane performance, such as less fuel use, less noise, and more maneuverability.*

Copies of the report on *The Participation of Women in Scientific Research* may be obtained from the U.S. Department of Commerce, National Technical Information Service, Springfield, Virginia 22151. Request number: PB 288260. Paperback: $10.75; microfiche: $3.

Recommendations to NSF

"We know the statistics, we know the problems," said Janet Welsh Brown, head of the Office of Opportunities, AAAS. And now—as a result of policy recommendations prepared by the conferees—the National Science Foundation (NSF) knows what some of the answers and solutions might be.

Conferees were concerned about being "unselfish, yet self-serving," as one woman phrased it, in compiling their recommendations. They wanted science in general to be better served, while paying attention to women and minorities in particular. The crucial consideration underlying all their ideas, statements, strategies, examples, and suggestions is the expansion of the pool of "active and visible women scientists at all levels."

Following is the final list of policy recommendations emerging from the contributions of the conferees and subsequent work of the AAAS study staff. These recommendations have been submitted to NSF for consideration and action.

1. Recommendations for NSF policies and procedures related to advisory bodies, review procedures, and personnel. (No additional budget required.)

- Women should be appointed in appropriate numbers to all **advisory committees and task forces.** This will help acquaint women with the Foundation's planning and program evaluation procedures, as well as enlarge the males' understanding of the female experience, which is different from their own.
- Women should be appointed in appropriate numbers as reviewers of proposals, and data on the sex of all persons involved in the **peer review** system should be collected systematically.
- NSF should require all **grant recipients** to specify the sex of scientists who will be working on the project, and reporting requirements should follow the same pattern.
- In **recruitment of staff,** NSF should evaluate its current effort for women and minorities and establish new goals, making sure that minority women are not counted twice.
- Programs within NSF should be evaluated to assess their **impact on women.** How much of their research and planning resources is going into studies and other efforts which affect women?

2. Recommendations for changes in NSF programs on data collection, research, and science education. (No additional budget required.)

- NSF's **data collection and analysis** should be improved to provide the information necessary for analysis of the status of women in science. At present, much of it is not useful for explaining observed differences between men and women.
- High priority should be given to research to determine why the **attrition** of women from science in education and careers exceeds that of their male colleagues.
- Studies should be funded on the integration of women into scientific networks via a new examination of **patterns of scholarly collaboration,** with the aim of equalizing the situation for women students and employees.
- Since current opportunities for women are statistically greater in **industrial and governmental** research, NSF should support studies about women in these areas. Most existing research is on women in academia, where opportunities are limited.
- Further study of **productivity** should be conducted, including more than previous studies on differences between the social and natural sciences and patterns in specific disciplines. Different measures for different work settings should be examined, as should possible additional criteria.
- **Evaluation of existing science education programs** should be undertaken to examine the participation of women students, teachers, and researchers in them and their impact on female students.
- All new science education programs should be planned with the **inclusion** of females consciously in mind.

3. Recommendations for selected new programs. (Additional budget required.)

- Varied and **flexible research support programs for young scientists** should be instigated as a major effort. They should include small grants for junior faculty and scientists without institutional affiliations, part-time grants and fellowships, and provisions for exchange and rotation appointments. These new criteria should replace existing restrictions, enabling researchers to change fields, return to work after time out, adapt to market needs, and otherwise function in ways that assure highest productivity.
- Mechanisms for **industry/university cooperation** should be developed on a short-term basis to facilitate communication about research opportunities in the private sector to women graduate students.

Winding up the conference on the Participation of Women in Scientific Research was a press briefing called by Senator Edward M. Kennedy on S. 2550, the Women in Science and Technology Equal Opportunity Act, where he outlined the bill's aim and provisions. Left to right: **Victoria Chan-Palay,** *Department of Neurobiology, Harvard Medical School;* **Janet Brown,** *Program Head, OOS-AAS;* **Senator Kennedy,** *D-Mass.;* **Cora Marrett,** *Department of Sociology, University of Wisconsin, Madison; and* **Barbara Krieger,** *Department of Chemical Engineering, University of Washington, Seattle.*

From Research to Action

Our system has allowed young women to come too late to the realization that without four years of math in high school their future careers will be limited to just five fields—humanities, music, social work, elementary education, and guidance counseling.

Senator Edward M. Kennedy (D-Mass.)
Address to the National Science Teachers Association
April 7, 1978

On February 21, 1978, Senator Kennedy introduced Senate bill S.2550 which would seek to remedy the situation cited. The "Women in Science and Technology Equal Opportunity Act" would establish a ten year, $250 million dollar program aimed at encouraging the participation of women in scientific and technical careers by removing some of the education, cultural, and institutional barriers which have resulted in a gross underrepresentation of women in science. Kennedy chairs the Subcommittee on Health and Scientific Research of the Committee on Human Resources, which oversees the NSF efforts on behalf of women and minorities.

One of S.2550's important specifics concerns elimination of the now existing "math filter," which turns women away from careers in science at an early age. The seemingly simple choice *not* to take a math class in high school can effectively exclude a young woman from 96 per cent of all careers later on, notably high-level careers. Kennedy's bill would promote math/science education for women, especially at the junior high school level, and establish research and information programs to interest and motivate women to enter scientific and technical careers.

"The plight of women in science has not been a primary concern of the scientific community," said Anne Strauss, professional staff member of Kennedy's subcommittee, recently. Kennedy's bill is the first of its kind and offers the potential for forging a link between the profession and equality of opportunity.

The bill also addresses the need for basic science literacy in everyday life. Competency in math and science is essential for anyone who ever wants to balance a checkbook, take a baby's temperature, compute overtime pay, figure interest on a loan, or function efficiently in a technological society.

Hearings on S.2550 were held April 10, 1978, at the same time as the annual authorization for the National Science Foundation. The bill has been mailed out extensively to get additional comments prior to redrafting. On the basis of over 400 comments received to date, some change in emphasis may be expected. "The revised bill will reflect those comments," said Strauss, "and will be reasonably close to a bill that can be sent to the Senate floor. We expect to hold a day of hearings, as part of a series of hearings on issues of concern to women, and to move the bill forward." No similar bill was introduced in the House in 1978, but there may be some action on the House side in 1979, Strauss indicated.

The conference on the Participation of Women in Scientific Research held in connection with the research study project of the Office of Opportunities in Science, American Association for the Advancement of Science, had two main purposes:

- **To add to the general body of knowledge about young women's career patterns in science through the accumulation of data and discussion;**
- **To convert this information into recommendations for new policies designed to increase the participation of women in scientific research.**

A third purpose was to disseminate the information gained from these activities widely to stimulate public interest and action. This publication, supported by the National Science Foundation under purchase order number 78-SP-1219, was prepared by Jo Hartley, Editor/Publisher of COMMENT, A Research/Action Report on Wo/Men, as part of the dissemination effort.

ABSTRACTS

The following material related to the participation of women in scientific research comes from several sources. Marrett and Walbot prepared papers, based on data from the AAAS research study project, for presentation at the AAAS Annual Meeting, Washington, D.C., February 1978. Astin's summary of the literature on scholarly productivity served as a background paper for the conference and is supplemented by material from conference participants incorporated into the final report. Odegaard's discussion paper, also prepared for the AAAS Meeting, 1978, sets the scene for an in-depth analysis of the particular situation of minority women in science, the result of a 1975 AAAS conference.

MARRETT, CORA BAGLEY. "Entering the Sciences in the Post-Sputnik Era."

The AAAS research study project, designed to portray the "post-Sputnik" era scientists and to compare the experiences of men and women, found that these scientists, paralleling those in prior periods, chose this field because they had the interest, ability, and backing to do so.

The patterns reported for the sample in this study are suggestive only, not descriptive of all young American research scientists. Autobiographical statements augmented questionnaires which covered demographic and attitudinal topics. Because women are overrepresented in the sample, the composite image could more closely describe female than male respondents.

Responses suggest that, while typically the subjects grew up with siblings and a disproportionate 43 per cent of those with siblings were first-borns, family size and sibship position are merely surrogates for the quality and quantity of interaction within the family. Some attributed their intellectual growth directly to the family make-up, while others implied that family configuration interacting with socioeconomic variables accounted for their career decisions.

Corroborating earlier research findings that scientists come from the ranks of middle-class, educated professionals, this study suggests also that the individuals *image* of his or her family's resources, drawn from comparisons with neighbors and acquaintances, may influence the career choice. There is no consistent data that caliber of undergraduate institution is a contributing factor.

Respondents indicated that at the time they were choosing vocations sciences were respected and well-financed. Now they are concerned about impending reductions in support, overcrowding which forces the talented and trained into unfitting jobs or out of science altogether, and government's role in the tenure and funding problems of current careerists.

Nevertheless, the responses contain a sense of continuing excitement and unending fascination with systematic inquiry and stress the significance of the role of parents and teachers.

—Department of Sociology, University of Wisconsin-Madison

WALBOT, VIRGINIA. "On the Financial Aids Received by Survey Participants during Undergraduate, Graduate, and Postdoctoral Education."

This analysis of undergraduate and graduate male and female science students' finances from the AAAS research study project discusses funding sources, extent of federal support, and respondents' perceptions of their money problems, and presents recommendations.

For undergraduates, the major supports were family contributions and scholarships, followed by loans and job earnings, with a shift toward a heavier student contribution in the mid-sixties. The major sex-related difference occurred in students' earnings. A higher proportion of males than females earned money for college. Married men earned more than three times as much as married women, and unmarried men twice as much as unmarried women.

At the graduate level, science students switched to almost exclusive dependence on fellowships or teaching and research assistantships, with men only slightly more likely to have received government or foundation support.

Respondents' essays revealed contrasting concerns about financial aid. Most women considered being female disadvantageous in obtaining aid, although men thought women had an advantage. Most married men, while feeling guilty, expected wives would support husbands through graduate school. Men emphasized their financial problems, whereas women considered them secondary to concerns about self-confidence, marriage vs. career, and dealing with faculty. Only 13 per cent of the women mentioned low salaries as a disadvantage of the career choice, while 40 per cent of the men did.

To motivate women and minorities toward the sciences and to increase both their numbers in graduate science departments and their own self-esteem requires equalization of funds available to all students; abolition of base pay differences for typical student jobs held by males and females; increased support for and numbers of summer science programs, research opportunities, competitive fellowships, and student stipends, and directed financial support for these target groups.

– Department of Biology, Washington University, St. Louis

ASTIN, HELEN S. "Factors Affecting Women's Scholarly Productivity." Chapter in *The Higher Education of Women: Essays in Honor of Rosemary Park*, Helen S. Astin and Werner Z. Hirsch, editors. New York: Praeger Publishers, 1978.

Previous studies on scholarly productivity as demonstrated in published works indicated that universities provide the most conducive atmosphere for research, science is the most productive specialization, and full professors and younger

faculty publish more than those from intermediate ranks. Women's acknowledged lower productivity results from their greater concentration in humanities and education, their employment in colleges, their greater involvement in teaching, and the fact that fewer women hold doctorates.

This examination of training and employing institutions, specialization, and rank as variables found that, contrary to current folklore, the career paths of men and married women are more similar in educational preparation, field of study, and publications than are those of men and single women, dispelling the tendency to attribute academic women's lower status to constraints of marriage and family life.

Emerging from the study as important predictors for all faculty are pure and applied research in the biological and physical sciences for published articles, work in humanities and education for published books. Also associated with overall high productivity are current employment at a university and graduate study support from fellowships, scholarships, or research assistantships.

For married and single women, the common predictors are age, previous university employment, and the quality of the highest degree-granting institution. For married women, a former nonteaching research position predicts productivity. Unique predictors for men are current university employment in the Northeast, engagement in policy research, and being married.

Negative predictors for women are employment at a women's or a southern college and teaching assistantship support during graduate school.

The exceptional finding that married women assistant professors are the least productive is possibly attributable to their being more likely to have young children. Among single women, full professors tend to be less productive, possibly because a higher proportion of them hold administrative responsibilities.

The findings indicate that married women are more productive than single women, and this productivity increases dramatically with rank, so that, among full professors, married women tend to be more productive than men. This suggests that judging married women on the basis of their performance as assistant professors might not do justice to their potential.

—Graduate School of Education, University of California—Los Angeles

Other Measures of Productivity

Conference participants defined productivity to include teaching, counseling, serving on committees, attending professional meetings, and participating in caucuses as well as publishing, and noted that different employers and different sciences assigned different weight to such factors in evaluating work.

Despite her concentration on publishing, Astin cites earlier reports of women's greater interest in teaching and their heavier teaching loads than men. This emphasis on teaching may reflect women's greater undergraduate experience at liberal arts colleges rather than at research universities. The group agreed that student and colleague evaluations of teaching should be based on criteria clearly stated in writing and made available in advance to all who were to be judged by them.

Publishing Politics

Participants questioned the worth of much that is published, pointing out that rigorous scientists may publish only exact, comprehensive results of research and thereby be considered insufficiently productive. The compulsion to publish often results in premature reports requiring subsequent correction. The practice discourages long-term study and, for some, hinders pleasure in research for its own sake. Some professors use students' work without credit. In effect, hard work is not always reflected in publishing activity.

Problems in the publishing process itself came under scrutiny. Discussants distinguished between publication in reviewed vs. unreviewed journals, noted the inconsistency of rejection and acceptance of the same papers, and questioned the quality of reviewers' work and the degree of their expertise.

Co-Authorship Question

The conferees noted a difference in co-authorship patterns between men and women in the sample. Men co-authored publications, while women's names appeared more often as single authors—a reflection, possibly, of the isolation which has been identified as a disadvantage women scientists suffer. The value of collaboration in research and in acquiring grants underpinned their concern about imperfect collegial and mentor relations which inhibit productivity.

Another difficulty in co-author arrangements was being considered by colleagues as the junior author on a paper co-authored by a male. Examples showed that, in a team effort, a woman who did three times as much work as the men was seldom first author on their papers. A woman doing computer research at home could not get her papers published until a friend gave her associate status in his department.

In comparing their productivity with men's, the participants viewed themselves as having more varied interests, disliking isolation, less ambitious and less self-confident, more critical of their own work, more approachable by students and colleagues, and hence more prone to be interrupted. Women also attributed differences in productivity to institutional conditions: low job status, limited authority, nonresearch duties, inadequate undergraduate assistance, poor access to facilities and equipment, and lack of funds.

The women concluded they should be better informed about their rights to credit in published research and more assertive about asking for it. And one participant, from her own study of junior faculty, challenged women to develop a more realistic evaluation of their work and greater selectivity in how they spend their time—i.e. more of it for research and publishing.

—Jean Lamden
Abstracts Editor, COMMENT

ODEGAARD, CHARLES E. Comments on Science Education for Women and Minorities.

Women and minorities are still seriously underrepresented in science careers and science-based professions.

To correct this imbalance, schools and colleges must inform women and minorities of science career possibilities and preparatory educational programs, help them acquire skills, and provide both psychological and academic supports for the special strains and loneliness which they encounter in an environment still dominated by men and the white majority.

Intercommunication among teachers and counselors at all levels of the educational process is necessary to assure these special groups access to higher institutions, which, in turn, must set an example for potential employers by themselves hiring women and minorities.

Existing programs for educational counselors to alter attitudes, summer programs in math and science, promotional visits to schools by women and minority scientists as role models, and internships in scientific laboratories require increased financial support. Problems arising from charges of reverse discrimination must be overcome.

For all these efforts to succeed, however, a substantial issue remains. The commitment of the majority to change requires a deep, rational understanding of racial prejudice, its causes, and how it operates, in both personal and institutional forms. More of us need to know more about the conflict of cultures and the subtle and varied ways in which we, ourselves, are involved as actors and doers.

The study of our society's subcultures, an area unfamiliar to most majority Americans, should find a place in the curriculum for majority and minority alike. Those in educational institutions who would encourage minorities need to learn about them. Adjustments and mutual understanding are required from both sides in this social, cultural, and psychological exchange. The problem with minorities must be perceived as a problem with the majority, as well.

Similarly, to open up science careers for women requires a serious study of sexism in our society, as it affects both men and women, and the development of a teaching curriculum to analyze their conflicting interrelationships.

President Emeritus, University of Washington, Seattle

Minority Female Scientists

In December, 1975, under AAAS auspices, 30 scientists in the general fields of biological and physical science, engineering, mathematics, and health care delivery met to define and illuminate "the double bind." They were minority female scientists—victims of the double bind of racial and sexist prejudice—women who had withstood these combined stresses, plus strong cultural traditions, and still had become scientists.

As Dr. Odegaard points out, most of the negative experience dealt to minority women is unconscious, and the conferees at this earlier conference agreed the first step toward effecting change is to create awareness on the part of the majority.

What had been these scientists' common experience in their communities, in school, and on the job?

Although their minority cultures differ, these Black, Mexican-American, American Indian, and Puerto Rican women were alike in that they had experienced racism as children and adolescents and sexism in their graduate training and careers. Because special programs for women are usually geared to majority women and programs for minorities to minority males, these individuals found they fell into the cracks between. The minority woman was seen as different in both the scientific community, which was dominated by white males, and in her own cultural group because she had chosen a nontraditional career.

As positive forces in early family life, the conferees were encouraged toward education for their own security and independence, and it was assumed that women would work outside the home. On the other hand, negative experiences resulted from special cultural barriers to careers in science based on traditional views of marriage roles and conceptions of relatives about women's priorities.

These minority women also found that schools offered inadequate counseling and failed to accommodate their cultural differences. Those who had attended segregated ethnic schools complained of inferior equipment and facilities. Graduates of integrated schools reported they had met challenge and competition but, as minority women, they were often patronized and teachers held lower expectations for them.

When they were ready for college, the conferees found themselves unprepared. Graduate school was more of a struggle because they were excluded from informal study groups. Pressure to choose a traditional career, to marry, to remain in or return to the community of their youth was constant. Those who married felt the conflicting demands and responsibilities of family life.

On the job, minority women scientists encountered discrimination in hiring, differences in salary and benefit packages between men and women, differences in types of assignments, and unfair promotion practices. Repeatedly, they were forced to reassert their competence and work around the hazards of tokenism. They were often the targets of sexist language, insults, and insinuating social gestures and advances.

Among results of the conference directed specifically toward improving the status of minority women were recommendations to the media for increased visibility and presentation of new images of minority women scientists, to educational institutions for the selection and training of role models to help with language and cultural difficulties, and to all involved institutions for the preparation of fair tools for measuring capacity and achievement.

The conference report, *The Double Bind: The Price of Being a Minority Woman in Science*, by Shirley Mahaley Malcom, Paula Quick Hall, and Janet Welsh Brown (AAAS, April 1976, from which this material was extrapolated) was directed to employers of scientists and engineers; to policy makers and administrators in education, government, and funding agencies; to university faculty; and to school administrators and teachers.

—*J.L.*