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ABSTRACT

These proceedings are divided into three sections entitled: (1) Introduction, (2) Role-Model Presentations, and (3) General Status of the Women's Rights Movement. Speeches related to each section are grouped by topic. The report also includes appendices with the conference program and a list of conference attendees. (HLM)

CAREER GUIDANCE FOR WOMEN ENTERING ENGINEERING

Edited by

Nancy D. Fitzroy

PROCEEDINGS OF AN ENGINEERING FOUNDATION CONFERENCE
New England College, Henniker, New Hampshire
August 19-24, 1973

CAREER GUIDANCE FOR WOMEN ENTERING ENGINEERING

Nancy D. Fitzroy
Conference Chair'n

Sandford S. Cole
Director, Engineering Foundation Conference

PROCEEDINGS OF AN ENGINEERING FOUNDATION CONFERENCE
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SPONSORSHIP

The Conference was cosponsored by the Engineering Foundation and the Society of Women Engineers, with the cooperation of the following societies:

- American Institute of Chemical Engineers
- American Society for Engineering Education
- American Society of Mechanical Engineers
- Engineers' Council for Professional Development
- Institute of Electrical and Electronics Engineers

ACKNOWLEDGMENTS

First, our thanks to Professor John B. Parrish, who served as the Conference Vice-Chair'n. John's experience in working with bright young women college students and the experimental courses which he ran on their behalf at the University of Illinois provided invaluable insight into planning the format of the overall program.

Second, appreciation is due my very capable committee chair'n, who led the daily sessions and followed the myriad of details which such a program with published proceedings entails. They are (in order of their appearance on the program):

Session Chair'n	Session Vice-Chair'n
Alva T. Matthews	Arminta J. Harness
James A. Mason, Jr.	Carolyn F. Phillips
John B. Parrish	Martha I. Beach
Della M. Roy	Josefina E. Sabadell

Third, we who planned the program for this conference are particularly indebted to those who made financial support available to the Society of Women Engineers for the conference. Without such contributions we could not have enjoyed the participation of many of the practicing women engineers from academia, industry, and government, nor of the fifty women engineering students who attended. As a small token of our appreciation to these contributors I have listed them below:

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University of Illinois

We are also indebted to the Honorable Jacqueline G. Gutwillig, Chairman of the Citizen's Advisory Council on the Status of Women, by appointment of the President, for her assistance in contacting speakers at the national level.

Nancy D. Fitzroy
Conference Chair'n

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Part I

INTRODUCTION

THE SOCIETY OF WOMEN ENGINEERS -- PAST AND PRESENT

Naomi J. McAfee*

National President
Society of Women Engineers

As President of the Society of Women Engineers it is my pleasure to welcome you to Henniker III. With that you might ask, What were Hennikers I and II? In 1971, the Engineering Foundation and the Society of Women Engineers cosponsored a Conference entitled "Women in Engineering -- Bridging the Gap Between Society and Technology." This was followed by another Conference in 1972, entitled "Women in Engineering and Management," and here we are in 1973, continuing the trend to lead society from darkness into light with "Career Guidance for Women Entering Engineering."

The conception and formation of the Society of Women Engineers was a gigantic step. A step that was born of bold thoughts, a willingness to accept risk, an unwillingness to accept the status quo, and a desire to induce change through the peaceful process of education. All of this started in 1949, when small groups of women in Boston, New York, Philadelphia, and Washington, D.C. started meeting. There were only 50 people altogether and they banded together to share their collective experiences. Their basic purposes were:

- To make known the country's need for women engineers.
- To encourage young women to consider an engineering education.
- To inform young women, their parents, counselors, and the general public of the qualifications and achievements of women engineers and the opportunities open to them.
- To serve as a center of information on women in engineering.
- To encourage women engineers to attain high levels of educational and professional achievement.

These are still the purposes and objectives of the Society of Women Engineers.

In 1952, two major events occurred. One was the incorporation of the Society (this was done at a grand cost of $1.50), and the second was the initiation of the Achievement Award. The Award honors outstanding women for notable achievement in engineering. To date there have been 22 winners and we are fortunate to have the last three Achievement Award Winners with us today. They are: Dr. Alva T. Matthews, the 1971 Award Winner, who will chair Tuesday's Conference session; Nancy Fitzroy, the 1972 Award Winner, who is the Conference Chairman; and Dr. Irene Peden, the 1973 Award Winner, who will act as a role model.

*Engineering Manager - Quality and Reliability Assurance
Defense and Electronic Systems Center
Westinghouse Electric Corporation, Baltimore, Maryland

The next historic event occurred in 1953, when the Lillian Moller Gilbreth Scholarship was established. This scholarship is given annually to a junior or senior woman engineering student of outstanding achievement and potential. Dr. Gilbreth, in whose honor the scholarship is named, was well known for the many contributions which she made to the fields of industrial engineering and management

The next gigantic step occurred in 1961, when the Society established its headquarters office in the newly opened United Engineering Center in New York City. There SWE joined many of the engineering societies representing specific engineering disciplines, as well as the Engineers Joint Council and the Engineers' Council for Professional Development.

In 1964 the Society made a huge step forward by sponsoring the First International Conference of Women Engineers and Scientists. The Conference was held in New York and was an outstanding success. Another event occurred that year, unrelated to SWE, which may have contributed to some of the Conference's success; that was the passage of Title VII of the Civil Rights Act. Title VII states that employers shall hire individuals without regard to race, creed, national origin, or sex. It has had a significant impact on subsequent events both within and outside SWE.

Following the First International Conference in 1966, SWE established the Rodney D. Chipp Memorial Award. The Award recognizes significant contributions to the advancement of women in the engineering profession by an individual, group, or corporation. It was established as a memorial to the late Mr. Rodney D. Chipp, internationally prominent engineer and husband of Dr. Beatrice A. Hicks, first national president of SWE. There have been two recipients: Col. Clarence E. Davies and Dr. Alfred E. Ingersoll.

In 1967, a separate autonomous organization known as the Men's Auxiliary of the Society of Women Engineers was established by husbands, relatives, and friends of SWE members.

We then moved from the cautiously conservative 60's to the torridly turbulent 70's. It was a time to pause and take stock of where SWE was, where it had been, and where it was going. Looking back, it seems that the Society moved forward very slowly in the 21 years from 1949 to 1970. Many factors contributed to this, but the heroic women who nurtured the Society and made it it grow during this period operated on faith alone. What is faith? Well, the best definition that I have seen is in the King James version of the Bible; specifically, Hebrews 11.1: "Now faith is the substance of things hoped for, the evidence of things not seen."

As we moved from one decade to another we entered a time of significant social change. The attitude about women was changing throughout the country. Suddenly they were in the spotlight, emphasis was being placed on their needs and desires -- SWE's programs kept pace with this change. In 1971 the Con-

ference on "Women in Engineering -- Bridging the Gap Between Society and Technology" was held, and in 1972 the Conference on "Women in Engineering and Management" was held. Also, in 1972, SWE changed administrations. As SWE moved from one set of standard bearers to another, it found that it had begun a new decade. It moved from leaders who were the initiators and movers of the Society in the 1950's to those who joined the Society in the 1960's. The latter were tempered by a different set of environments, motivations, opportunities, and rewards. The Society had progressed from struggling for its existence, financially, to the point where it is almost self-perpetuating. As a result, it is now able to start working on its goals more fully. The financial problem has eased -- but has not disappeared; money always seems to be a problem. However, the original programs are being evaluated and reoriented as required and fewer trade-offs or put-offs of programs are necessary.

This leads us to today; where are we in relation to the goals which were established for this administration? Well, let's see.

The first goal was to improve the professional image of SWE by such means as affiliating with other professional societies and working closely with other technical groups. To achieve this, a multipronged program was established. This included working with other professional women's organizations as well as with professional societies.

First, SWE has been working with the Federation of Organizations of Professional Women since its inception November 18, 1972. This work consisted of the SWE President serving as a member of the Organizing Steering Committee and as Chairman of the Bylaws Committee. The purpose of the Federation is "to provide member organizations with a mechanism for combining their efforts to optimize the position of women in American society by promoting equality of opportunity in education at all levels and in careers in all fields." The Federation has 25 affiliates; SWE is not among them. However as soon as the Federation's bylaws are approved and its tax status established a recommendation will be made by the Executive Committee to the Council of Section Representatives as to whether SWE should become an affiliate.

Second, the Society of Women Engineers - National Society of Professional Engineers liaison agreement was signed on February 20, 1973. With this act SWE joined with ten other professional technical societies in an attempt to establish a united engineering community. There is some concern within SWE as to the long-range impact of this agreement. Only time will tell. However, SWE's name cannot be used on any agreement or in conjunction with any position paper without the express written agreement of SWE. Let me describe some of the events that have taken place since the agreement was signed on February 20, 1973.

On February 26, 1972 I attended a meeting of all of the liaison society presidents. Immediately, each of the presidents offered to give SWE a list

of names of his society's women members; that is, where they could be identified. Ironically, almost all groups have removed sex from their records and can only identify a woman by her given name. SWE doesn't have that problem!!!! For the first time in the history of SWE the membership chairman was crying aunt. This really isn't the significant result of the affiliation. The possibility of gaining new members is good, but only a tidbit. Immediately (within six hours) upon signing the liaison agreement the National Academy of Engineering (NAE) requested SWE to submit names of women engineers qualified to serve on Advisory Committees, and the National Academy of Sciences (NAS) requested SWE to nominate women engineers to participate in the Conference on Women in Science and Engineering. Both requests were fulfilled immediately.

The NAS Conference on Women in Science and Engineering was held June 11-12, 1973. The purpose of the conference was to determine ways of increasing the participation of women engineers, scientists, and physicians in the activities of the NAS, the NAE, the Institute of Medicine (IOM), and the National Research Council (NRC). The major item discussed by the conference group of 16 members who represented various women's professional organizations, 15 staff members from NAS, and five guest speakers was the identification of qualified women to serve on the advisory boards within the NAS-NAE-IOM/NRC. Each conference member was asked to submit names of qualified women engineers and scientists whose research interests and qualifications seem to match those of the NRC committees. SWE submitted the names of 44 women engineers who are qualified to serve on the NRC. The Conference Recommendations and Report was submitted to NAS July 2, 1973 and is being reviewed. The prime recommendation was that a woman member of the NAS should be added to the advisory committee of the NAS Forum and women members should be included in the planning committees for future Forum and NRC activities. The NAS currently has 1024 members, of whom 13 are women.

Perhaps all of this was coincidence. History indicates that it was not. For the past three years SWE had been actively trying to infiltrate the National Academy of Engineering without success. It appears that the profession needed for SWE to make some overt move to show that it was both willing and strong enough to stand and be counted for those things in which it believes: equality of opportunity based on ability -- promotion and advancement based on demonstrated capability. This it has done, and the gains have been significant.

On August 7-8 1973, SWE participated, for the first time, in the ECPD-sponsored Joint Societies Forum (JSF). Thirty-four engineering societies were invited and 27 sent representatives to the meeting. The JSF was established to serve as an informal get-together of the elected chief officers of the technical engineering societies, and as such is not an action group. The subjects considered were: efforts for greater engineering unity; the outlook for engineering education, advanced program accreditation — first year experience; and whether engineers can effectively reach the people who are

responsible for social change and legislation. The two-day session allowed ample opportunity to meet the other engineering societies' leaders and to share with them SWE's challenges and how it is planning for tomorrow. So we continue.

The second goal was to reevaluate the objectives and establish long-range plans by developing programs which will implement the objectives. This has been done. The original goal of the Society was to make known the need for women engineers and to encourage young women to consider an engineering education and career. The Long Range Planning Committee has determined that these goals are as sound today as they were in the 1940's and will probably be as valid in the 1990's as they are now. SWE is actively pursuing them with some of the following programs.

It has been recognized that convincing youngsters to pursue anything is a job that begins the day they are born and must be followed until they finally make a career choice. This effort must start before school and follow all the way through. It is too late to begin in high school. SWE's efforts to reach the youngsters (preschoolers) started in July 1972, with an initial contact with the Women Doctors Association to work with them in helping the Mister Rogers television show put across to children the idea that professions are not restricted to one sex or the other. The first of these shows has been completed with the advent of one of SWE's young members talking to a precocious four-year-old about her career in engineering. More shows are planned, but the scripts aren't complete.

Next, we are trying to develop a book for preschoolers. Herein lies a gigantic problem. Engineers can communicate -- although they do have trouble occasionally getting their peers to understand what is being said; they are notoriously poor in written communication, and when you try to take what is your adult lifework and write it in terms that a 3-, 4-, or 5-year-old can understand, it becomes painfully obvious that someone who has a knack for that sort of thing is needed. So we wrote to Dr. Seuss and asked him if he would be interested in doing such a book. He has replied -- he didn't say yes; but he didn't say no. He wanted more information. This was supplied the next day and negotiations are still underway. If he agrees to write this book it will take about three years from inception to completion. Also, in conjunction with the Academy for Educational Development, SWE is trying to obtain grants to develop vocational workbooks for preschool children and to develop guidance films for grade school, junior-high, and senior-high-school girls.

At the high-school level there has been more success than in other areas. Dr. Sarah Splaver has just finished a book called Non-Traditional Careers for Women. The book is to be published September 17, 1973 by Julian Messner and it features a chapter entitled "Engineering Women Have Fast-Growing Futures." Caroline Bird of Born Female fame has also completed a book which features the career development of at least one woman engineer. The title is Everything a Woman Needs to Know to Get Paid What She's Worth

(McKay); it was also serialized in FAMILY CIRCLE magazine. SWE has continued the Certificate of Merit program which was developed some years ago. These certificates are presented by each SWE Section to graduating high-school girls who have attained three years' high achievement in mathematics and science. Dr. John Parrish, Conference Vice-Chairman, is working on a series of reports on "Women in Engineering as Told by Women Engineers." The first report is entitled: "My Career as a Heat Transfer Engineer," by Nancy Fitzroy, and has been distributed to the conference attendees to critique.

At the college level we have, as always, the Lillian Moller Gilbreth Scholarship. This year a special effort was made to reach the college students by sponsoring this conference on "Career Guidance for Women Entering Engineering." Plans for extending and continuing this type of effort are underway.

After college what? There are those of us who pursue an engineering career without a break. There are others who temporarily retire to rear a family. How do these women get ready to reenter the profession? There is no one way. However, we worked with Catalyst (a national non-profit organization whose aim is to serve the interest of educated women wishing to enter or resume professional careers) in preparing an article on engineering. The publication (ENGINEERING, Career Opportunities Series C-9) has been released and may be obtained from Catalyst, 6 East 82nd Street, New York, New York 10028.

The third goal was to assure the perpetuation of the Lillian Moller Gilbreth Scholarship Award by adding $1000 to the existing monies and to increase the number of scholarships to be administered by the Society. During 1972-73 the Gilbreth Scholarship was fully endowed. Of course, since 1958 the Society had had only one scholarship, and then in 1972 MASWE added another scholarship, the Herbert White Award. During the spring of 1973, four more scholarships were added. The first of these was the Elaine Eleanor Emerson Hutchins Scholarship. This scholarship was offered to the Society by Dr. Sandra Hutchins in her mother's memory "in recognition of the fact that her mother believed in all of her endeavors no matter how farfetched they may have seemed at the time." Finally, the Westinghouse Educational Foundation granted $4500 to the Society to support its scholarship program. The grant of $1500 annually, 1973 through 1975, will be used to award three $500 scholarships to freshman women entering engineering. The scholarships are named the Bertha Lamme-Westinghouse Scholarship Award, in honor of the first women to received an engineering degree in the United States, and are to serve as an additional enticement to encourage young women to choose engineering as a career. A gigantic step has been taken in this area and every effort will be made to increase the number of scholarships during the 1973-74 fiscal year.

These are some of the highlights of the Society's activities during this administration. There are many other items underway, most of which are con-

tinuations of older programs. Have these activities been successful? The only real indicators are membership levels, and they are at an all time high. The membership has increased by one-third, from 1084 in June 1972 to over 1600 in July 1973. Of these, 700 are students. We have chartered 11 student sections and have three more waiting in the wings to be chartered by the end of September, and we have increased the number of Corporate members from 24 to 26. These are our successes.

The Society has been in existence 24 years. It has had twelve previous administrations. This is the 13th administration and by all of the signs it has been a success. You have heard what we are doing. Are these the right things? Where should we go from here?

Naomi J. McAfee

Naomi J. McAfee currently is directing the reliability, quality, maintainability, and safety engineering activities, and the failure analysis laboratory and data center for the Aerospace and Electronic Systems Division and the Systems Development Division of the Westinghouse Defense and Electronic Systems Center. Prior to this assignment she was Manager - Reliability, Maintainability and Safety Engineering. She has planned and directed the reliability and maintainability efforts for such programs as the environmental measurements experiment for the Application Technology Satellite, the AN/AWG-10 Airborne Missile Control System and special support equipment, and the AN/SPG-59 radar for the Typhon Weapon System.

She received her BS degree in physics at Western Kentucky University in 1956, and joined Westinghouse the same year, as a mathematician in the Reliability Engineering Section.

Ms. McAfee is a senior member of the Institute of Electrical and Electronics Engineers, the American Society for Quality Control, and the Society of Women Engineers. She has served as Executive Secretary of ASQC and is currently President of the Society of Women Engineers. She was elected January 1, 1973 to serve on the Administrative Committee of the IEEE Group on Reliability. She is listed in Who's Who of American Women, Who's Who in the South, and Two Thousand Women of Distinction.

Ms. McAfee has published numerous papers and is co-editor of the Reliability Training Text. She is an ASQC Certified Reliability Engineer (No. R-250) and a Certified Quality Engineer (No. 618).

A SENIOR ENGINEER'S POINT OF VIEW

Nancy D. Fitzroy

Manager - Heat Transfer Consulting
Research and Development Center
General Electric Company, Schenectady, New York

WHY WOMEN IN ENGINEERING?

We are all here because the concept of the traditional roles for women is changing. I think women want more challenge and responsibility, particularly if they want a full-time career. They want to establish a firm base from which they can develop a career that is satisfying and rewarding and is not a dead-end street.

Women now comprise approximately 40 percent of the work force; yet only a few make over $7000 annually. About the only chance is in medicine, law, accounting, teaching, science, or engineering. The chance for acceptance of women in engineering is very good.

Women want to do something vital which is responsive to the social and environmental needs of the community. Engineering offers that opportunity. The environmentalists and ecologists say that nothing but zero pollution is acceptable; yet we all know perfectly well that we are not willing to do without electric power and automobiles and heated houses with their pollutants. What we need is education of the public as to what kind of tradeoffs are available so wise choices can be made. Women engineers can fill this need. They have a "natural" communication link with the community through their neighborhood, school, PTA, church, and similar relationships. They could use this communication link to educate other women about technological matters. This is a unique public relations area, which is not open to their male counterparts. It's about time that we put a stop to the current attitude that is voiced in the media about all the ills of the present day being attributable to engineers and technology, without mention of the benefits technological advances have brought and can bring to us. Even if a women should not choose to pursue a career in engineering after study of all technical subjects, the background knowledge gained will help her understanding of the practical aspects of the technological solution of environmental problems.

MORE ENGINEERING OPPORTUNITIES FOR WOMEN IN THE FUTURE

The opportunities for advancement are starting to come along. All large companies now have very strong "affirmative action plans" designed to help women and minorities to develop their career potentials. There are now opportunities for women to go into management. This used to be practically unheard of, and still is not very common; women of the right age and engineer-

ing experience are not ready for management positions, simply because they have not thought it possible to attain such positions and therefore have acquired neither formal nor self training in that field. Opportunities in the "parallel path" of straight technical development are much more promising for women. In this area, top job levels tend to be equivalent to the second level of management (counted from the bottom upward).

SHOULD ENGINEERING BE RECOMMENDED AS A CAREER?

I think that more young women should be encouraged to consider engineering as a career if they have a natural bent in that direction. It is one of only a handful of careers where a woman can make decisions for whose outcome she is responsible and where the salary is commensurate with that responsibility. Even if she should not choose to pursue engineering as a lifelong career, she will find that it has given her invaluable understanding of the many technological problems of our modern world.

ENGINEERING SHOULD BEGIN BEFORE COLLEGE

A high-school girl who seems to have a natural ability for math and science should be encouraged to take all the courses she can in those fields -- algebra, geometry, trigonometry, physics, chemistry, and biology -- so that when the time comes for her to select her field of study for college she will have all the necessary course work and will not be stymied by the lack of it. Even if she should opt for some course other than engineering, I think she could find those basic studies extremely useful in her everyday life.

WHY A CONFERENCE AT HENNIKER?

This may very likely be your first experience with a conference that has a rather formally planned program yet is held in a setting which is very informal, with plenty of free time in the afternoon for informal discussion between the speakers and the other conference participants. It was a new experience for me when I came to the first conference on women engineers two years ago. It seemed like such a good idea to have the afternoons free for recreation and to have sessions in the evening when there really wasn't anything else to do anyway. But those afternoon free times turned out to be, in retrospect, far more productive than it might have seemed at the time. In the afternoons, when you're at the lake with a group of other people from the conference, going for a swim and sitting around the beach and chatting, you really get to know the other members of the group and gain some insight into their points of view and their hopes and problems with their careers. I think this is a unique opportunity to get acquainted.

With women engineers still only one percent of the engineering population, most of you have had very little opportunity to get to know another girl in similar circumstances. Bringing a group together at one site gives us a

chance to compare notes and to talk over the good and the bad times in our engineering careers. More often than not in the past, each time I talked to young women engineering students, they would tell me that I was the first practicing woman engineer that they had ever met, and I expect that other role models will relate similar experiences. We would prefer to have one-to-one personal contacts, but because we are such a small fraction of the engineering population, it's somewhat difficult for us to spread our time around to cover many colleges and undergraduate students. So we're hoping by the presentations at this conference, which will be published and available to the general public, that some contact with practicing women engineers will be available to all students in the written word if not as a personal contact.

You may have noticed from the roster that about half of the participants here are students. The other half are divided approximately in half again, with half being role model presentations and the other half people interested in the guidance field, either as guidance counselors, deans of engineering, or related activities. What we hope to learn from you students is whether you think this is the right kind of presentation; is it the kind of material you would have liked to have seen when you were thinking about studying engineering? Would it have helped you to make your decision? Perhaps you would have decided not to study engineering. Do you think it is the right kind of material to provide for high-school guidance? And if not, why not? In what areas should it be changed? Do we need more amplification or description of specific types of jobs that we work on, that is, in problem solving? Perhaps you feel that more emphasis is needed in the personal area; that is, what the personal problems are, what the working relationships are in pretty much of an all-male world.

We hope that you will keep all of these things in mind and give us feedback on them later, because the Conference's specific goal is to present material which would be of interest to you as students. We want to learn what it is that interests you and that you find useful. In the past it has seemed that we've been talking to one another and deciding what the students need, and I think it's about time we got feedback from the student population to see if we are on the right track.

I personally find it very rewarding when I learn that I've helped some young lady decide to put her bright little mind to good use. I don't think for a minute that engineering is the only place to put a bright mind to good use, but I do feel that engineering has been neglected as a possible career choice for girls, as evidenced by the very low percentage of women in engineering. When I graduated in engineering, something like two-tenths of a percent of the engineers were women, and now we are up to something like one percent. I don't know what the exact numbers are, but Dr. Parrish has some very interesting statistics on the subject of careers of all types for women, which he will present to you a little later this morning.

I hope that by the time this week is over, each and every one of you will feel that she has benefited by the interaction with other women in the engineering community. Last but not least, and perhaps even more importantly, the published proceedings of this conference will provide written documentation of role models of practicing women engineers. As you will see before the week is out, we have attempted to get a good varied cross section of the various disciplines of engineering, to include role models from industry, government, and academia, and also to get a variation in geographic distribution around the United States, because this in many ways influences the type of engineering activity being performed; not because of the geography itself but because of the types of industries which are located in specific parts of the country.

We hope that the high-school guidance people will find the proceedings of this conference useful source material when counseling girls who have appropriate aptitudes for studying engineering. I'll be happy if the only productive outcome of the Conference is publication of the proceedings, but I'll be an awful lot happier yet if you feel that this experience has been useful and rewarding for each and every one of you.

Nancy D. Fitzroy

Nancy D. Fitzroy's work for the General Electric Company's Research and Development Center is in the area of heat transfer analysis and special thermal equipment design. In addition to providing consultation on thermal problems in the design of proposed products and the operation of existing equipment, she is responsible for the evaluation of existing heat-transfer data and for the dissemination of new information on heat transfer and fluid flow. She is editor and contributor for the Heat Transfer and Fluid Flow Data Books, which are published by the General Electric Company, and for q's and p's, a newsletter on heat transfer that is distributed Company-wide.

A native of Pittsfield, Massachusetts, she received her BChE from Rensselaer Polytechnic Institute. In 1950, she joined the Heat Transfer Group of the Knolls Atomic Power Laboratory, which is operated by the General Electric Company, transferring two years later to the Heat Transfer Unit of the Research and Development Center for work on the Project Hermes guided missile program. From 1953 to 1971 she was Heat Transfer Engineer, performing analytical and experimental work on complex technical problems. In November 1971 she was named Manager-Heat Transfer Consulting. She is the author of many papers published in technical journals and approximately 100 General Electric reports.

In 1963, Mrs. Fitzroy was elected chairman of the Hudson-Mohawk Section of the American Society of Mechanical Engineers, the first woman to be

so honored in the history of that society. She served for three years as her Section's representative to the Regional Activities Council of Region III (Mid-Atlantic) ASME. She is also past-secretary for Region III, again the first woman to be appointed to the post. She served on the ASME Goal 14, "Equal Opportunity," Working Party. Mrs. Fitzroy has held numerous other technical society offices, including chairmanship of the Joint Activities Council of Engineers, which represents local sections of national engineering societies in Schenectady. She is an honorary life member of the Society of Women Engineers and a recipient of the Society's 1972 Achievement Award; also a member of the American Institute of Chemical Engineers, the National Science Foundation Advisory Committee for Research, and the American Helicopter Society, and an affiliate of the National Society of Professional Engineers.

A STUDENT'S POINT OF VIEW

Deborah A. Kaminski

Heat Transfer Engineer
Research and Development Center
General Electric Company, Schenectady, New York

One night, when I was traveling alone by train, I met a very pleasant and talkative woman. By-and-by, I learned she was a journalist and I began to tell her of my background. When she heard I was an engineer, she was delighted. What a story I must have. What anecdotes and experiences. Why I could write a best-selling autobiography. I knew she was imagining the story of a dedicated, sincere young woman struggling to convince skeptics of her serious intent to become an engineer, fighting off discrimination and so on. Well, it wasn't like that. Since I decided to become an engineer, I have received only encouragement. In my four years at college, I can't recall even one incident when I was treated any differently than one of the guys. The only general complaint about the coeds was that there weren't enough of them.

The real test came with job interviews. There were a few tired old objections aired; one interviewer complained that his plant had no toilet facilities for women, another thought that women were too emotional, always broke down and cried when the job got to be too much for them. But, except for these few remnants from a darker age, the interviewers were very fair and considerate. From my observations, I received as many or more job offers than other students in my department.

The biggest stumbling block for me in becoming an engineer was not finding acceptance but finding out enough about engineering to become interested in it in the first place. In high school, I had no idea what an engineer did, and I'm sure most of my fellow students, whether male or female, didn't either. This is partly because high-school teachers generally have a poor conception of engineering.

I remember my Latin teacher, during a long discussion of why I should become a Latin teacher, telling me how awful it would be if I decided to go to school at RPI, an engineering school. He said "You'll become an engineer, and then they'll stick you at General Electric and tell you to design a better coffeepot." Well, now I am at G.E., developing better products, and I like it. The technical problems are in no way trivial or uninteresting, but I didn't know that in high school.

In college, I majored in physics, and did not decide to study engineering until my junior year. I had been reading course work to a blind electrical-engineering student, and, after I admitted to myself that his courses were more interesting than mine, I switched to engineering.

But I wish I'd known earlier. There are many young women in school now who could become excellent engineers but, because of their misconceptions or lack of information, have not even considered engineering as a career. I know that at this conference we will find ways of reaching these women. This is a rare opportunity for such a broad cross section of women who have been involved in career guidance to come together. And there is nothing more fruitful than the cross-pollination of ideas.

I believe that the effort to increase the number of women engineers till they become some reasonable percentage of the total number of engineers must begin by convincing young women that a woman can have a full and satisfying life as an engineer. To win over these women is a tremendous job, as tough as or tougher than securing the cooperation of industry and government in allowing women fair opportunities in their careers. Yet less emphasis has been placed on career guidance than on the effort to secure equal opportunities. And it is this lack of guidance to which we at the Conference should address ourselves.

Deborah Kaminski

Deborah Kaminski is a 1973 graduate of Rensselaer Polytechnic Institute, where she was editor of the Rensselaer Engineer, the student technical journal. She studied physics as well as engineering at RPI and is a member of the physics honor society, Sigma Pi Sigma.

THE "NEW ERA" FOR WOMEN IN THE PROFESSIONS

John B. Parrish

Professor of Economics
College of Commerce and Business Administration
University of Illinois, Urbana-Champaign, Illinois

This is a "new era" for women in the professions.

There have been greater increases in the enrollment of women in the professions in the last five years (in some fields in the last three years), both absolutely and relative to men, than in the previous half century.

This upsurge of women as a professional resource has come on so fast, many well informed observers are not even aware of its dimension.

With the aid of some graphic displays, I should like to describe, very briefly, this new era for women professionals in general, and for women in engineering in particular. I shall take a look at seven other professions first, and then take a close look at what is happening in engineering.

Let me begin with architecture. In 1960 there were 780 women enrolled in this discipline. Enrollments rose slowly until 1966, when it jumped to 938. By 1968 it had moved up sharply again to 1114. In 1971 there were 1620 women enrolled in architecture, or twice the number in 1960. Prior to 1968 women had never comprised more than five percent of total enrollment. In 1971 a breakout occurred for the first time, women's percent rising to six. In 1972 it is believed to have risen to seven.

In dentistry, women never comprised more than one percent of the enrollment before 1972. Suddenly, in 1972, the half-century record was abruptly broken on the up side, women's percent of total rising to three. In terms of numbers there were only 167 women enrolled in United States dentistry schools in 1968. Look what happened after that. By 1970 the number had moved up to 231, and in 1972 the number more than doubled in a single year, reaching 511. Women are on their way for the first time in substantial numbers, in dentistry.

Law represents very dramatic change for women. Prior to 1968 women were never more than five percent of students studying law. After 1968 they enrolled much more rapidly than men, with the result that in 1972 women comprised 12 percent of all law students.

In terms of numbers the upsurge is even more dramatic. In 1960 only 1651 women were studying law. Numbers enrolled rose substantially to 1968 and then literally exploded. In 1970, 7388 women were enrolled in law schools, and two years later the number had soared to 12,728. It will likely reach close to 15,000 this Fall. This is quite a change from the 1651 of 1960.

Medicine represents another discipline in which women's role is moving up very fast. In 1960 there were 1745 women enrolled in U.S. medical schools. The number rose slowly to 1966. Since then enrollment has accelerated rapidly, reaching 6000 in 1972.

Women as a percent of first-year enrollments fluctuated between eight and nine percent through 1968. Then look what happened. Women began to enroll in medicine much faster than men. The result: by 1972 women comprised 17 percent of all first-year U.S. medical students.

Optometry has never attracted very many women in this country. Prior to 1970 women were never more than three percent of optometry enrollments. Very suddenly this changed. In 1971 the percent moved up to four and in 1972 moved up again to five. While numbers are still low, the rise is nevertheless impressive. There were only 80 women studying optometry in 1970. In 1972 the number had doubled. That's rapid change.

Women started moving into pharmacy in substantial numbers, both absolutely and relative to men, a decade ago. In 1962 there were 1365 enrolled. By 1972 this had moved up very fast to 4639. In 1968 women were 18 percent of enrollment in pharmacy. Since then the percent has risen steadily until, in 1972, one out of every four pharmacy students was a woman.

The rush of women into veterinary medicine has been particularly strong. In 1956 there were only 28 women studying in this discipline. Ten years later, in 1966, there were still only 113 enrolled. After that, women's enrollments really took off, rising to 170 in 1969, up to 266 in 1971, with a big jump to 343 in 1972. The rise of women as a percent of total enrollment in this field has been truly extraordinary. Women were only two percent of veterinary medical students in 1956. In 1972 nearly 20 percent of all first-year students were women. That is spectacular change.

Is the sudden rise of women in professional enrollments likely to continue? Certainly for the near future the answer is a strong "yes." In 1972 women were 12 percent of enrollment in all classes of law but were 16 percent of first-year enrollment. In medicine women were 13 percent of total enrollments but were 17 percent of first-year enrollment. In veterinary medicine women were 14 percent of total enrollment but were 19 percent of first-year students.

ENGINEERING

And now let's take a look at women in engineering. The rise in numbers is impressive. In 1967 there were 2950 women enrolled in engineering. In 1972 there were 5817 women engineering students, or somewhat more than doubled in the five-year period.

Since engineering is the largest of all professions, this rise in numbers is somewhat obscured in terms of percentages. In 1967 women were only one percent of total engineering enrollment. But in five years this percent, which had persisted as far back as records exist, suddenly moved upward to three. Preliminary reports from leading schools indicate it is likely to reach four percent for the first time in engineering's history in the Fall of 1973.

This movement of women into engineering is particularly significant in terms of trends in enrollment of men. Between 1967 and 1972, because of headline scares about "surplus engineers" and severe cutbacks in space and defense projects, the number of men enrolling in engineering declined 21 percent. Yet in the face of these adverse reports, women's enrollment rose 112 percent. The rise in women's interest in engineering appears rather solid. It is one that is likely to continue, to the advantage of women and the engineering profession.

The potential of engineering as a career for women is tremendous. It surpassed all the other professions by a wide margin. Women are moving rapidly into veterinary medicine, for example, but in 1970 there were only 24,000 doctors of veterinary medicine. It's a small field, relatively. So is dentistry. There were only 91,000 dentists in the United States in 1970. There were 120,000 pharmacists, 266,000 doctors, 287,000 lawyers. Then consider engineering. There were 1,100,000 reported by the 1970 census. Engineering is big, very big. If only ten percent of the engineers are women, one is talking about 100,000 jobs. This conference can urge more talented young women to consider engineering as a career with the assurance that the opportunities are there now and will be there for a very long time to come.

John B. Parrish

As a labor economist, John B. Parrish has had extensive experience in government service, teaching, and consulting. He attended the University of Illinois, where he received the AB degree in 1934 and the PhD degree in 1938.

Dr. Parrish served as Assistant Supervisor of Research, U.S. Employment Service, Occupational Research Project in 1938-1939; Assistant Professor of Economics, Southern Illinois University from 1939 to 1942; Senior Economist, War Manpower Commission in 1942-1943; Principal Economist, Assistant to the Director, Wage Stabilization Division, National War Labor Board from 1942 to 1944; and Regional Director, Bureau of Labor Statistics from 1944 to 1947. He joined the University of Illinois in 1947, and has been teaching there as Professor of Economics since 1955.

Professor Parrish is a member of the American Economic Association, the Midwest Economic Association, and the National Defense Executive

Reserve. He has been awarded Phi Beta Kappa, Kappa Zeta Psi, Phi Eta Sigma, and has been a Ford Foundation Fellow. In 1968 he won an award for Outstanding Achievement in the Social Services from Pi Gamma Mu.

Professor Parrish has published an extensive number of articles and studies and has been one of the very few outstanding economists to devote continuing attention to the study of the employment of women in the professions, with special emphasis on women in the sciences and engineering.

Part II

ROLE-MODEL PRESENTATIONS

FROM KATHARINE GIBBS TO PAUL WEIDLINGER

Kathryn E. Anner

Structural Engineer
Weidlinger Associates, New York, New York

The first time I was sent out on my own to visit a job site, I was nervous and worried about what questions I would be asked and what problems I would have to solve "on the spot" without the security blanket of the office and the other more experienced engineers. The major problem that day was a sidewalk outside the building, which was cracking. The architect, contractor, owner's representative, and myself were standing around. I asked if the soil had been properly compacted before the concrete had been poured. The contractor turned around, looked at me, and said "Who are you?" The architect introduced me as "the structural engineer from Paul Weidlinger's office."

Well, I'm still the "structural engineer from Paul Weidlinger's office," but what does that mean? As a structural engineer I am a graduate civil engineer specializing in the structural design of buildings and bridges rather than the design of roads, dams, or sewers. In school you receive training in all of these specialties in addition to getting fundamental courses in electrical and mechanical engineering. The structural engineer's job is to make the building stand up. He also has an obligation to the owner to design the building as economically as possible, to the architect to help him make it as esthetically pleasing as possible, and to the contractor to make it as easy to build as possible. As you can gather from this, the engineer's job is not just one of designing beams and columns; it encompasses a great deal more than that. The experienced engineer, both mechanical and structural, is consulted by the architect usually at the very earliest stages of the design. That is why it is important to have some understanding of the problems and aims of the architect and mechanical engineer.

During the construction phase of the project, we are called on by the contractor to interpret what is on the drawings, to offer alternate solutions to expedite the work in the field, and to help remedy mistakes that might be made in the field. It is also necessary to be familiar with the local building codes, and when called upon we must be ready to go to the Building Department to answer questions and explain our calculations and drawings. In building a building you start at the foundation and end at the roof. In designing a building you start at the roof and work your way down. This is a big problem for today's engineer. Because of rapidly rising construction costs, the contractor usually wants to start building the foundation while you're still designing the roof. A designer is involved from the preliminary planning of a building through the construction phase of the project.

I wish I could talk more about the jobs I work on rather than about myself, but as a "role model" I hope it will be helpful to you to know how I got here.

After graduation from high school, I went to Katharine Gibbs Secretarial School. Before deciding on becoming a secretary, I had considered going to college, but I really didn't know what I wanted to study. I knew I didn't want to be a teacher or a nurse. I had always like math, but I didn't at that time know what I could use it for, and besides, I really was anxious to earn some money and have some sense of independence. When I finished the year at secretarial school, I got a job through the placement office of the school with Drilled-In Caisson Corporation, a heavy foundation contractor. At Drilled-In Caisson I was exposed to the below-ground part of engineering -- caissons, piles, and borings -- and also to the hectic, tense period when a job was being bid on. I remember on one occasion working till late on a bid and then delivering it by hand to the general contractors. It was very exciting, but also very disappointing when we didn't get the job. Even though I had this attraction to engineering, and as a child my greatest treat was when my uncle would take me to see steamshovels at work, the idea never occurred to me that I could become an engineer. I didn't select the job at Drilled-In Caisson because it was an engineering firm, but rather because it was a small, one-girl office, and one thing I was very sure of was that I did not want to work for a large company. I also wanted a job that was diversified. This was the beginning of the direction my life would take.

In a couple of years that company went out of business, and I had to look for another job. To my original requirements of a small office with diversified work was added a third; that it should be an engineering office. Once again I went back to Katharine Gibbs' placement office, and through them I got a job as secretary to Paul Weidlinger.

Working in a design office was somewhat different from working in a construction office. In construction the engineers were very seldom in the office except when things were slow; whereas, in a design office they were very seldom out except on periodic inspection visits.

After working a year or two in my first job, I had begun to get the urge to go back to school, but I still did not know what I wanted to be. I attended Fordham University evening session, taking courses such as philosophy, English, and history without any particular direction.

During this time my "role model," Alva Matthews, started to work for Paul Weidlinger. I don't remember Alva proselytizing or trying to sell me the idea of becoming an engineer, but just the fact that she was an engineer put the idea in my mind, and I was sure that was what I wanted to do. When I told Alva, she was delighted and, of course, gave me tremendous encouragement.

I enrolled in the preengineering course in the first evening session given by Bronx Community College. Despite Alva's encouragement, I was still doubtful as to whether I would be able to do it. It had been several years

since I had graduated from high school, and the first year of math and physics courses was very tough. Once I got through the first year, I knew I would be able to continue, and that I wanted to continue.

Mr. Weidlinger was not aware at first that I was planning on becoming an engineer, but one day he caught me getting some help on a math problem. From then on he helped and encouraged me, often giving me statics problems in between dictation. He is an excellent teacher, and his ambition for me now is that I get my PhD and go back to being his secretary.

I spent six years at Bronx Community College, and when halfway through I switched from secretarial work to drafting. As the time drew near when I would be completing my preengineering course at Bronx Community College, I had to start thinking of transferring to a four-year school to complete my studies.

Taking a leave of absence from work, I registered at New York University as a full-time day student, and in 1968 was graduated as a civil engineer. Fortunately I had a job and lots of help and encouragement waiting for me at Paul Weidlinger's office.

At this time I would like to summarize my background and experience.

My secretarial training and experience has been invaluable to me; first as a livelihood, secondly as a position from which I could look objectively at the good and bad points of my future career, and finally, as an aid during my college days and even now. One thing in common between my three careers was that difficult period after getting out of school and thinking you know so much and then realizing, after a few days' work, how much you still have to learn. Experience is that all-important learning process, and it's a struggle getting through that beginning period.

When I was a part-time evening student I was able to afford to travel and do things I was not able to do as a full-time student, although I had to take advantage of every minute of time in order to accomplish everything. As a full-time day student I had more time for study and more contact with other students, which was extremely helpful as an aid to study and getting through the volume of homework and projects. I also feel that there was more continuity to my education at this time.

Aside from these considerations, however, going back to school at that time in my life was a tremendous experience for me. It was a complete change of pace from the nine-to-five structured environment of an office, and was a wonderful, revitalizing experience for me.

Since graduation I have not had the urge to go back to school, perhaps because every day is a learning experience. Just when you think you've mastered one thing, a new problem comes along. Sometimes I think every problem

in engineering is unique, but perhaps that is the challenge that makes it interesting and exciting.

Why did I become an engineer? To me it was, I think, a natural progression from one thing to the next. I enjoyed my secretarial work. My job brought me in contact with many intelligent and important people. The days went by quickly as I was constantly moving from one thing to the next. I was surrounded by engineers and scientists, but I didn't speak the language, and I was anxious to learn and be a part of their world. There was nothing more I could learn about being a secretary.

I didn't enjoy being a draftsman as much as being a secretary because I was very dependent on the engineer, and I also missed the contacts with the outside world and the perpetual motion of secretarial work. Now, as an engineer, I probably am a much better draftsman than I was at that time. As long as engineering is a challenge I will be happy as an engineer.

Discrimination? I have to say honestly that I have never felt discriminated against because I was a woman. During my years of work, I have had contact with, in addition to Alva, a structural engineer who now has her own office, a draftsman who is now an engineering professor at Fairleigh Dickinson University, a former secretary who through her hobby of photography became interested in the construction end of engineering, went to New York University evenings, and is now a construction manager for a large contracting firm. In addition I have worked with women architects.

Perhaps because of my contacts with these women, or perhaps because of the attitude of my teachers, fellow-students, and coworkers, once the decision to be an engineer was made I lost any self-consciousness I might have had about being a <u>woman</u> engineer and settled down to trying to be a <u>good</u> engineer.

<u>Kathryn Anner</u>

Kathryn Anner has a BS degree in Civil Engineering from New York University. She is currently a structural designer for Weidlinger Associates in New York City, where she has been involved in the design of a $90 million manufacturing complex. At present she is engaged in the design of the Tropical Asia Exhibit for the Bronx Zoo.

CONFESSIONS OF TWO PRESIDENTIAL ASSISTANTS INVOLVED IN WATER...POLLUTION CONTROL

Martha I. Beach

Vice-President and Secretary-Treasurer
N-CON Systems Company, Inc., New Rochelle, New York

and

Betty A. Rose

Senior Associate and Assistant to the President
Gurnham and Associates, Inc., Chicago, Illinois

Our first confession must be that neither of us has an engineering degree, nor testified before a Senate investigating committee. Our second confession is that neither of us considered or sought a career in engineering while in college. In spite of this, we frequently do the work of qualified engineers and are accepted and respected, in most instances, as such. By combining and using our assorted interests, talents, and experience we have developed challenging and rewarding careers in the field of pollution control.

My work is primarily in equipment sales, design and production. Betty, as Assistant to the President of Gurnham and Associates, Inc., covers research, field investigation, project scheduling and coordination, and preparation of proposals, reports, and technical papers for publication. We have both presented papers at technical conferences.

While trying to determine what to pass on to you in this presentation, I asked several executives and engineers, both men and women, what they felt were the key ingredients of their success. The most frequently mentioned were ability, opportunity, and motivation.

In my case, it was my husband who provided both the opportunity and motivation. The ability factor, usually associated with education and training, is somewhat harder to assess. My education was straight liberal arts. I entered Sweet Briar College intending to major in physics because it was my favorite subject in high school. I soon became disenchanted with physics, due in part to the poorly equipped lab and having to repeat first-year physics in spite of scoring in the top ten percent in the College Board Examinations. During my sophomore year I changed my major to history of art. While this may seem a far cry from physics and my present work, I realize, in retrospect, that my first choice of topics for my senior thesis -- bridges, aquaducts, and sewers -- was in fact prophetic. However, as this subject was not considered to have sufficient artistic merit, I ended up discoursing on tomb architecture and decor! With this in mind, perhaps someday I shall apply myself to the decorative potential of solid waste disposal.

Although I make light of my history and art background, it has often served me well. Once, because I recognized and admired an original 17th Century en-

graving of the Cloacca Maxima, the great sewer of ancient Rome, displayed in an office, the consulting engineer, formerly "too busy" to see me, found time for a delightful exchange of stories about our travels in Italy. Specifications for sewage treatment plants designed by his firm now regularly include N-CON samplers.

My most formal technical training, while not credited to my degree, came from one of my favorite extracurricular activities. During my junior and senior years, the dormitories in which I lived were replumbed and I spent a good deal of my spare time watching and assisting the plumbers. Although he was not my guidance counselor, Mr. Lloyd Hoilman, the late superintendent of buildings and grounds, was not far from the truth when he laughingly suggested I should consider a future in plumbing.

Frankly, I was very immature socially and unhappy in college. I was not highly motivated or career-oriented, although I enjoyed learning and always had summer jobs either teaching or in a local bookstore.

Perhaps some clues to what prepared me best for the work I am now doing can be found long before college. I was a tomboy, a tinker, and a reader. I always liked building things, blocks, erector sets, elaborate cardboard villages, tree huts, model boats and airplanes. My jackknife was my most prized possession. I built countless little dams and waterwheels in the brook near the farm camp where I spent summers from age 9 to 13. It was also in this period that I had my first experience with waste disposal systems. I fed the pigs, shoveled out the horse and cow barns, drove the manure spreader, and helped to build our new outhouse which we proudly named "Sweet Pea."

The more feminine creative arts also kept my hands busy. By the time I reached third grade, my mother and grandmothers had taught me to knit, crochet, embroider, cross-stitch, and needle-point. I still enjoy these activities today. However, when it came to the formal feminine craft classes I refused to participate, and after a great struggle, won admission to the boys' woodworking class. There I thoroughly enjoyed learning to mitre corners and countersink nails. I wore overalls, which were not then haute-couture for girls; had my hair cut like a boy's, in the days when boys had crew cuts; and insisted on being called Billy. My parents and teachers despaired. Even my voracious reading did not give them much hope for my future. Although I read most of the classics, I also sent away for pamphlets on breeding better dairy goats and poured over every copy of POPULAR MECHANICS I could locate.

Several years ago, while I reviewed my childhood library before passing it on to my children, I came across two books which I now realize influenced my thinking about what girls could do. One was The Glass Book, one of the first children's books illustrated with photographs. In it Martha and Bill were taken on a trip to a glass factory to see how various kinds of glass were made and used. Believe it or not, pre-women's lib Martha was permitted to ask

some questions and make some intelligent comments. The second was a book which had been my mother's, John Martin's Big Book for Little Folk, published in 1918. In it is a story about Margaret Knight, who, when her brothers would not let her use their sled, locked herself in the woodshed and built a better and faster one. When she grew up, she supposedly invented and was granted a patent for a paper-bag-folding machine. Recently, on one of my trips to the patent office, I decided to see if this was true. Sure enough, her first patent was issued in 1871, followed by approximately 27 more, including a series on rotary engines and motors. This is all the more remarkable when you consider that she had no formal education beyond secondary level, and was born in 1838. I did not know these facts when I read her story, years ago, but I have always remembered, in the back of my mind, her reply when friends asked if she was not surprised when the patent was awarded: "No, I am not surprised. Ever since I was a little girl, I have worked on machinery and making pieces of material fit together for some purpose. Why shouldn't I make something important and useful?" She was a successful nonconformist and my ideal.

I am sure most of you who are engineers or potential engineers have similar stories to tell of being nonconformists. If you were lucky, a friend or teacher, guidance counselor, or even a parent directed your youthful enthusiasm and energy toward what you are now doing. I was discouraged from following my inclinations. It was not until I was married and had a family that I was thrust into my present career by my husband and necessity. At that time Jack was working for a company making fractional-watt motors and instruments for weather, upper atmosphere, and oceanographic research. When his boss did not wish to develop further some of Jack's ideas for devices to collect industrial wastewater samples for product loss studies, we decided to start our own company.

From its humble beginnings on our kitchen table, N-CON has grown to a leading company designing and producing equipment used to collect samples from municipal treatment plants, industrial complexes, and receiving waters. Other products include an incubator control, control and safety devices for stand-by generators, and an incinerating toilet. Users of N-CON products form a veritable who's who of government agencies, industries, municipalities, universities, and consultants. N-CON equipment is in use in Europe, South America, and Israel, as well as in Canada and most of the fifty states.

When we started out we could not afford to hire secretaries, bookkeepers, engineers, draftsmen, production personnel, or salesmen, so Jack and I shared these jobs. Our early circuits would curl or uncurl your hair, as the case may be, if you are an electrical engineer. We learned by doing and blowing fuses. When I insisted on color-coded wiring, Jack attributed it to my art training. Actually I had found out that it was safer than sticking numbers on the wrong wires. As a dividend, our children learned their colors and to count to ten "helping Mommy" long before the advent of Sesame Street. Somehow our our trial-and-error methods, combined with the frustratingly slow growth of

the field, contributed to our learning and subsequent success. The Salada Tea tagline which reads "Our courage gets credit when our stubbornness should be blamed" could have been written for N-CON.

The art and science of wastewater sampling were extremely crude in 1959. The environmental crisis had not yet excited the public or the politicians. Industries were concerned not so much with the problems their wastewater created as with the loss of raw materials and products in the wastewater. A few farsighted municipalities were developing methods for charging industry for the treatment provided for their wastewaters and were finding that random manual sampling techniques were not a satisfactory basis for charges. A man with a can on a stick, dipping into a sewer every once in a while, was neither an accurate nor an economical method for determining the quality and quantity of wastewater. Jack convinced several consulting engineers and municipal plant superintendents that our automatic samplers could collect the samples more economically, more reliably and, better still, in proportion to the volume of flow. Slowly the orders came in, and one by one Jack and I built the samplers. No one was in a hurry in those days. I produced our third child in less time than it often took to produce some of the samplers. Meanwhile, I was learning by reading, listening, and doing. What I know of sanitary engineering I learned by the Berlitz method . . . total saturation, literally as well as figuratively. Our son, when in first grade, was asked what his father did. He announced solemnly, "He goes in sewers." To the question "What does your mother do?" he replied, "She goes with him." When his teacher relayed this story to me, she thought it very cute. She backed off when I confirmed it was the truth!

So much for my education. My career, while heartily endorsed by my husband, was viewed with less than enthusiasm by our families and friends. I was besieged with criticism and advice. The consensus was that I was working too hard on a dead-end business, that the children needed my full attention, and that Jack should go out and get a secure job to support us in a manner consistent with our social status. In 1968 preservation and improvement of the environment had not yet attained top priority status. Certainly manufacturing sewage samplers was not a prestigious or lucrative occupation. I became thoroughly depressed and quit work to stay home with the children and bake cookies (dammit!).

I had read somewhere that stringing macaroni with your offspring was FUN. In desperation we tried it. The sage author of that advertising gem had never met my children. We were all miserable. I was exhausted or cross most of the time. The doctor's advice, along with a prescription for vitamin pills, was to see a psychiatrist or my minister. I chose my minister.

Together Dr. Bishop and I delved into the causes of my misery. Basically I liked working. I felt more useful building things than just staying home looking after children. I knew how to do a job that needed doing, but I was bowing to public opinion and parental disapproval because I lacked confidence in my

ability. I was afraid my work would not be acceptable to people I felt were better educated than I. It seems funny now, but at the time it was paralyzing. Dr. Bishop convinced me that I should return to working with Jack and put my knowledge and enthusiasm for our products to work selling them. He summed it upwith his usual wit and wisdom by saying, "The world doesn't end at your kitchen sink. You know very well where it goes, so get with it!"

A few weeks later, scared but determined, I found myself on a plane bound for California. There I participated in the Engineering Foundation's first conference on environmental engineering in the food industry and demonstrated some of our equipment. It was an overwhelming experience to find out that I really did know a good deal about pollution control, things other people wanted and needed to know, and it was exciting to learn that they were willing to share their knowledge and experience with me. That was the beginning of my new career as a sales engineer.

That same meeting resulted in the renewal of friendship with a consulting engineer we had known slightly for ten years. A few weeks later he wrote to ask Jack if he would co-author a paper on automatic sampling, as I had made it seem a very promising topic. Jack, who will never be elected male chauvinist of the year, suggested that I should be the co-author, as it was my idea and I usually wrote his papers anyway. Our friend, Dr. C. Fred Gurnham, agreed. That paper was the next step in my career and provided my introduction to Betty Rose. Following a good deal of skillful editing by my co-author, Dr. Gurnham, and his newly hired assistant, Betty, the paper was presented at the Ontario Water Resources Commission's 17th Industrial Waste Conference. As it turned out, I was also the first woman to author a paper for that conference. It has since been published in WATER & WASTES ENGINEERING and reprinted as a part of Basics of Pollution Control, prepared for the Environmental Protection Agency's Technology Transfer industrial waste seminars. This success encouraged me to continue writing, and I have since presented five additional papers.

Writing and presenting technical papers, however, is only part of my work. I spend a large part of my time attending meetings and seminars on industrial and municipal pollution control. The purpose of this is twofold. I try to learn what each industry's specific problems are, how they have attempted to solve these problems, and how Federal and local legislation is being developed and enforced. This insight helps us to tailor equipment to meet their requirements. These meetings also enable me to meet key people in both industry and regulatory agencies concerned with pollution control, and to make them aware of N-CON products. This is a soft-sell approach, but it has proved highly effective.

I also do more direct sales engineering by calling on consulting engineers and industry pollution control managers to keep them informed about our equipment and to assist them in coordinating it with other components in their waste control programs.

Trade shows and field demonstrations provide me with another opportunity to make use of my years of assembly and design experience, as well as that knowledge I have picked up at conferences. Knowing just how each unit in a treatment system works, its proper application, and the alternative or competitive systems available, combined with an awareness of industry or municipal problems, gives me a very strong edge in sales. Self-confidence and confidence in a company, its products, and services are transferred to the potential buyer. That buyer is more readily convinced when I have asked him questions and encouraged him to talk about his project and its problems.

In spite of the current emphasis in my career on writing and selling, I have maintained my interest in design and production. Whenever I am in the office and can sneak away from my desk, I head for production. I still do most of the prototype layout and wiring for new or redesigned products.

Unless you are blessed with a husband like Jack, I do not recommend you follow my route to a career in engineering if you have a choice. It does, however, prove that with ability, motivation, and opportunity, sprinkled with a lot of love, luck, determination, and willingness to do more than is required, a woman can have an exciting and rewarding career in engineering or any other field she chooses.

Betty's career developed in quite a different but equally devious manner. While she agrees that ability, motivation, and opportunity are basic ingredients of success, she adds another, and more unusual one .... a knowledge of when to quit and when not to quit. Like most young girls in the 1940's, her career dreams were dictated by an overexposure to the typically feminine role of homemaker, and the related and socially acceptable careers in nursing and teaching. All the professional women in her family were nurses. Although her mother retired, at the age of 40, to marry and raise a family, she had remained active in various local nursing associations. Prior to her "retirement," Betty's mother had been supervisor of the obstetrical department at the local hospital. Betty's delivery was witnessed by all her mother's former associates. When she appeared several years later at nursing functions, she was the center of attraction, and the butt of all those comments about changes since her squalling moment of arrival. Now she feels that it was more that attention than any practical interest which dictated her first career choice, nursing. Elizabeth Blackwell's autobiography temporarily diverted her into medicine, but her more practical parents pointed out their obvious lack of funds for such a venture.

Betty's father had no formal education, but she feels that his ready wit and subtle sense of humor contributed more to any writing skills she may have developed than any professor. She was totally isolated from her father's work as a tool and die maker. The brass mill where he worked was off limits to her until 1971, when she toured that facility as an investigator on a Gurnham and Associates contract. She speculates that had she been exposed to the rod mill earlier, she might have followed an entirely different college curriculum.

However, her fascination with her father's micrometer was not sufficient by itself to instill any interest in engineering.

June of 1951 was an eventful month for Betty. She received the first of three scholarships to the University of Wisconsin, she graduated from high school, and she got her first job as a ward clerk in that hospital where her mother had trained and she had been born. On almost the same day, her mother died. Her father's death followed several months later. Betty found herself at this point an indigent ward of the court. She lost her appetite for nursing, but she did not quit the hospital job or give up her ideas of a university education. She continued her hospital work on an intermittent basis for seven years in order to pay for that education.

When she entered the University of Wisconsin, she had no career plan, and felt completely unequipped to select any area of specialization. After a battery of tests, she sought career guidance. Her counselor waved his new PhD at her and said she could succeed in anything she chose to do. That shrewd bit of counseling left her with no curriculum plan, but her personal economics dictated that she make a quick choice. Only the more financially secure students can take a random course through college.

Betty admits to being a social dud in both high school and college, but that shrewd counselor did her one good turn. He virtually insisted that she get active in student government affairs. She learned that she had a talent for planning and organization when she was made responsible for feeding more than 300 delegates to a student council conference. The University allotted her a budget of $1.00 per student for lunches and $1.50 per student for dinners. Since the conference was being held at the Kenosha Extension Center, which had no dormitory or dining facilities, she had to provide for the feeding of the 300 in various local churches. Even in 1952 dollars, the budget was such that she needed the miracles which only church ladies' aids could perform; however, no ladies' group could tolerate performing for more than one meal. Therefore, the sponsor had to provide Betty with a car and driver, so that she could race from meal site to meal site. She claims that every meal was filling, if not tasty, and that each was served on time.

At about this time she scored her first big academic success in college. The expository writing which she produced for her English prof soon boosted her out of freshman English, ahead of schedule, and into the dazzling world of advanced comp. She reasoned that if she could achieve such dizzying heights as a lowly freshman, her path to fame and fortune must be tied to a major in English. Because of what she calls her immature fascination with Romantic and Victorian poets, she bypassed journalism, a more logical choice for budding writers, and eventually ended up teaching English literature in rural and then suburban public high schools.

Early in her teaching career, which lasted for eight years, she discovered that it was not to her taste to discuss "The Merchant of Venice" with high-school

sophomores. She did, however, enjoy trying to make sense out of expository writing for her college-bound seniors, principally because such writing calls for a great deal of mental discipline and organization, traits which she now knows are essential in engineering as well.

Because of her apparent success with seniors, the school superintendent asked her, first, to take over the student newspaper, and then to develop and execute a public relations program. The purpose of the new p.r. effort was to program the voters, over a two-year period, to pass a referendum to issue bonds for the construction of a new high school. During that period, Betty worked 12 hours a day, teaching three classes, producing newsletters for parents, writing five weekly by-line columns in area newspapers, and running a speakers' bureau. At the end, just before the election, she collapsed and wound up in the hospital, but the referendum passed on the first ballot ... an unheard-of occurrence in Illinois in 1963. That rigorous two years had proved that she enjoyed writing and doing better than teaching, and she turned in her resignation.

After a year spent working for a textbook publisher (she couldn't stand the slow pace), she found an editorial job on ROADS AND STREETS magazine, writing new-product announcements. Editing manufacturers' often-exaggerated claims about equipment was at first a challenge, for it required that she learn what was really necessary to make a serviceable highway, bridge, or tunnel. But it also served to introduce her to the problems which engineers face when they try to write. When front-end loaders became routine, she moved on to organize a computer system for processing reader inquiries, and then to writing short feature stories. These stories were good, but she could not have a by-line because her name was Betty. She was listed on the masthead as B. A. Rose.

When her publisher refused to consider her for advancement because of sex, she quit again. His refusal to let a woman out into the field to watch a road-paving operation was supposedly to protect her fragile femininity, but she suspects that it was really to protect the more delicate male egos who didn't want it known that there was nothing terribly difficult about watching a slip-form paver.

At this point she joined Scranton Publishing as Presentation Editor of WATER & SEWAGE WORKS. The publisher, who was wise in the ways of marketing, agreed to her desire to do field work, but the editor maintained that a woman's place was behind the desk proofreading copy and cropping photos, not out in a sludge lagoon. In September 1968, the Water Pollution Control Federation was scheduled to hold its annual meeting in Chicago, where Scranton Publishing had its offices. Betty's editor, who was located in Michigan, asked her to contact Vinton Bacon, then Superintendent of the giant Metropolitan Sanitary District (MSD) of Greater Chicago, about his writing a story for the special convention issue. Lord bless Bacon, he took Betty to lunch to explain that he had no time to write stories. Because he did want

the publicity, however, he promised the resources of his department if Betty would write the story and take the pictures. He delegated his director of research and development to give her a crash course in waste treatment, and then to take her on a complete tour of the 800 square miles the district served.

Although Betty, as an editor, had mastered the technical definitions and successfully translated engineers' dissertations into publishable prose, she had no real concept of what was meant by terms such as "grit chamber," "primary effluent," "activated sludge," or "BOD." She got her first practical education on this assignment when she found herself snapping pictures of aeration tanks while leaning out of a helicopter, squatting in sludge beds, and sniffing anaerobic lagoons. She selected the experimental use of digested sludge to reclaim farmland as the subject of her first by-line story. Her astute publisher introduced the story and its author at a cocktail party during the Federation meeting, and made much of her daring feats of aerial photography. The Chicago MSD made much more of the first major feature on sludge farming. Her by-line became more common after that, although she admits that it still printed out as B. A. Rose.

In 1969, she recommended that Scranton Publishing retain Dr. C. Fred Gurnham as editor of its new magazine, INDUSTRIAL WASTES. Dr. Gurnham and Betty worked well together. When she indicated in 1970 that she was ready to quit Scranton Publishing for greener pastures, he offered her a position with his newly organized consulting firm.

As Dr. Gurnham's assistant, she finds herself actively participating in every phase of the firm's activities as pollution control consultants. She still write reports, proposals, speeches, articles (or papers, as scientists call them), sales letters, and promotional materials. Betty still claims that she knows when to quit. Now it is not her job she quits but pointless attempts to contradict militant male chauvinists who insist on discussing electroplating wastes only with male engineers. She has too much to do to waste time and energy in hopeless battles.

At the same time, she is not shy to respond to new challenges. Shortly after she started with Gurnham and Associates, the firm got contracts to conduct industrial wastewater surveys of the nonferrous metals industry and the automobile/aerospace industry. The tight time schedule imposed by the Federal Environmental Protection Agency for both contracts made it impossible for Dr. Gurnham to attend all of the initial planning sessions with industry committees. Betty was the only available substitute for the first meeting with representatives from aerospace. Her reception as a professional was encouraging, and by the end of the meeting she found herself delegated as principal investigator on that segment of the contract.

The work called for the same skills which had produced the sludge story: the capacity to learn, in two or three days, all the steps necessary to make

an airplane or spacecraft, and then the collection and analysis of massive amounts of data. Her writing skills came back into play when she was assigned the task of writing the final reports on both contracts. The aluminum section of the nonferrous report was rated as the best industrial survey the EPA had received up to that time, and it also earned her a tribute from the Aluminum Association. Their representative commented, "For an English teacher, Betty, you're a damn good chemical engineer." She is more than a little pleased that as a result of her work on these studies the EPA has since requested that she be a part of the G & A team assigned to subsequent federal jobs.

As Betty says, it is important to take advantage of every opportunity to broaden your experience, and to introduce yourself and your talents to others in your profession. Last year she accepted an appointment as editor of the newsletter for the Central States Water Pollution Control Association. Although gathering and editing the news, as well as supervising the production and distribution of three 4- to 8-page publications each year, takes a hunk of valuable time, it has its distinct rewards. Her name and her professional status are known to all 1600 members. And because Central States is the largest affiliate of the Water Pollution Control Federation, her work is recognized by many outside the three-state area served by her newsletter. Her exposure with the Federation certainly paved the way for her acceptance as a technical speaker at the first WWEMA (Water and Wastewater Equipment Manufacturers' Association) industrial water and pollution exhibition and conference this spring.

Dr. Gurnham is an internationally recognized authority on industrial pollution control, and Betty is very much aware of the weight his name carries with the WWEMA or any other committee. Although he would strongly disagree, he is not any more of a male chauvinist than my husband Jack. He was the first to suggest that her full name should be affixed to speeches or articles which she writes, and that as principal author she should make the oral presentations. Betty adds that it is a definite advantage to work for an executive who insists that the coworkers or subordinates who do the work must get the credit. Unfortunately, that attitude is not yet common in most professional groups.

The purpose of our joint confessions has been twofold: to illustrate that women do play vital roles in the world of engineering, and to point out that that world is multidisciplinary. It is in those other disciplines that women may find their greatest opportunities. We do not mean to discourage anyone from the formal engineering curriculum, but rather to encourage you to expand into other areas as well. In recent years technology has become a dirty word in many people's vocabulary, and as a result our legislators have made public participation in engineering projects mandatory. There is no profession that has a worse reputation for communication. Too many practicing engineers fall back on the academic research-paper format when writing final reports for clients. Therefore a report on recommendations for the treatment of a

client's dairy wastes includes a two-page discussion of the procedures used to wash BOD bottles. Maybe it was necessary to prove to college professors that student engineers knew the proper procedures, but it is extravagant to waste clients' time and money discussing accepted or standard procedures.

Betty personally feels that women have a better sense of proportion, and are therefore more capable of selecting ideas within a report which need emphasis. And she maintains that any English teacher would agree that women master the basics of written communications earlier than men. Men who go directly from high school into engineering curriculums never do perfect those basics. It warms her heart to hear many consulting engineering executives tell her that their firms desperately need someone like her. What they are admitting is that no man on their staffs is capable of transferring his ideas into meaningful documents which can be understood by other engineers, lawyers, CPA's and the ever-present public critics.

A final confession which may hearten an aspiring engineer struggling with mathematics is that neither Betty nor I excelled in this subject in school. Perhaps this is because at the time we could see no use for pure mathematics and were not motivated by abstract formulae. For this reason we are eternally grateful to electronic slide-rule calculators and computers, as we are frequently called upon to prepare profit-and-loss statements, production cost ratios, materials balances, and so forth. We have also learned that mathematics provides a good deal of satisfaction when it is applied to real situations, particularly when the results show a profit or confirm a theory.

Although militant women's liberationists may object, it is still necessary for a budding woman engineer, or non-engineer, to work harder than her male counterpart. Therefore, unless you want to be the "female spook who sits inside the door," the token employee who proves that the firm does not discriminate, we urge you to consider developing a second or third area of specialization, whether it be history of art, English, biology, economics, or interior design. These additional skills will distinguish you from other staff engineers, and place you in a position to advance more quickly into a position of authority.

Both Betty and I did it the roundabout way, but we would like to add that, while our firms employ several engineers, each has only one Presidential Assistant.

Martha I. Beach

Mrs. Martha I. Beach has had 12 years of experience in design, prototype fabrication, and production of automatic sampling and control equipment. She is currently responsible for N-CON Systems Company sales, advertising, and public relations programs. These activities include advertising copy and

layout, participation in pollution control seminars, trade shows, field demonstrations, and liaison with the Federal Environmental Protection Agency and consulting engineers.

She received her BA degree at Sweet Briar College in 1954 and did graduate work at New York University.

She is her company's delegate to the Water and Wastewater Equipment Manufacturers' Association (WWEMA) and has served on the Water Pollution Control Federation subcommittee on instrumentation and control.

Mrs. Beach has also been active on the organizing committees of the International Association for Pollution Control (IAPC) Marine Pollution Control Conference, the WWEMA Industrial Water and Pollution Conference and Exposition, and the Engineering Foundation Conferences on Environmental Engineering in the Food Industry (she will serve as cochairman of the 1974 conference). Combining her interests in education and pollution control, she has presented talks and demonstrations on water pollution control in schools and led tours through local sewage-treatment plants, for children ranging from pre-school to high school as well as civic groups.

Mrs. Beach has written or co-authored seven technical papers on the subject of automatic sampling. She is a member of the International Association for Pollution Control, the National Canners Association, the Southeastern Poultry and Egg Association, the Water and Wastewater Equipment Manufacturers Association, and the Water Pollution Control Federation (New York Water Pollution Control Association).

Betty A. Rose

Miss Betty A. Rose is responsible for scheduling her firm's projects and preparing proposals and reports for industrial and municipal clients. Through research into the literature and through personal interviews, she compiles data for state-of-the-art studies on pollution control problems. She is responsible for the firm's public relations program and serves as a consultant to clients in developing their public relations programs.

She earned her BS in Education at the University of Wisconsin in 1955 and studied further at Northwestern University, the University of Indiana, and the Graphic Arts Institute of Chicago. She is a member of Sigma Epsilon Sigma and Phi Kappa Phi.

An active member of the Central States Water Pollution Control Association, Inc., Miss Rose serves as editor of its official publication, WISILLMINN, and was recently elected to the Public Relations Committee. As presentation editor for the Scranton Publishing Company, Inc., Miss Rose wrote a number

of articles on pollution control and was responsible for the final copy editing, layout, and production of WATER AND SEWAGE WORKS, INDUSTRIAL WASTES, and WATER AND WASTES DIGEST. She was the first woman elected to membership in the Construction Writers Association. While assistant editor of ROADS & STREETS and RURAL & URBAN ROADS for the R. H. Donnelley Corporation, she established a computer-operated program to speed the dissemination of equipment information.

At Harcourt, Brace & World, Inc., Miss Rose initiated a Midwest advertising program and worked with state committees on textbook adoptions. At Luxemburg High School, she performed the dual function of teacher and dramatics director.

She is a member of the Construction Writers Association, the Society of Technical Writers and Publishers, the American Society of Business Press Editors, the Water Pollution Control Federation, the Central States Water Pollution Control Association, and the American Institute of Chemical Engineers, Environmental Division.

THEY FORGOT TO TELL ME I COULDN'T DO IT

Yvonne Y. Clark

Associate Professor
Department of Mechanical Engineering
Tennessee State University, Nashville, Tennessee

Miss Phillips, fellow panelists, participants, and guests, my life hasn't been overly exciting, but to me it has had its rewards.

When most girls were playing with dolls, I was troubleshooting my parents' coal-stoker furnace. Every once in a while an oversized piece of coal would just throw the mechanism out of gear or commission, and believe me, when it would get cold at night--my parents appreciated my skill. I was handy around the house in other ways, such as replacing worn-out cords and just keeping most things in working order, or telling them what was wrong when things were taken out for repairs. For Christmas, I wanted an erector set or other mechanical toys, or models of anything that I could build from given directions.

In high school, I ran into a temporary setback when the male instructor in charge of mechanical drawing would not allow a female to take his course. In spite of the fact that the class was not closed, I could not persuade him that I wanted the course and that I believed I could succeed. I don't think he believed that I had been reading schematics or prints and building scaled models. He has since changed his policy on enrollment. I also became interested in mechanical drawing because it would have been helpful in an aeronautics course in which I was enrolled. This science course was to span a year, and during the second semester each student had to make a successful flight of a rubber-propelled model aeroplane that was flown from the third floor to the ground. I had a successful flight and mine was the best-looking aeroplane model in the class. I was real proud of this accomplishment. Praise from the instructor was as gratifying as the grade I received. The aeronautics course led me to join the local Civil Air Patrol unit, which served to heighten my interests in aeronautical engineering.

My academic progress was without further incident. I had taken all of the required mathematics plus trigonometry and solid geometry and one year each of chemistry and physics. If you notice the lack of the "birds and bees" science courses (zoology and biology), you are correct; even now, when I go fishing I use artificial bait, including the worm.

At the beginning of my senior high-school year I began to explore the offerings of colleges to which I might seek admission the following September. Sarah Lawrence, Massachusetts Institute of Technology, Illinois Institute of Technology at Urbana, and Howard University are the ones that I remember. I took entrance examinations to some and made visits to others. Even though

I had a good B or better average in high school, I was considered too young for college in the area of aeronautical engineering.

I followed my parents' suggestion that maybe two years in a northern high school would help my chances to succeed in my chosen vocation. To my dismay, I found out that Girls' Latin High School in Boston considered my southern high-school diploma equivalent to their sophomore class. I enrolled with a full sophomore schedule that September and also participated in their intramural activities, some of which I had not previously enjoyed. My second year in Massachusetts, I attended Roxbury Memorial High School for Girls. Here I was considered a post-high-school student and was able to enroll in courses that would further strengthen my college preparation.

Two Septembers after I had received my southern segregated-high-school diploma, dormitory residence or non-dormitory residence became a factor in my selection of a college. I chose Howard University, in Washington, D. C. Knowing that the curriculum for the first two years for a major in aeronautical engineering was identical with the mechanical engineering curriculum, I agreed to transfer to Illinois Institute of Technology at Urbana at the completion of my sophomore year. After my sophomore year, I wanted to stay at Howard University, and since my parents made the mistake of not saying it couldn't be done, I did it! I received my baccalaureate degree from Howard University.

During my stay at Howard I was the only girl in the Engineering School, and this had its drawbacks. I couldn't study in the building after dark due to a dormitory ruling and it appeared to me that I was called on everyday to recite in class. So from the first quarter I knew I had to have my homework finished for every class period. This was a handicap but in the end paid off. After a couple of years I moved into a girl's dormitory off-campus so that I could study at night in the engineering building.

Upon completion of all requirements for graduation, I was told that I was the first girl in the history of the University to graduate from that department.

During the Spring and Fall quarters of my last year, I signed up for interviews with the few companies that were visiting our campus. One interviewer said that in their training program, which took each graduate engineer from the shop on up to the design area, I wasn't physically strong enough to break down the equipment to repair it. Philadelphia Shipyard wasn't hiring women engineers because of a "seaman omen." A female on a shakedown cruise was just bad luck. Some interviewers just went through the interviewing process because I was on their schedule and others said their company wasn't hiring single female engineers. During these school interviews race didn't cross my mind and the interviewers didn't have to bring it up because they could use sex as a reason for not hiring.

Between December and March of the next year, I became aware of my parents' apprehensions. They were beginning to question my chances of securing employment in my field with the double handicap of race and sex. A Negro girl trying to find a job as a mechanical engineer was unheard of. I filled out the necessary government and other application forms and mailed them to installations and companies in the northeastern area of the United States. Finally I received a favorable reply from Frankford Arsenal, Gage Laboratory, in Philadelphia.

I was pleased with my first job as an engineer. I took my instructions straight from my supervisor and was classified as a Gage Design Engineer. After six months, I applied for a GS-7 classification and was told there were no openings.

During this time, I ran into a problem that I didn't know how to handle. My overtime was cut out because my check was as large as the fellows in my section who had worked up through ranks, and I had come in with a degree and no experience. They told our supervisor that if their demands were not met, his schedules would not be completed on time. My overtime was reduced but nevertheless the schedules were met and I now had time to see Philadelphia.

After some investigating, I found out that there would be a GS-7 opening if one of the employees was able to obtain a bank loan to start his own business. Even to me this was not definite enough, so in my spare time I began looking for another job.

I received an offer from RCA-Camden, New Jersey, in October, for a position as a mechanical engineer. After turning in my two-week notice to the Gage Laboratory, I joined industry. I was one of a new group of trainees and we were briefed regarding our six-month training program, which would include assignments to four different groups. My last rotation became my permanent assignment, at the Tube Division, Harrison, New Jersey. Once again I was the only girl in the section except for the secretary. I was quite happy with my surroundings as a mechanical equipment design engineer on the board and had progressed to signing off my own engineering work, with a couple of draftsmen under my direction.

Love intervened, and in December, after three years at RCA, I joined my husband in Tennessee. I accepted a teaching position in January with my present employer, Tennessee (Agricultural and Industrial) State University, in Nashville.

Once again I was the victim of a communication problem. It happened that the offer I had received was not included in the University budget, and I was informed of this as I was given my first paycheck by the Dean of the Engineering School. My husband and I talked this situation over, and since I wanted to work and to gain the new experience of teaching we accepted the

situation. With my usual enthusiasm, I began my new adventure and added a new dimension to my work experience. A big plus is seeing a freshman mature and become a productive individual in his chosen vocation.

After two years our engineering school went on a nine-month calendar, with faculty free during the summer months to obtain other experience and income, in industry or government. Once again I ran into a job problem, and I think I can say in all honesty, in the South it was the problem of race. On this job hunt, I was more selective with my geographical locations because I was trying to stay near home. The only favorable offer I received was from the first installation that had hired me as a new graduate, Frankford Arsenal.

I worked four summers in their Pittman-Dunn Laboratory as a general ordnance design engineer (mechanical). During my summer employments, I have been quite fortunate to get room and board with families, so as to cut down on living expenses. Since I was a female, I couldn't get the tax break of maintaining two homes, as my male colleagues could.

In the summer of 1962, I accepted an offer to work at Redstone Arsenal, Huntsville, Alabama. This meant I could come home on week-ends as opposed to not getting home at all. I found out here that the personnel office had really done their homework regarding me. My previous employers had been asked "how I handled myself in all-male and/or integrated situations."

My first assigment was with the Dynamic Analysis Group. I enjoyed my work very much, even though some of the problems a mathematics major with a master's would have found difficult. Needless to say, I studied at night for the next day's work. On this assignment, I wrote a technical publication that can be found in the Library of Congress. For the next three summers, I enjoyed my family on week-ends and worked on the Reservation with the Ground Support Group and the George C. Marshall Space Flight Center (NASA) in the design area. While in Alabama, I met professionals who had not worked with a Black Engineer, needless to say a female.

I interrupted my summer government employment when I accepted a fellowship with the University of Houston that was cosponsored by ASEE-NASA. Here I broadened my experience with seminar-type classwork at the University of Houston and engineering work at the Manned Spacecraft Center.

My last summer away from home was with the Westinghouse Electric Corporation, Defense and Space Center, at Baltimore. This was the first assignment where I was concerned with software (people) rather than hardware (equipment) as a member of an interdisciplinarian team of engineers and social scientists. We were involved with a new effort under a Model Urban Neighborhood Program grant. It was this brief experience that served as the impetus toward transferring my interest from hardware to software.

In 1970, Tennessee State University received a Kellogg Grant for faculty improvement. I received permission and financial aid to pursue the Master of Science degree at Vanderbilt University on the Engineering Management Program, in the Mechanical Engineering Department. This two-year program has a year's internship sandwiched between two semesters on campus, plus a thesis. The participants usually are engineers with experience or a new graduate engineer with cooperative education experience.

Again I ran into a job (internship) problem. Industry was in an economic recession, and I could not leave Nashville because of my three-year-old daughter.

After many interviews, in December, I received an offer to come to work in January from the Nashville Glass Plant - Ford Motor Company. At this location, I had a completely new experience as Research Consultant; that is, working in a production plant but involved with a construction area. I was Ford's (Nashville) first female engineer who happend to be black. As usual there was concern: "will she fit in?" - "will the fellows accept her?" - "how will she fare in the plant area with the hourly workers?" I was also the first female to work regularly in the plant area, and this caused more concern during the rebuilding and construction of a float glass furnace. I wore my slacks and shop coat, with my hair under my hard hat (I had hats of three different colors) and went right along with my assignments. One day a worker made a request: would I please wear my earrings when I was in the plant so that I could be recognized at a distance? I thanked him for his suggestion because I knew that shop talk at times should not fall on feminine ears.

Once again I felt I had shown that a female engineer can get a job done and meet a predetermined schedule.

Having completed the internship successfully and apparently with flying colors according to Ford's Industrial Schedule, I returned to the classroom to finish the requirements for the degree. I was the first female to complete this graduate program.

For my next summer employment, I hope that I will be able to work using my engineering management schooling and my industry experience, within commuting distance of my family.

A list of credits of the individuals that had faith in me and my capabilities need not be acknowledged at this time; however, I would like to indicate to all of those who neglected to tell me it couldn't be done, a sincere thank you to each and every one, for I did it.

Yvonne Y. Clark

Yvonne Young Clark, P.E., is the first woman in the history of Howard University, Washington, D.C., to receive a Bachelor of Science degree in Mechanical Engineering. She was the first woman to graduate from the Engineering Management Program at Vanderbilt University, Nashville, Tennessee, where she earned her Master of Science degree.

She was the engineer who at Frankford Arsenal Pittman-Dunn Laboratory in Philadelphia solved the cold-weather jamming condition of a certain ballistic weapon which had stumped male coworkers. At the National Aeronautics and Space Administration's George C. Marshall Space Flight Center, Huntsville, Alabama, she helped check out the Saturn rocket booster that today is man's ticket to the moon.

She was the first female engineer at the Nashville Glass Plant, Ford Motor Company.

The first woman Associate Professor of Mechanical Engineering in Tennessee, she is a senior member and an elected member of the Executive Committee of the Society of Women Engineers, and a member of the American Society for Engineering Education, the National Society of Professional Engineers, the Tennessee Society of Professional Engineers (Chapter Director for 1973-1974), the American Society of Mechanical Engineers, the National Technical Association, the Tennessee Education Association, the American Association of University Professors, and Order of the Engineer.

Married and the mother of two children, she also serves as chairman of the Buildings and Grounds Committee, and chairman of the Child Welfare Committee on the Board of the 18th Avenue Community Center. She has been a recipient of the Long Rifle Award -- Boy Scouts of America, Central District.

STUMBLING INTO ELECTRICAL ENGINEERING

Mildred S. Dresselhaus

Associate Department Head, Electrical Science and Engineering
Electrical Engineering Department and Center for Materials Science and Engineering
Massachusetts Institute of Technology, Cambridge, Massachusetts

It was my fortune to have lived through a most exciting era in science and technology and to have had the opportunity to participate in the action. In this presentation I will tell a little about my background, how it happened that I became an engineer, and then comment on my professional life and work. I never planned to become an engineer. I didn't really learn what engineers do until I was well along in high school. In fact, it was not until I was well established in a career in science (solid-state physics) that I came into electrical engineering through the back door. As far as my professional activities are concerned, I could today be equally well classified as a solid-state physicist or as an electrical engineer.

I will now relate how it happened that I started working in this area. I came from a background of poverty and disadvantage. My parents were immigrants, and had little education. I was raised in New York City during the depression years. I can remember times when I had only one set of clothes and we survived on a subsistence diet. This environment threw me into the work force at an early age. The most difficult job I ever had in my life was my first job, teaching a mentally retarded child to read and write. I was 11 years old at the time I took the job, which involved three hours of work per day, five days a week, for 50¢ pay per week. As I got older, I worked in factories doing assembly-type work. Working conditions were difficult and the pay was low. I learned a great deal from these work experiences. I came to realize at an early age that an education was imperative to overcome my poverty situation. From this work experience I developed a strong motivation to succeed in whatever I did and also to utilize my time effectively.

One factor which influenced my early life was my musical education. My older brother was bestowed with a remarkable intellect and musical talent. At the age of 3-1/2 he took his first violin lesson at a neighborhood settlement house, and he was so outstanding that everyone in town wanted to teach him. By the age of six he was playing concertos with community orchestras. As a consequence of his success, his music teachers were anxious to teach me, too. Although I did not have quite as much talent as he did, nevertheless, it was adequate to enable me to have a very extensive musical education at no cost to my family. Through this musical education, I came in contact with children from the "other side of the tracks," and learned how people of the middle class lived. These other children and their parents became my role models and raised my aspiration level.

As a consequence of my desire to climb out of the confines of my ghetto environment, I aspired to gain entrance to the only good high school that was

available to me -- Hunter College High School, a special school for talented girls in the Greater New York area. No girl from my junior high school had ever passed the entrance exam and the teachers laughed at me for even thinking of applying. I never worried too much about what people said, and, if anything, discouragement from well-meaning people always left me with increased determination to succeed in things that were supposed to lie beyond me. At any rate, between school, my job, and music school, I found bits of time here and there for study. Without really knowing what I was doing, I prepared myself for the entrance exam completely on my own. In passing the exam, I achieved a perfect score on the mathematics portion, an accomplishment which meant a great deal for my self-confidence.

My first few months at Hunter High were an uphill struggle since I had to overcome the handicap of years of ghetto schooling. However, it was not long before I was in the top group of my class. Before the end of my first year at Hunter, I was clearly a highly respected math-science student.

My high-school days were happy days. I loved the intellectual stimulation of this wonderful school and was completely happy doing my daily routine -- school, my job, music school. I gave no serious thought to a professional career. Because of my very modest circumstances, the school guidance counselor offered me no career counseling, nor did I seek such counseling. It was therefore by inertia that I passed from Hunter High School to Hunter College. At Hunter College, I planned to major in elementary-school teaching, and to me, at the time, this seemed to be a realistic and rewarding goal in life.

My professional career can be said to have started with freshman physics. My performance in that class impressed my teacher sufficiently so that she, on her own, started to offer me career counseling. She suggested that a career in science would be more suitable than elementary-school teaching; this lady professor maintained an interest in me throughout my undergraduate days at Hunter College and broadened my horizons by many orders of magnitude. While at Hunter College, I took essentially every course that was offered in physics, chemistry, and mathematics. (No engineering courses were available.) These courses were not very sophisticated or advanced and were in many ways an inadequate preparation for a top-flight graduate school program. However, I didn't find this shaky preparation to present a serious obstacle in my career. Being a star at a lesser woman's college had its benefits in terms of guidance, encouragement, and financial reward. In fact, as an undergraduate I earned not only enough money to pay all undergraduate costs but also enough savings to finance most of my graduate education.

The people at Hunter College were very supportive and encouraging, and sort of pushed me into the "big time." From Hunter College I was awarded a Fulbright Fellowship to study physics for a year at the Cavendish Laboratory in Cambridge University, England. For someone whose experience hardly extended beyond the confines of New York City, this opportunity was far beyond expectations or comprehension. I worked hard at Cambridge and had a most

rewarding experience both professionally and socially. I used this year to overcome some inadequacies in preparation and to learn what science was all about. I found that I could compete successfully with the very talented students at Cambridge. Being an American helped greatly with the social side of life; my strong liberal arts background and my extensive musical education disguised my humble background, which would otherwise have been a serious obstacle in the class-conscious England of the early 1950's.

From Cambridge, England I went to Cambridge, Massachusetts to study at Radcliffe College, and it was here that I completed most of my graduate course work in physics. This was an exciting time in the Harvard Physics Department. My arrival followed shortly after Professor Schwinger's major breakthrough in quantum electrodynamics, for which he later received the Nobel Prize in physics. During my first term at Radcliffe, Professor Purcell was awarded the Nobel Prize for his pioneering work in nuclear magnetic resonance. Solid-state physics was also beginning to emerge at that time as a discipline. In 1947 the transistor was discovered, ushering in an age of semiconductor technology.

After completing the requirements for the AM degree I left Radcliffe, for purely personal reasons, to continue with my graduate education at the University of Chicago.

At the University of Chicago, I developed a great deal of professional independence and self-confidence because of their emphasis on individual and independent thesis research. Although my thesis advisor was totally unsympathetic toward careers for women, this had very little effect on me because I did my thesis work pretty much on my own, with essentially no help from him. This was not particularly a matter of planning; it just happened that way. I started working on a problem in the high-frequency behavior of a superconductor in a magnetic field, with a visiting professor from the Cavendish Laboratory in England, and there were not many people around Chicago who could provide me with much help.

My teaching career had started with my first job, teaching a mentally retarded child to read and write. Throughout high school and college, I did a vast amount of tutoring. In those years I tutored anything that was needed, and was very successful at it. This work not only provided me with a plush income but gave me extensive teaching experience. When there was a need for a teaching assistant at the University of Chicago, I volunteered because of my own interest and not for any financial reward (I remember having a fellowship). I loved this job and was especially good at it. It was flattering to have all these men students coming to my recitation sections rather than sections run by the male teaching assistants. I found that I could be natural, friendly, and relaxed with men students. This experience turned out to be very valuable later on.

When I took my PhD degree in physics at the University of Chicago, I had all kinds of professional opportunities. I have no idea whether the men had

better opportunities than I did, but I could essentially choose what I wanted to do. I decided, for personal reasons, to go to Cornell University as a National Science Foundation postdoctoral fellow. It was at this time that I married Gene Dresselhaus, a theoretical solid-state physicist who was a junior faculty member at Cornell. During the two years at Cornell I did some research and undergraduate teaching in the Physics Department, but my performance was not in any way outstanding. During that period my first child arrived. I was, in part, learning how to manage a family and career, and I never did get things organized particularly well. Because of nepotism rules, it was clear that my husband and I both didn't have a promising professional future at Cornell, so we decided to go to a place where we could both get good jobs and do research work together.

We found an opportunity at the Massachusetts Institute of Technology Lincoln Laboratory. My seven years at Lincoln Laboratory proved to be the most productive years of my research career. The research facilities here were excellent, and I was given a great deal of encouragement and support. At this time I was still classified as a solid-state physicist. My years at Lincoln Laboratory were the years when the children were coming thick and fast (my four children came in less than five years). By work on a number of research problems with my husband, the mechanics of running an active research career and a home were easily solved. Dr. Benjamin Lax, who headed the Solid State Division at Lincoln Laboratory, had an enlightened view toward women scientists and was very proud to have both Laura Roth and me in his research group.

Some of my research activities brought me to the M.I.T. campus and to the National Magnet Laboratory. As a result of this interaction with the solid state research groups on campus I was offered, in 1967, a visiting professorship in the Electrical Engineering Department under the auspices of the Abby Rockefeller Mauzé Chair. I would consider this the time when I entered the engineering field. My appointment as a visiting professor allowed me to try out the life of a professor for a year in order to see what it was like. I was fortunate in having an active research program in progress at M.I.T.; this gave me some time to do other things. There seemed to be a need for a more comprehensive solid-state graduate course and I began to teach such a course in the Electrical Engineering Department. I sensed a need for an interdepartmental student research seminar in the solid-state area and organized that, too. I got lots of student support and enthusiasm for these efforts. In addition, I ran a little discussion group for women students which addressed itself to problems faced by career women.

I really loved this year at M.I.T., and I suppose that my enthusiasm attracted the attention of some of the important people in the Electrical Engineering Department. And so it happened that the Electrical Engineering Department did offer me a permanent professorship when the visiting appointment expired. I served in this capacity for three and a half years (1968-1972), after which time I was appointed an associate department head, in the Electrical Science and Engineering part of the department. This represents a

significant administrative commitment because the department has about 100 faculty members and 1100 students.

During my stay at M.I.T. I have been involved with the normal activities of a professor in the Engineering School. I have been active in teaching graduate and undergraduate courses. I have supervised theses of PhD, EE, MS, and BS candidates. Our research group has been deeply involved in studies of the electronic properties of solids, with particular reference to optical and magneto-optical properties of semiconductors, semimetals, and metals. In these activities, I have interacted almost exclusively with men. I have not found my sex to be an obstacle in getting any particular job done. In a first encounter I am sometimes not taken seriously, but it soon becomes clear that I am a professional and mean business. It may be that I have encountered discriminatory practices during my professional career, but I was not aware of it. Whether it is true or not, I have always felt that being a woman benefited my professional career. I have always received a good deal of professional attention and recognition.

It is also of some significance to discuss my professional activities in the cause of women. From the beginning, I have been involved with informal counseling of women students. I have worked for a number of years with the Undergraduate Admissions office to increase the number of women students at M.I.T. It is our experience that our women students tend to study science and engineering courses in the same proportion as our men students. Therefore, the increase in the number of women students from about 6 percent when I came to M.I.T. to 15 percent in this year's freshman class represents a major increase in the pool of women in science and engineering.

Two years ago, I worked with a group of students and a staff on a study of the Role of Women Students at M.I.T. A number of reforms followed which have had a big impact on the lives of women students there. I have also been involved in starting the Women's Forum, a weekly discussion group on women's issues, attended by women who work and study at M.I.T. This group has been instrumental in bringing about many improvements in working conditions for women staff members and employees. We have started an open-house meeting for prospective engineering students, mainly addressed to freshmen; this was very successful and we hope to continue this program in future years. We have also had a Careers Day program for high-school students within 200 miles of M.I.T., sponsored by the Admissions Office and the Women's Student Association. This program has also been extremely successful and we hope to continue reaching high-school students and interesting them in science and engineering.

In closing, I must acknowledge the continued help, support, and encouragement from a loving husband and four wonderful children. My husband has always been interested in furthering my career. With his help and a faithful baby-sitter who has worked with us lovingly for 12 years, our household has been managed happily. Our children take an interest in both mother's and father's work and are quite fascinated by all the interesting house guests and foreign travel that

are by-products of our careers. Our children have been given a great deal of independence and responsibility at an early age and are the better for it. I would assert that it is possible to provide loving care to a family while carrying out an active professional career.

Mildred S. Dresselhaus

Mildred S. Dresselhaus is Associate Department Head in Electrical Science and Engineering, of the Electrical Engineering Department, and a member of the Center for Materials Science and Engineering, at the Massachusetts Institute of Technology. She is also associated with the Francis Bitter National Magnet Laboratory there, where most of the experimental work of her group is carried out. She has been active in the study of the electronic properties of solids, optical and magneto-optical properties of solids, transport properties at high magnetic fields, electronic energy bands, semimetals, semiconductors, magnetic semiconductors, and microwave properties of superconductors in a magnetic field.

She received her AB at Hunter College in 1951 and was a Fulbright fellow at Newnham College, Cambridge University (England) in 1952; received her AM at Radcliffe College in 1953 and her PhD at the University of Chicago in 1958; she was a Bell Laboratories fellow at Chicago in 1956-57 and a National Science Foundation postdoctoral fellow at Cornell University from 1958 to 1960.

Her first association with the Massachusetts Institute of Technology was as a staff member in the Lincoln Laboratory. After seven years there she held the Abby Rockefeller Mauzé Chair as visiting professor in the Massachusetts Institute of Technology Electrical Engineering Department in 1967, and joined the department in 1968. She has been a visiting professor in physics at the University of Campinas (Brazil), at the Technion, Israel Institute of Technology (Israel), and at Aoyama Gakuin University and Nihon University (Japan) during the summers of 1971, 1972, and 1973, respectively.

Mrs. Dresselhaus is a Fellow of the American Physical Society, a senior member of the Institute of Electrical and Electronics Engineers, a consultant to the National Science Foundation Materials Science Program, and a member of the National Academy of Sciences Solid State Sciences Advisory Panel. She received the Hunter College Hall of Fame Alumni Award in 1972 and the Radcliffe College Annual Alumnae Award in 1973.

Married and the mother of four children, Mrs. Dresselhaus in private life is active in the music field.

MY CAREER AS A HEAT TRANSFER ENGINEER

Nancy D. Fitzroy

Manager - Heat Transfer Consulting
Research and Development Center
General Electric Company, Schenectady, New York

HOW I STARTED IN ENGINEERING

I first started thinking about engineering studies when I was a senior in high school. I deliberately avoid the word "career" when referring to that point in time because it never occurred to me that I might start work at the finish of school (which at the time of my graduation was the bachelor's level for most engineering students) or that I would continue to work until the present time. I won't belabor that point, because I believe that the social pressures that dictated that "ladies do not work" are no longer valid. Anyhow, there I was nearing the end of my senior year in high school and I had not yet applied to any college for entrance, nor, indeed, was I interested in spending four years studying English, as most of the other young ladies in my college-preparatory course were planning to do. As you might expect, my father and a friend of his, who was vice-principal of my high school, had a "talk" with me.

The discussion went down the usual route of teaching, nursing, mathematics (so that I could teach, of course), et cetera. Finally Mr. Goodwin (my vice-principal) said, "Have you considered engineering?" At first I thought he was being facetious; then we realized he was serious and it was worth further thought. My eldest brother was an engineer and my father a building contractor, so I had someone to talk to about what engineering was all about. I do not remember any comments from two elder sisters and another elder brother. I only have the impression that they were not surprised by my choice of engineering.

The next step was to find a school which had a good engineering curriculum. Mother wanted me to go to a girls' school. To seek advice, I wrote to the two schools which had reputations as being the best engineering schools in the east (M. I. T., R. P. I.), albeit they were men's schools (or so we thought!). Lo and behold, they both sent back applications for enrollment, with no mention of any other engineering schools. I filled out the forms and returned the applications (a bit tongue-in-cheek). They both accepted me for enrollment.

My choice of a branch of engineering was based on my idea of where it was most likely that girls would be accepted in the work force and on the basis of my strengths in high school, viz., mathematics and chemistry. I had not had the opportunity to study physics or drafting in high school. I wish I had had physics. It wasn't until much later that I found out how much fun understanding the physical principles underlying things can be.

I think that all branches of engineering offer employment opportunities for women today. Where once civil engineering was the last place for a woman to look, today I think she would find almost limitless opportunities, with the current emphasis on the control of our environment.

The actual completion of the course work for a bachelor's degree in chemical engineering poses the fewest difficulties for a girl. The students don't seem to mind your being there. For the most part the professors don't mind either, except for one or two of the old school who resent their classes being "disrupted" by the presence of a female. The only concrete objection which I heard was that it cramped their style in joke telling. I hope that wasn't their total basis for rapport with their students. The curriculum was carefully scheduled, with few electives, so there was not much decision-making required on the part of the student in that area. Study partners were nonexistent, because I lived off campus (in a well-chaperoned private residence). In my senior year, we girls were able to convince the president to make a private house available for girl students, although I remained in the same residence for all four years.

GETTING THE FIRST JOB

Getting the first job is the big hurdle. You can prove yourself after you are there, but how to get there? Jobs were scarce when I graduated; scarce for men, particularly so for girls. I was not able to convince anyone that I was serious about staying in an engineering job for a least five years. I was told that the norm for girls was two years and that in a professional job it takes at least three years before anyone is worth his salt. Somehow, those two numbers came out negative. I was hired by a large corporation as an engineering assistant, to perform engineering calculations. Actually I did junior-engineer-type work. In two years, when some really exciting work on guided missiles came up in another department of our company, I applied for a job doing thermodynamic analysis of the alcohol and liquid-oxygen tanks of the missile during flight. Again, I met the same impasse. If you can do engineering work, why aren't you being treated as an engineer now? My prospective employer gave me a written test! I was terrified, and somewhat lacking in confidence because of my previous experience. I must have passed the test, because I was offered employment in the new location, but still as an engineering assistant. I felt it was better to be on a job where "the action is," in spite of the same position level, so I took it. In six months' time, I received word that since I was doing the same caliber of work as the other engineers I would henceforth have the title of development engineer, and I was given a raise in salary, too.

Since that time, things have gone relatively smoothly. I have continued to be employed by the General Electric Company. I have continued to do very specialized technical work, consulting in the field of heat transfer. The fun in my job comes from the variety of prospective products which I work on -- everything from space satellites to new kitchen appliances.

Working with all-male engineers seems to pose no more problems than it did in school. Engineers in general are some of the most even-tempered, steadiest people whom I have met. They treat you according to the caliber of engineer you are. But may I add that for a girl it helps to be just a little better than average.

As for discrimination, I was treated fairly within the context of what was deemed fair at the time. I didn't make as much as the other (male) engineers, but I did make a whale of a lot more than any girl I knew (although I admit that none of my contemporaries continued to work for long). I do think that salaries for women engineers everywhere will soon be on a par with male engineers of the same caliber and productiveness. In fact, starting salaries for women engineers, in many cases, now exceed those for males.

WHAT ENGINEERS DO

The first question I am usually asked is "What do engineers do?" They invent, design, and manufacture nearly every article we use in our daily lives, from the clothes we wear to the satellites which permit us to get the news live while it's happening throughout the world. We also build all those things you didn't know you couldn't do without -- the electric toothbrush, self-cleaning ovens, ice makers and automatic defrost for refrigerators, permanent-press fabrics, Teflon pots and pans, cordless appliances, electric light dimmers, air conditioners.

The example I like best, being a helicopter pilot, is the fact that although the initial concept of the helicopter was devised by Leonardo da Vinci, close to 400 years elapsed before a practical, flying helicopter was designed by Igor Sikorsky, simply because of the lack of design technology and of engineers to carry out Leonardo's ideas. All disciplines of engineering are represented in the helicopter: mechanical drives, electrical control system, engine design and combustion processes, and in more sophisticated flying machines, computers that take primary navigational information and provide flight commands and courses.

Another example which might interest you is the house of the future: a sealed house with odor removers, dust removers, electrostatic precipitators, and recirculating wastewater systems. In other words, it is a controlled, totally self-contained environment.

WHAT I DO AS A HEAT TRANSFER ENGINEER: A REPRESENTATIVE PROBLEM

A typical problem requires teamwork among several engineers with specialties in different technical areas. For example, I am part of a team working on the development of a high-temperature motor.

Why a high-temperature motor? Conventional motors familiar to most of us are designed to run in air at normal temperatures; that is, at temperatures encountered in a house (70° F) or those found outdoors in Phoenix, Arizona (110° F). The air that surrounds the motors is the coolant which keeps the motor from "running hot." Now, suppose a motor is needed which will operate in an environment where the air temperature available for cooling is very hot and where the surrounding surfaces are even hotter; for example, in a steel mill near the furnaces, where the nearby steel temperatures are as high as 1500° F, or in a power generation facility.

Why does it matter if the motor temperatures will be significantly higher than in normal operation? One of the criteria for selection of materials used in the electrical insulation used to insulate the coils in motors is the operating temperature. Conventional electrical-insulation materials are limited to temperatures below 400° F. Some special insulations can be used at temperatures to 430° F. These materials are limited in temperature because they are organic materials and they will "burn up" and the motor will short out (fail) if the temperature is too high. Therefore, if we need a motor which will run at higher temperatures, a special inorganic insulation will have to be developed. This is the job of the ceramics engineer or ceramist. He, too, will impose temperature limitations on the design because there will be a temperature above which his special insulation will not operate properly without deterioration of the electrical characteristics, although it won't actually "burn up." This temperature limitation will be much higher than for conventional insulations.

How do you cool a motor? The air surrounding the motor is blown over it or circulated through it. Sometimes the surrounding walls are cooler, and the motor thermally radiates to the cooler surroundings. The surroundings may be hotter than the motor, and thermal radiation shielding will be needed to minimize the incoming radiation. In addition to providing shielding for radiation protection from surfaces at higher temperatures, or providing fans to blow air, thermal analyses are made of the interior of the motor, namely in the coils, with their electrical insulation, and the steel laminations.

There may be other materials in the motor which will also have their own temperature limitations; for example, copper or aluminum wire oxidizes or loses strength if it becomes too hot. Heat-transfer calculations are made with a slide rule at first to "rough out" the design; when the geometry layout becomes more nearly final, a computer is used to predict the operating temperatures throughout the motor and to help to pinpoint areas where design changes can be made to give better heat transfer and, hence, lower temperatures. This is the job of the thermal (heat-transfer) engineer.

The electromagnetics (EM) engineer, also, can help the thermal engineer to reduce temperatures. It's he who decides on the number of turns of wire in the coil and their placement, and the amount or location of the steel

in the laminations (core). It is these parts which generate the heat and are responsible for the need for cooling. By judicious arrangement of coils and core, he can help to minimize the generated heat which the thermal engineer will have to dissipate and can provide low thermal resistance paths from the interior of the motor to the surface so that the heat generated in the interior can be removed.

These three engineers are the development part of the engineering team: the ceramics engineer, the thermal engineer, and the electromagnetics engineer. They must work together to make "trade-offs" which will give the best overall operation. In this stage of development, the work of these engineers is entirely analytical; that is, their expertise in their related fields is used to perform computer-aided calculations to predict whether such a design would operate as desired, both electrically and thermally.

The next stage is to make tests in the laboratory to determine whether the motor will perform as predicted in the calculations. A "prototype" motor is built in the development shop according to special design specifications arrived at from the analyses mentioned above.

A motor is then built and instrumented both electrically and thermally to confirm the temperatures shown by the thermal analysis. The instrumentation itself may not be simple. If the motor is very compact to keep it small enough to fit in a confined space, there may be very little space available to insert within the motor the numerous wires (thermocouples and magnetometers) which are necessary to obtain the required readings. Again a trade-off must be made between the number of thermocouples and magnetometers and the space available in the motor while still making certain that it is possible to take enough readings so that a successful design is assured.

The challenge comes in using one's ingenuity, combined with that of others on the team, to develop a workable design which will operate at conditions that are beyond the limitations of current practice in that area of design.

COMBINING WORK AND MARRIAGE

Combining work and marriage, for me, has not been difficult, for two reasons. One is that we have no children, and two is that I have, since marriage, had outside help with the housework and laundry and my husband has had help with yard and grounds maintenance. We have therefore had time to devote to things we liked to do together, like building our house single (two) handed without the help of architects, contractors, carpenters, and masons. I have always enjoyed cooking, and my husband is now taking it up. He's the fish chef. I encourage fish seven days a week! I used to make most of my clothes, including suits and coats, and have made sails for a small sailing pram and have kept the sails for our Starboat in shape. We still have time to do things together. We both like to travel and take occasional trips in our twin-engine airplane. I continue to fly helicopters on occasion, too.

I feel that a married woman engineer should have hired help with the household chores. The amount of money it takes from her salary will eventually be more than repaid by the promotions which come with being a good, competent engineer. In the meantime, the reward is that of personal satisfaction that comes with the work. Extra time must be devoted to the job occasionally (and sometimes frequently), as is required of all professionals.

ONE FINAL BIT OF ADVICE

A young woman should not expect lots of glamour and boys, because that is not the way it is. I'm a hard-working engineer, but it took something silly like flying the helicopter to get invited to the White House for tea.

Executive Officer, Deputy for Space Communications
Space and Missile Systems Organization
U.S. Air Force Systems Command, Los Angeles Air Force Station, California

Good Morning. I am delighted to have been asked to participate in this conference and highly flattered to have been asked to give a role-model presentation. Particularly when I consider the caliber of engineering talent represented on the stage this morning -- and that in the audience. As a matter of fact, after the presentations we've heard so far, I feel like Tommy Manville's tenth wife must have: I know what I'm expected to do -- I just don't know how to make it interesting and different.

It is best to start, I think, with the most important factors which have shaped my life and career and then briefly review some of the highlights of that career.

First and certainly the most important, of the three influencing factors of my life is the fact that I am an only child and that I have pretty special parents

As I grew up, I was never assigned a restrictive sex role, never told "you can't do that because you're a little girl." Except, perhaps, the time I blacked a little boy's eye on the football field and my mother explained that that really wasn't very ladylike. I had both dolls and guns, erector sets along with cooking sets, doll houses and toy microscopes. In other words, I was not conditioned to accept limitations in my career choices simply because I am a woman.

Additionally, it was taken for granted as I grew up that I would go to college and have some sort of career objective, in addition to a probable role as wife and mother. When I did make my career choices, first in engineering and later in the military, I received full support from my parents. I have to admit, however, that my mother wasn't overjoyed about my joining the Air Force. Fortunately, she later became one of our most enthusiastic recruiters.

The second most important element that influenced my career decisions was the fact that peer approval or disapproval was not as important to me as it appears to be for most young people. And I'm not sure I know why that should have been; perhaps because we moved so much as I was growing up. My father's oil-business career took us from Oklahoma to Texas, Kansas, Illinois, and Kentucky. All in all, I attended 19 schools and lived in some 60 houses before I went to college. Of necessity, I became pretty independent and self-assured. But whatever the reason, I rather liked being a "maverick," and my decision to become an aeronautical engineer in my sophomore year of high school fitted that pattern.

The decision to join the Air Force was another matter entirely. It was simply a matter of point in time, as I shall explain later. I have to list then, as the third influencing factor in my life, that particular part, of the 20th Century in which I have lived. Pearl Harbor occurred my freshman year in high school and World War II was over immediately following my graduation from high school.

I'm sure that all of you who are old enough to remember World War II are aware, but I doubt that our younger friends are, of the dynamic changes in attitudes toward the employment of women that came about as a result of that war. During our 1971 conference here, John Parrish told us, "Changes in the status of women and in the relations between the sexes tend to occur when they suit the needs of the society, which often means when they suit the needs of men. The traditional view of women's role is always shelved for the duration of a war, during which women are praised for leaving their homes and holding down a 'man's job' while men are in the military services. At the end of both world wars, fewer women returned home to traditional lives than had left their homes at the beginning of hostilities. A taste of independence and active engagement in the work of the world can have a heady quality to it.

"Overwhelming manpower requirements during the 1940 to 1945 time period coupled with extraordinary technological advancements produced a demand for engineers that could not be met by men alone. Women math and science majors found themselves courted by both industry and government. Many found themselves engineers-in-training, while others were enrolled in comprehensive, accelerated courses in almost every engineering discipline."

After the war, hundreds of young women -- and I was one of them -- joined the returning G.I. and quite literally flooded the nation's engineering schools. By 1950, there were 6314 women engineers in the United States, as opposed to 991 in 1940. I'm sure that the influence of that period on my life must be apparent.

As I said, my decision to become an aeronautical engineer was made my sophomore year in high school. I owe a great deal to a very wonderful woman -- my freshman algebra teacher -- for her guidance and help in arriving at that decision. It was through her wisdom that I investigated several careers that would combine my love of mathematics, aptitude for art and mechanics, and overwhelming interest in aviation.

It was at this same time that I received some small inkling of what it meant to be a woman in a man's career field. Because I was a girl, I was not allowed to take high-school courses in drafting or aeronautics. My choice of colleges was dictated to some degree by this same type of prejudiced thinking. I found that most schools offering a <u>good</u> curriculum in aeronautical engineering were not open to women in 1945. A notable exception, and one that prompted me eventually to travel from Owensboro, Kentucky, to Los Angeles, was the University of Southern California.

The trip was not direct. Although they supported my career choice my parents decided that, as a woman, I would need some balance that would not be provided in a College of Engineering. I therefore spent my first two years at a select girls' school in Missouri, where, incidentally, I had a ball!

From one extreme to another, I left Missouri to enter SC at the height of the post-World War II GI influx. The 1947 enrollment of the School of Engineering was 3000 students, eight of whom were rumored to be women! I say rumored because in my three years at SC I never had another woman in any of my engineering classes -- and, as a matter of fact, I only met one other girl foolhearted enough to brave the engineering campus! She, by the way, went on to become the first woman to earn her Master's in aeronautical engineering at SC.

I was privileged in 1963 to attend the National Conference on Women in Engineering sponsored by SC's School of Engineering. It was gratifying to see that in 13 years progress had indeed been made in tearing down the barriers to women in this field. For I discovered, in 1947, that although the University of Southern California allowed women to register in engineering, the Dean of Engineering and most of the professors didn't go along with the idea. Quite a few of them, and some of my fellow students, let me know quite emphatically that they felt that a woman's place was in the home. It was at this point I appreciated my past two years of girls'-school social life, for the next three years were just plain hard work.

My decision to join the Air Force when I graduated was a purely economic one and hadn't been a part of my original plans at all. This was just prior to the Korean War and aeronautical engineers were a dime a dozen. Many of the men who graduated a year ahead of me were still looking for jobs. Industry wasn't about to hire a woman! I thought that I would join the Air Force for a few years, get some experience under my belt, and thus be in a better position for a job in industry. I never dreamed that such a practical decision would lead me to a dedicated military career.

Incidentally, my one and only taste of industry employment didn't leave me with a very good impression. I had already been accepted by the Air Force but had a six-month delay before reporting to Officer Candidate School. I therefore took a job as a junior draftsman with a civilian firm who shall go unnamed. I replaced a man who had been drafted, and immediately took a $100-a-month cut in salary because I was a woman. I'm happy to hear that this isn't happening very much any more.

Looking back at my early days in the Air Force, I wonder why I thought it was any different. My first assignment as an officer was not as an engineer but, of all things, as a recruiting officer. We were, of course, in the midst of the Korean War and recruiting was an important job, but why an engineer? I still don't know the answer, but I must admit that I don't have any regrets (other than that I froze to death in Minnesota) for that assignment.

As I have since discovered, the best technical idea in this world is only as good as you can sell to the boss. And this can really become important if the "boss" is the Congress of the United States. SC didn't teach selling in engineering school, but it was an important part of recruiting. Furthermore, where, in an engineering job, could I have had the experience of having my own radio and television programs, of making dozens of speeches, and of meeting some wonderful and important people in show business, politics, and community affairs?

After 26 months of recruiting duty, the Air Force assigned me to one of our main research and development centers -- Wright-Patterson Air Force Base, in Dayton, Ohio. Although my orders said I was to be assigned as an aeronautical engineer, neither the Air Force nor myself reckoned with the human element! The officer in charge of making specific assignments was a very well-meaning if misguided man. He firmly believed that all women excelled in administrative work and so assigned me as a personnel officer in one of the R&D labs. But obviously the good Colonel had never read LADIES' HOME JOURNAL. He had not learned to "never underestimate the power of a woman!" He soon assigned to our lab a young male second lieutenant -- a Fish and Wildlife forestry major from the University of Oregon. Not finding any better way to use his talents, I trained the lieutenant as a personnal officer and my replacement, and assigned myself as an engineer. I've been one ever since.

My tour in the Reconnaissance Laboratory at Wright-Pat was the dream of every young Air Force engineer. We do not do much pure research or development in the military. Most of our work involves managing and monitoring the work of industry. My first engineering job -- to which I assigned myself -- was one of our few exceptions. My work involved the design and development of various atmospheric sampling devices, some mounted on high-speed aircraft and some ejected while in flight, with data being telemetered back to the aircraft. Each probe, instrument, or sounding device had a different purpose, but basically the information gathered by them was used to predict weather conditions or to measure nuclear or radiological particles in the atmosphere. As a part of the design effort required, I set up and ran my own wind-tunnel tests and correlated results by running my own flight tests.

Being on non-crew flight status for the purpose of testing my equipment introduced some interesting problems directly attributable to my being a woman. None of the standard Air Force oxygen masks fit me. They are all too wide at the bridge of the nose, causing a small stream of oxygen to be directed at each eye. The boys in the Aero medical lab finally solved that one by making me a new mask. It fitted like a glove. But, then, it should have; I spent six hours in a plaster facial to get it.

There was also a small problem of a parachute. Generally, parachutes are kept at a central supply station, where they are checked in and out before and after missions. After my first few flights, I was assigned my own parachute. Several six-foot, 200-pound pilots had expressed, in colorful language

I'm sure, their irate displeasure at having to let out all of the eight straps, which I had carefully pulled in so that the chute would fit me. And I might add that I was about 50 pounds lighter then!

It was at Wright-Patterson that I made my decision to make my career in the Air Force. Several things influenced that decision. First of all, I found I liked being in the military -- the people, the feeling of one big happy family, the travel (I was making an average of one or two trips a month -- to Washington, to California, Texas, etc.). But most of all I liked the work I was doing and the responsibility I was given. And at none of the contractors with whom I was working did I find women in positions comparable with mine. Finally, although it sounds a little corny to say so, I must admit that I enjoy knowing I am doing something for my country, even if I don't get paid as much as I would in industry to do it.

I could spend hours telling you of my five and a half years at Wright-Pat, but I'll summarize by saying that two of my most interesting projects involved the development of a high altitude, aircraft launched, rocket-sounding device; and the design and installation of weather reconnaissance equipment on the U-2 before Gary Powers made the world aware that we had such an aircraft.

From Wright-Patterson I went to Andrews Air Force Base in Washington, D.C., where I served on the staff of General Bernard Schriever, Commander of the Air Force Systems Command. My main task there was to help in the design and establishment of a real-time technical and management information system that would enable General Schriever to be immediately aware of the progress and problems of the key aeronautical, space, missile, and electronic systems under development for the Air Force.

The task was a real challenge, for the problems of how to best manage 40 percent of the Air Force budget are not easy ones. For one man to be aware of all problems and to be in a position to make final decisions concerning hundreds of systems and technical programs requires the application of the best technical management techniques. Timing for such information is particularly critical. I think that those who are in industry can especially appreciate the problem. When the president of Wigget Company, who is a contractor to the Aeronautical Systems Division in Ohio, calls his Congressman about some problem in his dealings with the Air Force, it is vital that the Air Force Systems Command in Washington also be aware of the problem, because all the Congressman will do is turn right around and call the Air Force. It was my job to be sure we knew all the facts before we received that call.

After four years in Washington, I was finally able to get back to California. And once more I had a challenging and exciting job. I was a captain when I arrived at Space Systems Division in Los Angeles and a lieutenant colonel when I returned to Washington five and a half years later. During that time, I served first as a project officer, later as deputy chief of engineering, and finally as chief of program control for the Gemini Target Vehicle System.

If you are at all familiar with the space program, you know that the Gemini manned space program belonged to the National Aeronautics and Space Administration. What most people do not realize is that the Air Force -- specifically the Space Systems Division -- launched over three-quarters of the nation's civilian spacecraft and scientific satellites and actually developed many of them for NASA.

My office was responsible for the design, development, test, and launch of the unmanned spacecraft which was used in space by the astronauts to develop the rendezvous and docking techniques which have been vital to the Apollo program. The Gemini Target was a modification of the Air Force Agena D standard space vehicle and was boosted into space by the Air Force Atlas standard launch vehicle. It was a fascinating program to work on, from writing the request for proposal through launching six vehicles into 161-nautical-mile circular earth orbits and the world's first successful docking of two vehicles in space. Not the least of its fascination was working with the astronauts themselves. I was particularly interested in our first moon landing because Buzz Aldrin, the second man to walk on the surface of the moon, was a fellow project officer in the early days of the Gemini program and had the desk next to mine.

I would like to emphasize, particularly for our students, that the day-to-day work on a program even as significant as Gemini is not glamorous or exciting. Each day is filled with dozens of small problems to solve, letters and reports to be written, messages to be coordinated, and meetings to be attended. It seems at times that the telephone is permanently attached to your ear and that every paper in your IN basket reproduces itself when you're not looking. The only real moments of excitement come when you sweat out the success or failure of each launch. It is only when you can look back on a program that you've had a small part in that the total picture becomes apparent.

There was another significant facet of my tour at Space Systems Division that I would like to discuss for a moment. As I stated earlier, I was promoted from captain to major to lieutenant colonel during this time period; all on one program. It was not until the program was completed and there was a need to reassign me to another job that I discovered that my wonderful Air Force, where I had encountered no discrimination since that first assignment at Wright-Patterson, was suddenly doing everything possible to keep from giving me a position of command. I must admit that encountering that management barrier was quite a shock. Perhaps it should not have been, perhaps I should have expected it, but I had really received no warning. I knew that women in other career fields in the Air Force were having some problems, but their circumstances were entirely different from mine. I was the only woman in the Air Force in my position and I really thought I had it made.

And I still thought so, although my confidence was shaken somewhat, when I was finally assigned as Chief of Program Control for the Agena program. A reorganization a short time later showed me the pattern of the future. I was

(Army, Navy, Air Force) agency of the Department of Defense, I carried a duty-title of Research and Development Director. It was a misleading title, however, for in fact I directed very little. Because it was concerned with our national intelligence program, I can say little more than that.

Without a doubt, I virtually assured that I would not be promoted when I pulled strings to be returned to Los Angeles. However, I was not aware of it at the time, or at least not aware that it was more than a calculated risk. I should have been. I should not have allowed the fact that I was away from the mainstream of the Air Force for two years to keep me from following the changes that were taking place. Priorities were changing within the Air Force, primarily because of the war. Even women were now pulling repeated tours in Viet Nam, and a Southeast Asia tour became almost a required ticket for promotion. The other magic ticket was command -- and I couldn't get one.

When I returned to Los Angeles to the renamed Space and Missile Systems Organization, I was first assigned as a Deputy Chief of Programs, Budget Division, and have very recently been reassigned as the Executive Officer for the organization responsible for all Department of Defense, and some international, space communication satellites. Both are important and interesting jobs, but they are not stepping stones for promotion. And I must admit that I am still finding that pill a little hard to swallow. For that reason I shall probably be leaving the Air Force within a year or two to explore the great civilian world outside.

To borrow a quote, "let me make it perfectly clear" that I am not feeling sorry for myself or invoking sympathy. I have deliberately told you of the disappointments of my career as well as the successes because I think they are important in career guidance discussions. Long ago one of my uncles told me to set my sights on the most distant star I could find. He told me that I might not reach it but I would certainly pass many bright and interesting stars along the way. And I have, and I expect to pass many more, but not on the original path I established. I fully expect that others will, however, for I am passing along my lessons learned to the women engineers who are following my footsteps in the United States Air Force.

In conclusion, then, I would just like to point out that success is a relative thing that can be measured in many ways. That is best illustrated, I think, by the story of a charwoman in a New York bank who was telling of her prowess in polishing floors.

"When I started to work here the floors was in bad shape. But since I've been doing them," she said with quiet pride, "three ladies has fell down." May all of our careers be as successful.

Arminta J. Harness

Lieutenant Colonel Arminta J. Harness, as the first woman engineer to join the United States Air Force, has been in the unique position of trail blazer for the 21 years of her military career. After two years at Lindenwood College for Women, St. Charles, Missouri, she became the second woman aeronautical engineering student enrolled at the University of Southern California, where she received her Bachelor of Engineering degree.

She entered the Air Force in 1950, serving as WAC/WAF recruiting officer in Minnesota, Kansas, and Missouri during the Korean conflict. In 1953, she was assigned to Wright-Patterson Air Force Base, Ohio, first as chief of the personnel section of the Reconnaissance Laboratory, then as a photographic and weather reconnaissance project engineer, and finally as technical executive officer to the laboratory chief.

Colonel Harness entered the field of research and development management in 1959, when she was transferred to Headquarters, Air Force Systems Command, Andrews Air Force Base, Washington, D.C. In 1963 she was assigned to the Space Systems Division, Los Angeles Air Force Station, working as deputy chief of engineering and later as chief of program control for the Gemini target vehicle program; in 1967, she received the Air Force Commendation Medal for outstanding work on the Gemini manned space program. She then was named chief of program control and later technical assistant to the deputy director for the Agena space vehicle program.

During a two-year assignment to the Defense Intelligence Agency (Special Activities Office) in Washington, as a research and development director, she was awarded the Joint Service Commendation Medal for her contribution to the national intelligence effort. Returning to Los Angeles Air Force Station in 1970 as deputy chief of the Programs Budget Division, she provided management direction for the $2 billion SAMSO budget. She was reassigned to her present postion in May 1973.

Colonel Harness is currently serving as president of the Los Angeles Club of Zonta International, is a senior life member of the Society of Women Engineers, a member of the Armed Forces Management Association and of the Air Force Association, and a Fellow of the Institute for the Advancement of Engineering.

In addition to her pioneering assignments in engineering and R&D management, Colonel Harness has established a number of other "firsts" in the Air Force: first woman on orders as a test engineer during flight testing of experimental equipment, first woman to receive the specialty rating of Staff Development Engineer, and first woman to be awarded both the Senior and Master Missileman badges. She remains the only woman holding the Master Missileman badge. In 1972, she became the first woman to serve as chairman for all Engineers Week activities in Los Angeles.

ENGINEERING AS AN IDEAL WOMAN'S CAREER

Alva T. Matthews

Consultant in Engineering Mechanics
Weidlinger Associates, New York, New York

My personal decision to study engineering came relatively early, at about age 15. It resulted from a liking for math and science, and partly from admiration for my father, who founded the industrial construction firm of Brown and Matthews. It never occurred to me at that time that a female could not be an engineer. My parents, bless them, brought me up to be a girl, but never indicated that there were any limitations implied by that role. I tramped over construction sites with my father, but spent most of the time with my mother, learning very domestic things.

In the early 50's a five-year "combined plan" of study was being encouraged for engineers. Three years of liberal arts, two of engineering were to lead to two degrees: a BS and a BA. I started out at Middlebury College, in Vermont, with expectation of spending three years there and two at M.I.T. The first week of school my physics teacher and advisor told me not to study engineering -- too difficult for a girl, and nobody would ever hire me. I was hurt and surprised. After the hurt wore off I decided to ignore him.

With the death of my father I gave up the five-year plan and transferred to Barnard College. I intended to enter the Columbia Engineering School in my junior year. I lacked one course that was available at the all-male Columbia College, but women were not permitted even to sit in their classes. I took the course during the summer, at my own extra expense. Neither Columbia nor Barnard thought this unusual or even worthy of comment. This time I was not hurt, I was mad.

By the time I entered engineering school as the only woman in sight (one other existed in another department) it was apparent what I had gotten myself into. Luckily, someone like Dean Wes Hennessey was there, who had started to encourage women to enter engineering, so I had no problems with entrance or with on-campus courses. Surveying Camp, however, was a requirement, and a special situation. Columbia had a summer camp in the hills of Connecticut, but the boys stayed in dorms, and no girl had attended. They said it was impossible; then had second thoughts, so I went a year later than normal. I stayed off-campus at a guest house.

The setting was country, and we lugged our transits over the hills and through the fields. One assignment included the sighting of the north star, Polaris, at a precise time near two o'clock in the morning. My quad partners were considerate enough to call for me and walk me the mile distance in the dark to the sighting area. It wasn't so bad for one night, but clouds covered that star for four nights running -- and for four nights running I dis-

appeared into the dark with two young men. The lady who owned the guest house registered her disapproval. I am quite sure she never believed a word of the story about Polaris.

For summer jobs I did secretarial work, assisted in the Graphics Department, and one summer worked in the field office of the contractor who was digging the Delaware Water Gap tunnels to increase the water supply to New York City. I gathered information from the field on quantities of construction materials used each day. I yearned to but was prohibited from going down into the tunnels. Superstition about women causing collapse of tunnels was very strong, and still is today. It was, however, a rare opportunity to see how heavy construction on a remote job site operates.

In retrospect my years at school were lonely. I was very tense about the uniqueness of my situation, afraid of upsetting the balance of what I thought were "privileges" being extended to me. As a result, I even avoided dating the male engineering students -- which surely must have been a mistake. Most of all I missed the give and take of information that students use as part of their learning process. All the attention, of course, was flattering, but I was scared silly of making mistakes and looking idiotic in the spotlight.

After graduation I joined the Civil Engineering Department as an instructor in the Strength of Materials Laboratory and assisted the head of the Department, Professor Garrelts, in his structures courses. This extended my Master's work to two years, but it was well worth it for the teaching experience. Then, through Professor Salvadori, I joined a small group of engineers organized by Paul Weidlinger to design unusual structures.

At first I worked on thin shell concrete design, but I later became involved in the research that Mel Baron was directing within the group in shock and vibration studies of huge gas storage tanks. That research involved a great deal of applied math and knowledge of elasticity and vibrations of structures. Those were the days before wide use of computers, and I remember spending three months just expanding five-by-five determinants on a Friden calculator. At the same time I continued taking courses at Columbia because I needed more theoretical background, and much more math.

At the doctoral level the pressures of being an "only woman" were lifted. Employment had proven to be no problem. In fact, in my working experience I have had no problems which can be related to being a female. Because I needed the knowledge in my work, taking courses in engineering mechanics at night was a bit easier. Sort of without my realizing it the course credits for the Doctor's degree were accumulated. I was then able to write a dissertation directly from work done at the office. If you can swing it, this is a most convenient way of completing degree requirements. The whole process took seven years from the time I got my Master's. There were many times when continuing seemed too much. But I did finish, and I must say that having that degree opens many doors and opportunities.

During the time I was going to school at night I married an industrial engineer with an MS, who quit work to go back to school for a second Master's in Business, so we studied together. Incidentally, I had first seen my husband-to-be at that surveying camp. When he had finished his degree, but I still had more to do on mine, he was offered a job with the Xerox Corporation in Rochester, New York. That brought up a problem that faces many professional women who are married. He of course should take the job. But where was Rochester? What about my degree that had taken so long was about to be finished? For one year my husband lived in Rochester, and commuted to New York on week ends. Then we moved there, and I started commuting to New York during the week, staying at my mother's home. The solution seemed to work. We felt unusual among corporation people at that time, but since then I have learned of more and more commuting solutions to maintaining a home and a marriage. We started before jets. Now, with jets, people even commute weekly between coasts.

After the doctorate was finished I worked for a while in Rochester, again with a small consulting firm. There I worked on dynamic analysis of helicopter blades. By this time big computers were part of every engineering research problem, and those of us with small firms had all become self-taught computer programmers. The helicopter blade study was a large computer problem, and I was very conscious of how the character of such research had changed. I was also part of a team investigating causes of automobile accidents. Together with another engineer and two doctors, we analyzed patient injuries and car wrecks to try to reconstruct what had happened. At the same time I taught elasticity and engineering mathematics at the University of Rochester, Department of Mechanical and Aerospace Sciences. This was great fun, and I hope always to be able to go back to teaching once in a while for the rejuvenation it brings to your thinking.

But I missed the work and the group at Weidlinger's, so I returned to the commuting route. Now, as a consultant, I work two and one-half days a week in New York. I do some work at home and, when necessary, can usually rearrange my working hours. With the mobility that modern corporations demand from their management personnel, "transfer" of my husband has loomed more than once. There is no question in my mind that we move if he has to. My job is more flexible, and as a consultant I could conceivably set up a practical commuting schedule from any city in the country. This working schedule gives me time also to teach, work on a book, and dip into some other areas I've longed to explore. I enjoy working around the house, in the garden, and riding Arabian horses.

My work as a consultant now is in the area of shock propagation in soils and rocks. We try to model mathematically what happens to soil or rock when high pressures (such as from a nuclear blast) travel through the ground over long distances. The work involves manipulation of some of the basic equations of elasticity and inelasticity. Final analysis of ground shock response is programmed for large scientific computers. The results are used for design of

underground defense structures, and for gauge placement in high explosive and underground nuclear testing.

Writing this paper has been a good exercise in looking back and sorting out. I find the only real difficulties I had were of my own making -- mostly overconcern about being "different." My generation of women engineers, and those preceding, now tend to romanticize the difficulties they had. Being told you cannot be an engineer, or not being able to enter a tunnel because you are a woman make good story telling. On the other hand, where there are injustices it was, and is, proper to speak up against them. You are entitled to some of these experiences yourselves. You are still pioneers because of your small numbers, and pioneers should have some problems to overcome.

I believe children are a valid option for women today. I think a lot about the fact that I do not have any. I enjoy other people's enormously. My life has been made infinitely easier by not having them, but I know it has lost something, too. If you plan to marry, please marry a man secure enough to be sympathetic to your goals. I sometimes wonder at my good fortune in finding Hap. He is understanding and encouraging, and expects me to do more sometimes than ever I myself expect.

Thus, from my own experience I feel the advantages of engineering specifically for women are unexplored. Aside from the obvious job satisfaction and salaries which are considerably better for a woman in engineering than in many of the more usual "female" occupations, there is the matter of flexibility. If a woman is to incorporate a husband, home, and family, she needs a job that will expand or contract or bend to the hours she wishes to devote to it in different periods of her life. One way to achieve this is through specialization; developing a particular talent or expertise that will enable an employer to justify hiring part-time, or with flexible hours. Engineering is a perfect field for the development of specialties. This masculine field has been perfect for my life as a woman.

Alva T. Matthews

Alva T. Matthews has made significant contributions in many areas of engineering mechanics and structures. Formerly senior research engineer, now consultant to Weidlinger Associates, her fundamental research on the mechanical behavior of materials which have been subjected to dynamic impact loads has influenced the development of models for wave propagation in soil and rock and extended to nuclear weapons effects on structures. Other areas of effort were the development and adaptation of large computer codes, structural design of thin shell concrete, application of Potential Theory to underwater acoustics, and computer programming in the development of the Telstar tracking antenna and of helicopter blade design.

Dr. Matthews earned her BS and MS (with honors) in Science and a Doctorate in Engineering Mechanics from Columbia University and is a member of Tau Beta Pi and Sigma Xi honoraries.

Her publications in conjunction with co-workers have won recognition as pioneering efforts in the area of pressure wave propagation and vibrations in elastic media. Dr. Matthews also serves as a consultant to the Rochester Applied Science Associates and lectures at the University of Rochester.

She has held office in the Society of Women Engineers, served on the Board of Directors of the Engineers Joint Council, and participated in the American Society of Mechanical Engineers and the New York State Professional Engineers. She received the 1971 Achievement Award of the Society of Women Engineers.

MY CAREER AS A RELIABILITY-QUALITY ENGINEER

Naomi J. McAfee

Engineering Manager — Quality & Reliability Assurance
Defense and Electronic Systems Center
Westinghouse Electric Corporation, Baltimore, Maryland

Looking back, it is difficult to understand how I have arrived where I am. The original plans were completely different. Engineering wasn't the goal at all. In fact, it was one of my last considerations for a career. How did it happen, then?

HOW IT BEGAN

During my freshman year in high school I drew an assignment to write a term paper on the development of the atomic bomb. I became so intrigued with all of the physical and chemical reactions that took place that a conscious decision to study chemistry was made. I dreamed of being a great chemist and of making discoveries that would equal those Marie Curie made in physics. So the dream began.

The choice of school was no problem. It was going to be Western Kentucky State College, because both of my brothers had gone there. It was a small, inexpensive college, which had a reputation for providing a good education, and it also had one of the best basketball teams in the country.

My family agreed that it was a good school, that I should go, but that my field of study should be either home economics or education, because these were fields where a woman could always get a job. They didn't waver and neither did I, and as a result my father withdrew all financial support. This turned out to be a blessing in disguise and only served to strengthen my resolve to complete the degree in the field of my choice.

I entered college in the fall of 1952 and began to study toward a BS degree in chemistry. All went well my freshman year, but during the first semester of my sophomore year, because of an altercation with a professor, I changed my major to physics. It was one of the best moves that I ever made. Finally, in 1956, I graduated with a BS degree in physics.

THE FIRST JOB

It was a great time to graduate because the job market was wide open. The space age was on the verge of beginning and everyone -- industry, government and academia -- was looking for physical scientists and engineers. To indicate how great it was, I had 17 job interviews and 16 job offers.

After considerable deliberation I accepted a job with the Westinghouse Electric Corporation in Baltimore, Maryland. Again as fate would have it,

the job that I had been hired for was cancelled the day I reported to work. That could have been catastrophic, but Westinghouse found me a job in another area, a job which was only to last until the original area got more work. As a result, my entry into engir .ring was purely accidental.

The area of endeavor I entered was Reliability Engineering, which was a rapidly developing new field. I've been there ever since. The Reliability Engineering Group was composed of four people, so we quickly became a rather tight-knit team. Two years later the entire group, sans me, left the company for greener pastures. I probably would have gone also, except that I had just gotten married. That in a way was fortunate, because at that time there was only one experienced reliability engineer in the complex - me! Of course, I was considered to be too young to direct the group activities, so new leadership was brought in. He brought with him a group of new people, most of whom had many years of experience, albeit in other engineering fields. I was given the task of providing technical direction to these people and it was a strange feeling having these older engineers follow my directions. The feeling was quickly overcome.

It was at this point that the only open discrimination I have encountered during my career occurred. In a discussion with my supervisor I suggested that a pay increase and a promotion were in order. He replied by saying "Oh, we couldn't do that. It would put you on the same level as your husband!" Needless to say, two weeks later I changed jobs within the company.

This turned out to be a very fortuitous happening, because it forced me to broaden my field of interest and let me see what system reliability analysis was. The original path as a reliability analyst was great fun, but it was a dead-end street with no room for growth. This happens to a lot of people and they discover it too late. It was also fortunate that it put me in a new area of reliability development, allowed me to interface with the customer and to deal with program management.

CAREER GROWTH

The new assignment was one of the best things that could have happened. It gave me needed self-confidence, and the program went so well that I received a double promotion. That program lasted for four years. However, at the end of 18 months it was obvious that there would be nothing new to be done. There was plenty of work, but no real challenge.

Not long after realizing this, I happened to see an old friend who worked in another area. He described the new program that was being sold. He pointed out the difficulty of meeting the stringent reliability requirements and described the type of individual needed to direct the reliability program. We talked another few minutes about fishing and hunting and other things; then he said, "I could be perfect for that spot -- it's yours if you want it."

This posed a dilemma. The program on which I was working had a lot of items to be completed -- no creative things but things that had to be done. The people had been extremely good to me and it was going to be very difficult to leave. In fact, leaving would show a total lack of gratitude for all of their support. After much deliberation I decided that gratitude was like a marriage certificate: if that is all you have, it's not worth much! So screwing up my courage, I announced my decision. It was not well received, many arguments were posed against it, but I took the new job.

It lasted two years and was great fun. There were eight people in the group and everyone seemed to accept the fact that the group leader was a woman. Still, the responsibility was only for technical direction, with no control over individual career growth, promotions, or salary administration.

At this time my boss was promoted to Manager, Reliability and Maintainability Engineering and moved out of program management. Without saying a word to me, he transferred me to the new group. The work was different, exciting and demanding. We were developing space hardware for the National Aeronautics and Space Administration, and I was assigned full-time to three different programs. This assignment lasted two years.

ENTRY INTO MANAGEMENT

After directing programs and people for a number of years, I began making it perfectly clear that I wanted to try my hand at management. There were many discussions about some of the unpleasant things that could happen. My boss wanted to know if I was really serious about going into management, because all I was going to do was add "lousy people problems" to the load of technical problems I had. After much rationalization the step was taken and I was promoted to supervisory engineer. There was an understanding that both parties had the right to back out; that is, if management felt that my performance was sub-par they would promote me to an advisory position, or if I didn't like the work I could say so and be moved to an advisory position. That happened in 1966 and I'm still in management: so draw your own conclusions.

My first management assignment was as a supervisory engineer responsible for the reliability engineering activities on all space programs. I was responsible for the administration and the technical direction of 13 engineers. We worked on the development of the Lunar Television Camera. This was the TV camera that the astronauts left on the moon. That program was typical of our efforts for over a year. Then one of the other supervisory engineers was put on special assignment and I had to handle all of the reliability programs for the Division, with 25 people to supervise. This assignment lasted for a year. The program activities required a lot of travel and this took a lot of time away from the day-to-day activities -- it was a hectic time. I was very happy when the man on special assignment came back to his job.

MANAGEMENT GROWTH

After the initial entry into management, moving ahead becomes much easier. When openings occur or new management positions are created, a member of management tends to get considered for these positions without regard to sex. So, when my boss took a special four-month assignment no one was really surprised when I was asked to fill in for him. He never returned, and the job became mine. I held the job for two years and began to wonder what I was going to do next. I had fallen into the trap of learning more and more about less and less, and consequently limited my own future. I didn't realize this when it was happening and was rudely awakened when my boss said that I could continue my narrow interests and remain the Manager of Reliability and Maintainability Engineering forever. That was a rather strong statement and made me do a lot of thinking about how to get my career back on the right track.

At this time, there was a sudden change in the economy. Everyone started talking austerity and cutting back on planned expenditures. Organizations began to shrink and similar operations were combined. The various assurance groups were combined into a single operation under the title of Quality and Reliability Assurance. Thus, the chance to advance my career came without any impetus from me. It wasn't long after the new organization was formed that I began to pick up additional responsibility, and today I have the title of Engineering Manager.

WHAT I DO AS ENGINEERING MANAGER

As Engineering Manager, Quality and Reliability Assurance for the Westinghouse Electric Corporation's Defense and Electronic Systems Center my responsibilities include directing all of the engineering department's reliability, maintainability, and safety engineering activities in support of the Center's development, equipment design, and production programs. It also includes planning, organizing, implementing, and controlling all functions of quality on all development programs as well as directing the activities of the Failure Analysis Laboratory, Data Center, and the Semiconductor Analysis Laboratory of the Applied Technology Center. The responsibilities include the development of new concepts and techniques, selection and training of personnel, establishing budgets, controlling expenditures, and maintaining schedules. To accomplish all of this I have a staff of six managers and four advisory engineers, who have 150 engineers working for them.

MARRIAGE AND A CAREER?

People ask, How do marriage and a career mix? The answer is: Great! He's an engineer also, and works in computer design. We share a common language for work, and many of our outside interests are the same. We are avid pro-football fans; in fact, we have held season tickets for the Baltimore Colt games for fifteen years. Early in our marriage, adjustments were made

so that our respective careers would work. He helps around the house, does his share of cooking and anything else that needs to be done. This allows us time to do many extra things we enjoy; last year we vacationed in Kenya, East Africa. My working also allows us to have the money to do that type of thing whenever we want to do it. It allows both of us more freedom than we could possibly have otherwise.

FINAL THOUGHTS

Being intelligent and a hard worker is not enough to assure success. You can be the most creative person in the whole world, but if the talent isn't needed or if people aren't aware that it exists, you'll never go anywhere. A lot of success is based on luck: being at the right spot at the right time is very important. This "right" spot is really being in the mind of the decision maker at the time he is deciding whom to choose to fill a slot. While there is luck involved in having the right position open up when you are ready for it, you can help the "luck" along by being sure your boss knows what your desires and ambitions are. While marching in and applying for a promotion opportunity that opens up may be a little too abrupt to be effective, there are plenty of more subtle ways of making it known that you are interested in being considered.

Don't be deterred by certain myths that arise. The same characteristics are often defined quite differently when displayed by a man and when displayed by a woman. For example, one argument given for not promoting women into management is that they subtly influence men. It's strange, but this ability in male executives is called leadership.

Know your boss. Learn to talk to him on a reasonable, rational basis. Tell him what you want to do, what your career goals are and the time schedule for accomplishing them. If you don't tell him, he will never know! Remember, people don't have glass heads, so other people can't read their minds. Think big and plan big; if you don't think big for yourself no one else will do it for you.

Along this line, I find that most men assume that a promotion to a new geographic location is impossible for a married woman because her husband isn't being offered a move to the same location; therefore the offer to the woman isn't made. It never occurs to them that the decision to move or not to move should be made by the most likely candidate. For some reason, when a woman is involved, men want to make that decision for her. Make it very clear that you want to make that decision!

Never be afraid to seek advice. You can't be successful by yourself. Be positive, and remember people always want to help. Almost everyone is flattered by being asked for advice and will respond accordingly.

JOB DESCRIPTION AND RESPONSIBILITIES

Donna Ozern

Engineer
Colorimetry and Sensitometry Unit
Xerox Corporation, Rochester, New York

Colorimetry and sensitometry are my areas of specialization in the field of optics. Basically, colorimetry concerns the quantification of color sensitometry involves the study of system responses.

ADMINISTRATIVE-TYPE RESPONSIBILITIES

I am responsible for the support of various projects within the C&S (Colorimetry and Sensitometry) unit of the Xerox Corporation. This includes negotiation and scheduling of completion dates with project engineers and the person (or persons) performing the task. Another responsibility is the planning and maintaining of a computer program library and card files. I have also been responsible for supervising an engineering aide and assisting in the PERT planning of developmental efforts.

TECHNICAL AREA

My engineering functions include initiating and performing analyses, summarizing the conclusions and recommendations in report form for distribution, as well as writing computer programs and providing extensive consultation.

An example of the type of analysis I am involved in would be the investigation of the effect of various parameters (filters, lamps, documents, etc.) on the process response of systems. This might be done to check the feasibility of a proposed system, improve a systems color copyability or its exposure. Another example along this line would be the determination of the theoretical and/or real filters or filter combinations which would: 1) provide the maximum color copyability for a system with fixed energy levels, or 2) best match one system to another system.

Specific examples of such analysis would include a theoretical phosphor blending study to develop a lamp which would provide increased energy in a system without degrading its color copyability. Another example is a spectral sensitometric Monte Carlo analysis of a color copier.

In the last few years, I have been extensively involved in the development of the recently announced Xerox 6500 color copier. I have worked on the design and specifications of the filters, lamps, and other parameters. I have also worked on the development of, and have written the sensitometric specifications for, lamps, filters, and colored input materials. Along this

same line I have provided extensive support to the characterization of colored toners and colorants for the development of the toner specifications.

The computer programs that I write and/or revise can be either of a general or very specific nature. The general programs are written to be as multi-purpose as possible. Usually they are used for analysis involving large amounts of data. A specific program is used to evaluate a component's adherence to its sensitometric specification based on its spectral response curve as measured on a spectrophotometer. The programs generally have "idiot-proofing" and decision-making capability programmed into them. The output might consist of 1) acceptable or 2) rejectable and why rejected. This capability will allow future evaluations of such materials to be made very quickly by a person with a very limited technical capability.

I have very definite opinions concerning computer programs. I feel that in the transition from the slide rule to the computer in engineering, the computer is not being used to its full capacity. Too many people use it as strictly a large calculator. I feel that in standardized procedures, if an engineer can look at the numerical output of a program and make a decision on such, then the computer program can be written to evaluate those same numbe and print out the evaluation.

Among my other duties I have had the sole responsibility for obtaining acceptable colored materials in the Xerox color creation kit. This has included development of optimum materials, writing of specifications, liaison work with the vendors and evaluating their facilities and technical capabilities, explaining technical requirements, and when necessary translating these requirements into their terminology.

In a time of crisis, when materials were badly needed, I traveled to the vendor and assisted in achieving acceptable colors and in "QCing" the materials as they were printed so that the delivery dates could be met. This included consultation in revising their ink formulations when necessary.

My duties on this particular project are quite diversified. I get to travel, attend a lot of meetings both in-house and outside of Xerox, meet a lot of people, see how other companies operate, and provide consultation both in and out of Xerox on the color creation kit.

The traveling and vendor contact with this job are an interesting diversion from my normal duties. In this position, being a female has resulted in some unusual experiences. Quite frequently, if I am traveling with a group of men (such as from Procurement, QC, etc.), most motels will put the men all together in one area and isolate me in another area. This is usually done when we arrive. The clerk erases the room number given to me when the reservations were made and replaces it with another. One clerk in New Jersey went so far as to put me in the only room visible from his desk, while the

men were at the extreme end of the motel. The only way he could have put me further from the guys would have been to give me a sleeping bag and put me out in the parking lot. We still haven't figured who room clerks in general don't trust, the guys or me. (I'm curious as to why this policy is so prevalent.)

Another common experience I have found when traveling to other companies as a woman with one or more men is that initially both the females and males that you come in contact with treat you as an excess piece of baggage. All conversation, other than "good morning" and introductions, is directed to the men. I have found receptionists and secretaries staring at my attaché case as if they are expecting any minute a steno pad to jump out (or possibly a bomb to go off). The men generally change when the technical part of the discussion is turned over to me. They find that I am a "technical expert" on the project and treat me as such. The women, on the other hand, are different. When they serve the coffee and when I leave, some of them actually stare at me as if I had three heads or had recently escaped from the zoo. On repeat visits to these companies, the men immediately treat me as an engineer, the "technical expert" from Xerox. The women still tend to behave strangely.

When this first occurred, I was rather surprised. But after giving some thought to it, I concluded that these are small companies (about 300 employees or less) in small towns and that the girls probably were brought up to believe women were secretaries and men were engineers, and anything else had to be some kind of freak or something.

Both in my work experience at Xerox and in visiting other companies, I have found that if you are technically competent, it does not take men long to regard you as a competent engineer who happens to be a woman rather than a "female" playing at engineering or one of those "Libbers."

The preferential treatment one gets traveling in this capacity is kind of nice. In addition to the escorted tours of their facilities and essentially complete attention when you talk, you dine in fine restaurants and sometimes get little goodies to take home with you (samples of their product).

At one place, when I ran out of cigarettes at a meeting the man in charge sent someone out of the meeting to get me a pack of the brand I smoked. A dedicated employee had given up a pack of cigarettes for me, as there was no vending machine in the company. Another time, the plant manager at a company called home and had his wife pack me a box lunch to eat on the airplane, as my flight schedule was such that I would not be able to have dinner till after 9:30 p.m. (as if I really needed any supper after the huge lunch I had eaten). We stopped by his home to pick up the lunch when he drove me to the airport. I find little things such as these quite enjoyable.

A challenging aspect of this vendor liaison work is explaining the technical requirements of the kit. As the technical capabilities of a company can vary from excellent to almost nonexistent, it can be quite tricky coming down to a level at which they can fully understand without overshooting the mark and insulting their intelligence. To do this, you must remain very observant of the reactions to everything you say (especially the nonverbal reactions). Occasionally, the person(s) whom you are interacting with will say yes, they understand everything, when in fact they don't understand a word you've said. Generally, this only occurs in meetings where their upper management is present.

As you can see, my work responsibilities and duties are quite diversified. I find it to be both challenging and quite satisfying.

HISTORY

I did not enter engineering by the normal route. Fourteen years ago, when I graduated from high school, the tendency was for guidance counselors to direct girls with an inclination to the sciences and mathematics into careers such as teaching, nursing, and dental technology. As I had no great desire to get into these fields, I skipped college, against much protest, and married my high-school sweetheart. By the age of 19 my career consisted of being a housewife and mother of two children. As with many teen-age marriages mine broke up, and since I had no plans for ever remarrying, I had to find a way to support and raise my two children.

I became a grinder and polisher of critical lenses in Precision Optics at Bausch and Lomb. While working there, my interests in science in general (optics specifically) were revived. I discovered a local college offered an Associates Degree in optics and enrolled in the program. During the day, I was a full-time student; eight hours a night, six nights a week, I was a lens polisher; and on week ends I was a mother. It was a rather busy schedule. Just prior to graduation, I enrolled in summer school at the University of Rochester and worked out a program with the University that would lead me to a BS degree in physics.

After graduation I was employed as an engineering technician, grade 7, in optical technology at the Xerox Corporation. My work for the next two years consisted of setting up experiments in the laboratory, taking data, and making spectral measurements of various optical components (lamps, filters, lenses, documents, etc.) on various equipment. During this time, I was let out of the labs just long enough to meet and marry one of my coworkers. Then I became extensively involved in the characterization of experimental high-pressure mercury arc sources and was promoted to a grade 10.

In August of 1969, I took a four-month maternity leave. Upon returning to Xerox, I started working for a new supervisor in a different area. This

was probably somewhat due to my demonstrating certain analytical abilities just prior to my leave of absence. At first I was a little disappointed about the change in supervisors, but later I discovered that as a manager he was far superior to my previous one. He not only spends extensive time helping his people to develop their technical capabilities but gives them as much responsibility as they can handle and are willing to accept. (It is not usual for engineering aides to be given the opportunity to participate in technical discussions at meetings.)

He points out areas where you can stand improvement as well as your assets. You might be told you should become more knowledgeable in a particular area as he finds and gives you references on the subject or he might tell you to be more outspoken at meetings (to stand up and back up your ideas). In other words, he gives his people the direction and the opportunity to improve their engineering skills and effectiveness. He is a stickler for documentation by the person doing the work. He also happens to be very competent in his field.

I hope you will excuse this slight diversion into a discussion of managers. I just wanted to point out that a good manager can help you reach your full potential as quickly as possible and a poor manager can hold you back and make your career advancement very slow. Be leery of any manager that insists on his documenting your work. In such cases your work may be outstanding, but no one will ever know. This also applies to managers who coauthor all their subordinates' work. In such cases, people tend to think that since he is the senior author, he is drawing all the conclusions and making all the recommendations and you are simply a data taker and manipulator.

Between December 1969 and June 1971, my work became more analytical in nature. It consisted of providing optical support in the areas of sensitometry, colorimetry, and radiometry. I took on the responsibility for C&S data files and computer programs.

In June 1971, I received my BS in mathematics and physics from the University of Rochester, and in July I was promoted to associate engineer. As such, I continued to carry out various sensitometry and colorimetry analysis, wrote computer programs for such analysis, and provided consultation in optical support to various Xerox projects. My promotion to engineer, grade 5, the following July reflected the increased responsibility I had assumed.

In 1972, I started taking courses in the Master of Engineering program at the Rochester Institute of Technology. At this time I hope to eventually get an ME degree in engineering management, or possibly an ME in electrical engineering. The reasons for the minor indecision at this point are that while I feel the management-type degree would be more beneficial in my career, I really prefer taking more technical courses than are required for a management degree. The choice of electrical engineering as an alternative

is strictly a practical reason: electrical engineering is the field of engineering in which RIT offers a degree which most closely approximates optical engineering.

COMBINING CAREERS

I have not had any difficulties being both an engineer and a wife and mother. On occasion, people have tried to tell me that this is impossible. That if a woman works she must automatically be neglecting her children. When this occurs I quietly point out that I did spend some time at home being strictly a housewife and was quite observant of other housewives. I saw that many, far too many, were so wrapped up in their "kaffee-klatches," clubs, and soap operas that the major part of the attention given the children consisted of "go out and play," "don't bother me," and so on. I also observed that as children grew older they were at school most of the day, and as they got still older they became involved in so many after-school activities that they generally were gone till supper time. These observations have led me to the conclusion that a working mother who gives her full attention to her children a few hours every evening and at least one day out of the week end is actually giving her children more, and at times better, quality attention than many nonworking mothers.

During the infant years, if a woman takes the time to look around she can generally find a "natural" mother (the type who just adores giving attention to young children) to baby-sit her child. In such a situation, the child is generally provided with far more attention than he could every need. Older preschool children can be put in highly qualified preschools where they have constant professional supervision, regulated play and learning, association with people their own size, and develop social skills.

SUMMARY

I enjoy being an engineer, wife, and mother and would not change this for anything in the world.

Donna Ozern

Donna Ozern is an Engineer in the Optical Technology Section of the Xerox Corporation. She has been extensively involved in the development of the recently announced Xerox 6500 color copier, and currently has sole responsibility for the Xerox Color Creation Kit.

She received an AAS in Optics from Monroe Community College in 1967, a BS in Mathematics and Physics from the University of Rochester in 1971, and is currently taking courses in the Masters of Engineering Program at the Rochester Institute of Technology.

She is a member of the Optical Society of American, Rochester Section. As a member of the Xerox Science Consultant Program, she teaches science to inner-city children. In private life she is Mrs. Mitchell Ozern and the mother of three children.

CEILING UNLIMITED

Irene Carswell Peden

Professor of Electrical Engineering
and Associate Dean of the College of Engineering
University of Washington, Seattle, Washington

If I have the correct perception of our mutual functions here, we are all interested in examining the reality of the proposition that engineering is a reasonable, workable, potentially satisfying career choice for young women to make. I admit to being totally persuaded that the statement is true. I have not said that the road to success is obstacle-free, nor will I say that at any time during the next half-hour. It is worth the trouble, though, for those who have the aptitude and interest.

Occupations are very important in our culture. They give us some unique satisfactions not obtainable in any other way. They permit us to know that we are of value in our society. This is particularly true of an applied quantitative field like engineering. Put simplistically, your bridge stands or falls; the radio you build either plays or it doesn't. I was hooked for good after my initial experience in a beginning electronics laboratory in college. We were given a kit and a wiring diagram with simple instructions. The job was to put together a little radio set. This was back in the 1940's, when radio was very big and television was not yet an option. Three of us worked on this task during the course of an afternoon, and when we were finally ready to throw the switch we all held our breath. It played! All we got was Ma Perkins, an old-time soap opera, but it played. There are no words to describe the satisfaction. It is this kind of success experience, which can be had at any level of sophistication and complexity, that sustains the engineer or scientist during the dry periods when nothing works (and there are plenty of those).

One's got to have success in some area of endeavor, and those of us who happen to like the science and math-based challenges can enjoy some very concrete moments of triumph. One does not have to do experiments; there is real satisfaction to be found in solving a math problem and knowing that your solution is indisputably correct. The kind of person who likes to argue a point of view in connection with a hopelessly complex problem that has no real solution seems to go into law, political science, and so forth. The kind of person who is attracted to engineering typically is pleased by the ability to obtain well-circumscribed solutions to well-defined problems. It is perfectly realistic to gauge your degree of match to an engineering career in terms of your liking for science and math in high school and early college. The problems become more complex as your education and experience increase, but this is a step-by-step process that presumably will not leave you behind. The good news is that the problems also become more interesting.

Mechanical aptitude has little to do with suitability for an engineering career anymore. In some fields, such as mine, it won't hurt you, but it won't do you any good, either. Much of modern engineering is done in partnership with the computer, in a laboratory, or at a desk. Students who succeed in engineering school are typically good at math, intelligent, and have rather intellectual hobbies. Scientific curiosity, abstract reasoning skills, and good spatial visualization are relevant characteristics. In common with other high-level professional pursuits, engineering also calls for self-discipline, emotional strength, and objectivity. One does not have to be terribly brilliant, however, because engineering does not require more intelligence than any other profession; just a different set of aptitudes and interests.

The situation is similar for women, and many women have these qualities. Still, there have been less than 1 percent of them in the engineering population during the recent past in this country. The reasons are cultural, in my view, conformance to a stereotype of feminity -- a response on the part of young women at the age of career decision to nearly overwhelming societal pressures. It is gratifying to see college women feeling more free to express themselves now via career choices and commitment than used to be the case. It is my hope that more and more of these young women will see themselves as potential engineers and that they will go on to succeed professionally. There are more opportunities available to them than ever before; for example, choices of jobs in new fields, promotion possibilities including management, support for graduate studies, and the welcoming attitudes of universities with respect to teaching and research positions for those who are so inclined and whose life circumstances make this possible.

I want to come back to that point; for the moment, the thread to follow concerns the role models that these young women would then become for women engineering students. More faculty role models for women engineering students could not help but serve the best interests of those students. We can provide moral support in addition to technical information, helping to sustain the woman student through periods of self-doubt, of loneliness and unfamiliarity with the university environment, difficulty with husband or male friend about the career choice, and other assorted personal problems. Most of us have experienced them all in some way.

The earlier the exposure to one's role model the better, however, and while the woman professor may play a part in assisting the student to stay in school and obtain her degree, her impact on initial motivation may be small. Female relatives and family friends are excellent sources of inspiration for many girls, and need not be engineers to serve this function. My role model was my mother, who had majored in mathematics in college and had taught in country high schools before her marriage. Mother was ahead of her time. She had even taken a course in surveying, just as a matter of interest, and loved to tell her three daughters about her college and teaching days. As a result, I had no particular negative feelings about math and science, although

I did not turn on to them until relatively late. My parents had programmed me to be a musician, so much time and energy went into practice and performance. High-school chemistry, which I selected because I had to have a science (the word was that physics was too hard), captured my interest completely and I entered college as a chemistry major. Then I took physics, and that was it!

The revelation was short-lived. In the early '40s, physics was still just something physicists did; one had to plan to obtain a PhD and to teach in a university. At 17, such lofty career goals were of no interest. My physics professor was very helpful at that point, and introduced me to the idea that there was a four-year curriculum available in any of several applied aspects of physics in which I had a good chance for success. Electricity and magnetism were the aspects of that very classical undergraduate course that had been most enjoyable. There was some time lost in changing gears and making up for lost time with prerequisites. It actually took 4 - 1/2 years, including two summer-school sessions, before I obtained my BS. This is not so unusual. Rather few engineering students today actually graduate in four calendar years, for a variety of reasons.

The chairman of the Electrical Engineering Department at my school was a fatherly type, near retirement age at that time. His well-intentioned advice to me was that I go immediately to business school to learn shorthand and typing. He was convinced that I would be much in demand as secretary to an engineer. It was not a deliberate put-down. This was 1947, and he had never heard of the professional success of any woman engineer. Possibly he never did.

My first job was won after much persistence in the face of rejection and discouragement. The phrase "but we have never had a woman engineer before" was an acceptable reason at that time to refuse even to interview you. When I finally did get past the personnel office and into that of a chief engineer, I learned that the position had been open for some time, and that small power and light company was really desperate. No other qualified applicant had been willing to work for such a substandard salary. In all fairness, I should say that I had married and lost my geographic mobility by that time, a problem not uncommon among professional women today.

I learned quite a bit on that job during the year and a half of association, including the fact that the old Department chairman was on the right track in some ways. The temptation of the chief engineer to turn me into his secretary was a real factor. Quickly, I learned to be a very bad typist, and on subsequent jobs I learned to say that I did not know how to type at all.

We moved to California in 1949 so that my husband could go to school at Stanford, and I found a job in the antenna laboratory of a now-prestigious research institute that was then just struggling to its feet. My four years of

undergraduate work were not sufficient to provide much insight into antenna theory and practice, and my brief experience with the power company had provided no basis either. I started out with a Friden desk calculator doing computations for the theorists; other awesome figures taught me how to do precision laboratory measurements. I learned a great deal at first, and the Exalted Ones were really very generous with their time, explaining the nature and goals of the projects insofar as I could understand them.

It became clear rather soon that the same hand and finger skills that had once threatened to make a violinist of me were very valuable for making precision measurements in the meter and centimeter wavelength ranges. The equipment was small and easy to handle. Heavy boxes of electronics gear could always be delegated to a technician to move around. In addition to fine finger dexterity, I learned that I had the patience with detail and close work that is said to be typical of women. It serves them well in sewing, knitting, and so forth, and would do so equally well in other nonstandard but prestigious fields now dominated by men -- surgery would be another example. The work was fun, though frustratingly difficult conceptually. We had a higher standard of living than most student couples.

The marriage lasted through three degrees (all his), but did not survive beyond the final graduation. I continued to work, and eventually found that I had reached the limit of my ability to learn the antenna business without some formal structure. The really interesting, responsible projects were going to those who had advanced degrees. For a while I hung on, not knowing which of the many unsatisfactory aspects of my life was accessible to change by my own efforts. My personal life was lonely and unhappy after the divorce, and the job held no further challenges that I seemed able to meet. Finally, I persuaded myself that a Master's degree in electrical engineering was what I really wanted, that it was within the scope of my capabilities, and that it would get life moving again. Thus I entered Stanford with high hopes and butterflies in the stomach.

To make a long story short, it was terribly difficult to be a student again, at first. The workloads and pressures were enormous, and the undergraduate material of ten years before was too out-of-date to be of any real help. The first quarter was awful, but survival and success were sweet. By the end of that year I couldn't quit. (Not being willing to quit may be a personality characteristic of women engineers. It certainly is where polar explorer types of both sexes are concerned.) I was then over 30, and my limited savings were dwindling fast, but I was saved by the offer of a research assistantship in the Stanford Microwave Laboratory. Four years later I had my PhD in that field, and some teaching experience in the Electrical Engineering Department. It was the first PhD the Stanford Engineering School had ever given to a woman, but I only learned that a couple of months ago. No one ever mentioned it while I was in school.

I was looking for a faculty position in the preaffirmative-action days of 1961, but no one was looking for a woman to fill such an opening. Some deans and department chairmen would not even interview me, but others were willing to overlook this obvious drawback, since I was clearly qualfied. Fortunately, the University of Washington was one of the latter. The department was staffed with dynamic people doing interesting things, good teaching was viewed as favorably as research, and Seattle was beautiful. It was a fortunate choice, career-wise and personally. My true life partner appeared on the scene only months after my arrival in Seattle, and we were married just a few months later. He had two preteenage daughters who spent their summers with us at first. Later, one of them came to live with us while she was in high school. Both have been with us for a year or more at a time while they were college students.

A faculty career is very consuming. We prepare and give lectures, develop new courses and curricula, advise and consult with students, write proposals and research papers, try to find a little time to just think about the research, guide graduate students who work with us on projects, often administer our own grants internally, and serve on various kinds of committees with the University and outside, in our professional areas. The faculty woman typically also runs a home and may also manage her husband's social life. It takes good health, a great deal of energy, strong commitment to all of your goals, flexibility, and the right husband. The importance of having the right husband cannot be overemphasized. When there is trouble at home, with all the subsequent division of attention and energy, I do not know how it could all be managed successfully. Neither do I know from personal experience how one manages with small children. I do know that it can be done, from my friends who have done or are presently doing it. There are women here at this conference who can share such experiences with you. I admire them most sincerely.

It seems safe to say that professional women, including faculty women, obtain real satisfaction from their work. I know that this is true of women engineers in four western states. Five years ago, a colleague, Helen L. Bee, and I did a study for the United Nations Educational, Scientific, and Cultural Organization (UNESCO) that culminated in a lengthy report entitled The Access of Technical Careers to Women in the West Coast States of the United States of America.* My colleague, a woman, is a developmental psychologist; the merger produced some interesting results, too many to recount here. From the responses of 59 women engineers to one of our questionnaires, we learned that 88 percent of them work for some degree of job satis-

*Some of the material quoted in this manuscript was taken directly from the unpublished report. Copies can be obtained from Julia T. Apter, MD, PhD, Chairwoman, IEEE Committee on Professional Opportunities for Women, Rush Medical College, 1753 West Congress Parkway, Chicago, Illinois 60612. Dr. Apter charges $2 to cover duplication and mailing costs.

faction whether or not they need to earn their own living. Seventeen percent were the only child in the family, which makes an interesting constrast with the 6 to 8 percent of only-children in the general population. Forty-one percent had been the oldest child; hence the percentage of first-borns (onlies plus oldests) in this sample is 58 percent; 40 to 45 percent would be expected in a sample of college women.

The following summary statement about first-born individuals was produced by the psychologist: they tend to be higher on academic achievement and motivation to achieve, but higher on affiliation -- that is, as a group, first borns are likely to prefer being with people to being alone, particularly in stressful situations. There is also evidence that first-borns are more conforming, which might well suggest that first-born girls would be more likely to select more traditional occupations or those in which solitary work is at a minimum. We examined that in light of the perceived similarity between the respondent and her parents.

For a woman to perceive herself as more like her father suggests that she has identified with him and would be attempting to be like him in other ways. There was a disproportionate identification of the women engineers in our sample with their fathers in terms of their belief that they were like him in personality and temperament, and 60 percent saw themselves as more like him in intelligence. Perhaps the very high rates of first-born women in our sample can be understood in these terms; these may be the first-borns who <u>did</u> identify with daddy, and who, because of the greater emphasis placed on achievement for first-borns, were more persistent in achieving their educational and professional objectives. It is also possible that the girl who could identify with her mother (or other female relative) and still choose an engineering career would find it less stressful to sustain that choice in our culture.

There is no question in my mind that women engineers are remarkably persistent. In another study done at the University of Washington several years ago, the following pattern was found: each of 19 women engineering students whose records were examined had a higher high-school grade point average than the average of her male classmates. Typically, she experienced more difficulty with academic performance in the engineering curriculum than they during the first year, as evidenced by her cumulative G. P. A. after three quarters. It was observed that it was not necessarily those girls with the best entering scholastic records who were the most successful during the freshman year, nor were they necessarily the women who eventually graduated from the engineering curriculum. Those who did graduate exhibited the gradual recovery pattern in their academic records that was typical of male classmates.

It was clear that the girls who selected engineering had more difficulty sustaining the choice than is typical of male students. After all, during the years 1962 to 1967, from which these records were taken, engineering was

viewed socially as a deviant choice for girls. I am hopeful that this is less so today. Although the attrition rate for all engineering students is high until the third year, these young women appeared to become discouraged sooner and more easily than men. The ability to persevere is not a simple function of scholastic success as evidenced by grades.

I have commented before on the role of faculty women in helping women students over the rough spots and in giving visibility to the message that long-range goals are worthy of some short-range sacrifice. I am told that there are about sixty of us in American engineering schools, not enough to go around. Perhaps we can be referred to as secondary role models. The primary model, the one who is a factor in the original choice, was mother in my case, an aunt in the case of my psychologist colleague, and might be a childhood teacher or family friend for someone else. High-school teachers were influential in my earlier days, some as positive models and others as negative factors. The college physics professor played a strong role. We did not have counselors in the schools or colleges in those days, so I cannot comment on their possible role; I suspect it is an important one for many students today. We asked our UNESCO study sample about the discouragement they had experienced from significant persons during their student days; 40 percent said they had been discouraged by high-school counselors, 28 percent by college counselors; specific high-school teachers had been more supportive. I hope that there is now more enthusiasm and support for young women when they express interest in engineering. The jobs are there, and so are the job satisfactions.

There is a current tendency on the part of college women to say that faculty women of my generation are poor role models for women students, insofar as direct combat with sexism is concerned. We are not sufficiently outspoken, it is said, and not militant enough in our feminism. Many of you are students. I am sure you would agree that you have no responsibility to meet the expectations of the faculty. The other side of that is that it is not realistic to ask us to meet your expectations. Early in our careers we learned that we had to work terribly hard and try to do everything a little better in order to stay even. We learned to be terribly tactful, even charming, on the job, and to avoid confrontations that would wound the male egos of peers and superiors. That was professional survival, and some degree of such adaptation can still smooth the path to success for all of us. What you <u>can</u> do is try to sort out for yourselves those of our characteristics that have relevance to your own lives. Although we typically did not have our consciousness raised very early in life, many of us have moved our points of reference considerably in recent years. One thing that hasn't changed is our desire to help you along the road to academic and professional success any way we can, and to cheer for the exciting opportunities that are available to you.

Engineering is a fine career choice. If you have already made it, stand by it. If you are in a position to recommend it to a qualified, talented, and interested girl, don't hesitate. The water's fine.

Irene C. Peden

Dr. Peden joined the faculty of the University of Washington in 1961 and has developed courses in radio science, electromagnetic theory, and microwave techniques. Her research interests are in radio science with applications to the polar regions, and she is the author of a number of publications in this field; she was the first American woman engineer scientist to live and work in the interior of the Antarctic continent (1970).

She holds the BS degree from the University of Colorado and the MS and PhD degrees from Stanford University, all in electrical engineering. Her earlier work included two years with the Delaware Power and Light Company, at Wilmington, before joining the staff of the Stanford Research Institute, Menlo Park, California, where she worked on antenna problems. From 1958 to 1961 she was a research assistant in the Stanford Microwave Laboratory, developing measurement techniques for microwave periodic circuits.

Dr. Peden is a senior member of the Institute of Electrical and Electronics Engineers, the first woman to chair a section of that organization. She has served on the Editorial Board of the Proceedings of the IEEE, and is now a member of the Educational Activities Board, the EAB Minority Committee, the Committee on Professional Opportunities for Women, and the Education Committee of the Group on Antennas and Propagation of the IEEE. She represents IEEE on Visiting Committees of the Engineering and Accreditation Committee of the Engineers' Council for Professional Development.

Dr. Peden is a senior member of the Society of Women Engineers (SWE) and a past-chairwoman of the Pacific Northwest Section. Other memberships include American Women in Science, American Association for the Advancement of Science, Tau Beta Pi, Sigma Xi, Mortar Board and the American Geophysical Union. Her many honors include the Alpha Chi Omega National Award of Achievement in 1972 and the 1973 SWE Achievement Award. She is a member of the Advisory Council to the School of Engineering of Stanford University and of the National Advisory Drug Committee of the Food and Drug Administration, and has been a consultant to UNESCO on the Access of Women to Technical Careers in the West Coast Region of the United States (1968).

In private life she is the wife of a Seattle attorney.

I WOULD NOT HAVE BELIEVED IT!

Carolyn F. Phillips

Senior Engineer
Division of Industrial Hygiene
New York State Department of Labor, New York, New York

If someone, during my last year as an undergraduate mechanical engineering student, had tried to tell me that 10 years later I would be a licensed professional engineer practicing in a field I had never heard of and currently fighting for a leave to do postgraduate research work involving animals, I would have assumed that they were completely out of their minds. But how true it turned out to be. However, let's go back and start at the beginning, if I can figure out where that was!

I grew up as an only child, in a household where there was a real do-it-yourself attitude toward repairs, as a money-saving method. I always had an interest in how things worked, what made them tick, and preferred my cousin's train set to my dolls. An avid reader, I found out in junior high school that science and mathematics were by far the most interesting of the required subjects, and in addition, I was interested in art.

I was fortunate to attend one of the better academic high schools in New York City, with opportunity for extra courses in math and science as well as special subjects, such as advertising art. I was encouraged by my mother to look for a field of study that would lead to a good career. My mother had only had the opportunity for an eighth-grade education and, my father having died when I was three, she faced the necessity of a lifetime of work that she was not well prepared for and had not expected. She strongly felt that, if at all possible, I should have the background for an interesting, well-paying career in case it should be necessary or I should desire it, married or not.

One of my first interests was commercial art, and while considering that I also came up with the idea of a drafting career. At this point in time I had no contact with engineers, knew little of the field, and probably considered it slightly "far out." I found that there was another girl in my class interested in the same types of things, and we requested permission to take the mechanical drawing course as one of our electives. That request proved to be the first stumbling block. "That's part of the boys' shop-course program. You can't take that." We asked around and found that the teacher was a woman, actually an art teacher who became a draftsman during World War II. Armed with that fact, we tried again with the guidance counselor, managed to get her support and eventually permission to take the course, which we both enjoyed; but we began to realize there was a lot more interesting work behind the drafting. Thus the idea of engineering became important.

I had never heard of SWE, which was in its early stages at that time, but wrote to engineering schools for information, tried to find people who knew

engineers, to get some more details, invaded the library, and began to be convinced that was what I'd like to have a go at. After all, it combined my interests in math and science, even touched on the art interest, and tied in with my interest in how and why things did work.

While there were some people who tried to discourage the idea of studying engineering, the second real stumbling block came when I found that some of the engineering schools in the New York City area did not accept women undergraduate students. (This has since changed!) I was fairly restricted to the New York State boundaries due to the Regents Scholarship I had, and because of other financial factors, a school that was within commuting distance was a better choice. This was helped by the number of schools in New York City.

The decision narrowed down to City College, a large city-supported engineering school with no tuition charges, or Pratt Institute, a small school where about 50 percent of the students lived on-campus, with a good reputation in engineering as well as art. The decision was made when Pratt offered some scholarship help, and I became a commuter to Brooklyn. I found it a tough curriculum, plenty of work, but challenging and interesting. There were some minor problems (the school wasn't used to women engineering students), but fortunately there were three of us in the mechanical engineering program. A few professors delighted in making life difficult, but we found our classmates friendly and helpful, and even an initial problem with gym classes turned out to be a benefit for us since we were allowed to take fencing and life-saving as substitutes. The guys in the classes (a good percentage recently back from Korea and studying under the G.I. bill) stood up for us to one professor who delighted in embarrassing us, and they thought it great fun when an older professor almost panicked when he saw three girls walk into his machine shop to use the equipment (we proved that we could run the lathe if shown how, and that our forged chisels were usable).

By my junior year in mechanical engineering I was becoming very interested in the nuclear field, and somehow managed to find a summer job at the Atomic Energy Commission's Health and Safety Laboratories in New York, doing drafting and some limited design work on parts that were built in the shop next door. Those machinists sure didn't hesitate to ask pointed questions when the drawing didn't make sense! While I learned nothing more about the nuclear field that summer, I at least had an introduction to the AEC and some of its workings.

Job hunting became another problem during our senior year. Many of the companies that came to the campus did not want to talk to women; some of those that I wrote to sent polite replies but had "good" excuses for not offering interviews. One was that I was too young; one company even required that my mother sign a form since I was under 21. I managed to get a job as a reactor engineer for the AEC at their New York Operations Office, and happily went to work. (The other girls in my class also had job difficulties and did not get them until after graduation.)

I worked on various SNAP (Systems for Nuclear Auxiliary Power) projects under a project engineer, visited work sites, and the various odds and ends that junior engineers in an organization get to do as they learn the ropes. I discovered I was given increasing responsibilities but was not considered eligible for a training program for young engineers involving periods at such places as Oak Ridge and Argonne National Laboratories. The real reason was that they were afraid I wouldn't stay long enough (I'd get married and leave), though other reasons were given. They did have a tuition reimbursement plan, so I started on a Master's degree at New York University, at night, in the nuclear engineering program. By my second year I was beginning to wonder if this was really what I wanted to spend a lifetime at, but before I came to a firm conclusion the AEC suffered a periodic budget cut and instituted a RIF (Reduction in Forces); being the low girl on the totem pole, I was given a RIF notice and started job hunting and rethinking my goals and interests.

I investigated a number of areas that I might be qualified to tackle, had a few offers in the nuclear field, and looked into the computer areas. Then by chance, someone suggested that I go to the New York State Employment Office, which had a section for professional people. I decided I had nothing to lose, so I went, and among the jobs that were possible was something that they called Industrial Hygiene Engineer. My immediate reaction was "What is it?"; but the interviewer knew only the brief description listed, which sounded interesting, as it involved field work and seemed to have a good deal of variety. We made an appointment for an interview with the chief engineer, though he was a bit doubtful about a girl. I became fascinated with the job -- the basis being the prevention of occupational health problems through engineering evaluations and control -- and he was interested in hiring me. However, he said one possible problem involved the mines. They were the responsibility of the group, but there was an old superstition among miners about letting women underground. We discussed the problem, and then he asked if I minded climbing or heights. My answer was "No," and he said some of the men were afraid to climb and wouldn't, so that if I'd do that he guessed it would work out evenly, and I was hired.

This was the turning point for me, and I've been in that field ever since. I switched my Master's program to the civil engineering curriculum, with the sanitary engineering option and an air and water pollution emphasis. So I was an industrial hygiene engineer, doing work mainly on air pollution problems in industry within New York State, as an employee of the Labor Department. We did a fair amount of stack sampling and somehow this got written up in the Department's paper and picked up by the NEW YORK TIMES, and there ensued a spate of articles with such titles as: "She's Up in Smoke," "She's Climbing in Her Career as an Engineer," "Woman Rises in Man's Position," and "Woman State Factory Inspector Reaches Heights in a Man's Job." The last title caused some consternation at work, as there was an inspection group, and we always had made sure we weren't considered a part of them. But I learned that writers do put words in your mouth that you see only when the item is printed. These even led to an appearance on "To Tell the Truth" that was great fun even if I was a nervous wreck (but they guessed me!).

I finished my evening studies, received a Master of Civil Engineering degree in 1964, and began studies for the professional engineering license that would be necessary for further promotions because of the involvement of our division in plan review of exhaust systems for control purposes in industrial installations. I had foolishly figured that I wouldn't need the P.E. license in the nuclear area and had not taken the Engineer-in-Training examinations when I first graduated, so I had to go back to the beginning and take all three parts. Finally, I did get my license, in 1967.

About 1968 or '69 I realized that there were a number of gaps in my background that I'd like to fill in. Because of the interdisciplinary nature of the work, I felt I needed better background training in some areas: engineering, medical, and laboratory. I felt that I had found the field for me, that it was a relevant career that allowed me to take constructive action in today's society, but that my scope needed to be broader. All along, I had been sent by the State to special courses in pollution control, noise evaluation, and such subjects, but I felt the need for a coordinated program. After some investigation of local facilities I enrolled in evening or late-afternoon courses at the New York University Post-Graduate Medical School's Institute of Environmental Medicine. After a year or so of this part-time study one of my professors asked what I intended to do; was this it or was I interested in going on for the PhD. I hadn't given too much serious thought to that aspect until then but began to do some asking around about potential research projects and possible funding, and to investigate the possibilities of a leave of absence to do the work. This brings us back to the point where I started this paper: I would not have believed it, would you?

It took a good deal of discussion and argument regarding benefits to the Division and the State, doubt about my return, and many other points before I was able to get a leave of absence for a two-year period to do potential PhD research, but I was successful. In October of 1970 I enrolled full-time in a joint program of the Institute of Environmental Medicine and the Graduate Engineering School at NYU for a PhD, through the Department of Civil Engineering. My research project was to involve the development of equipment for conducting the research experiments to evaluate the effect of mass concentrations of respirable-dusts inhalation on the clearance mechanisms of the lung. Since dust inhalation is frequently the cause of occupational disease, this project was directly job-related.

I began studies in toxicology, various environmental problems, and special analytical techniques, and became engrossed in the development of the experimental equipment. The innalation studies were conducted by using radioactive, tagged aerosols along with coal and iron-oxide dusts on miniature donkeys, with the data being taken via external detection of gamma ray emissions. Just picture an engineer, city born and raised, taking blood samples from a donkey!

I have now returned to New York State as a senior industrial hygiene engineer and am trying to complete the write-up of the thesis. The job now includes

evaluation of industrial installations, examination of complex plans for exhaust systems and actual installations for compliance with legal requirements as well as coordination with the medical and laboratory personnel on evaluation of potential effects of environmental toxicants, required sampling techniques and effective means of control, planning of joint field visits, and subsequent data analysis. Supervision of field teams often becomes humorous when some of the junior men are older than I or we have a joint visit with a woman doctor, male nurse, and both male and female engineers. I've noted that the plant engineers or managers often forget which of the men have been there recently but always remember me. That can be good or bad, depending on the report we submitted and its requirements.

During my two years at school I did some work as a consultant in the field: planning surveys, conducting field sampling, and making recommendations for engineering controls. This helped give me a slightly different perspective than I had from my work for the State government. All through these jobs I have been active or become active in professional groups such as ASME (mechanical engineers), APHA (public health), ACGIH (industrial hygiene), and of course SWE. I'm currently busy as a member of the ASME Safety Division's Executive Committee (which includes occupational health), and an Intersociety Committee on Particulate Sampling, and as Vice-President of SWE. These activities have been most beneficial, both personally and professionally, and I plan to continue them. Presentations of papers, seminars, and leading meetings have all added to my professional growth.

What's the next step? I do not know, but I'm quite positive that it will not be dull and have learned that you can make changes, that one curriculum does not lock you into a career, that sometimes changes must be made afterward, when you are better able to grasp the total picture and know what you want your life-style to be. Looking back, I have often realized that the turning point for me was probably the RIF notice. As much as it shattered me, momentarily, it was an event that forced new thoughts and decisions. It resulted in a totally new career that I would never have thought of and might never have known about.

At times, perhaps, I've had to be on my toes a little more than my male counterparts, be ready to overcome some problems -- discriminations that don't exist for a man ... some prejudices. But the barriers have crumbled, fewer doors are closed, and I've learned it's easy to command respect from male associates in general, both as a lady and as a professional. I have found that sometimes I can make a contribution because of differences in psychological makeup, combining them with training and aptitude to help find a unique solution to the problem of the moment.

In conclusion -- despite any stumbling blocks, temporary barriers, and some continuing antagonisms in coworkers in some areas, I've found engineering a multifaceted career with all kinds of potential, a lot of room for improve-

men's in terms of professional acceptance of engineers (in general, not just women) but full of fun, challenge, and fascination.

Carolyn F. Phillips

Miss Carolyn F. Phillips, specializing in industrial hygiene and air pollution control engineering, supervises engineering field teams in conducting complete industrial plant evaluations, from in-plant health and safety to surveys (including sampling for contaminants) of plant emissions. Her responsibilities also include the training, for office and field, of new industrial hygiene personnel.

She examines plans and installations of exhaust systems for compliance with the labor law, industrial codes, and sound engineering practice, approving proposed installations or making recommendations for revision or redesign. She evaluates process operations to discover possible ill effects to workers from industrial health hazards and checks air pollution control methods and techniques to determine compliance with rules and regulations of the Department of Environmental Conservation. Her work requires coordination with the state Medical Department and the Chemistry Laboratory in joint engineering/medical field visits and data compilation and analysis.

She received her BME from Pratt Institute in 1960 and her MCE (Sanitary/Nuclear) from New York University in 1964; she has completed her PhD studies and research at New York University. She is a registered professional engineer in the State of New York, and was previously a reactor engineer at the New York office of the U.S. Atomic Energy Commission and a consultant to Environmental Analysts Inc., of Garden City, New York.

Miss Phillips has written or coauthored numerous scientific papers and articles; she was an invited participant in the 1966 International Conference on Atmospheric Emissions from Sulfate Pulping, sponsored by the U.S. Public Health Service.

Her professional affiliations include senior membership in the Society of Women Engineers (vice-president, 1972-74) and membership and committee work in the American Society of Mechanical Engineers, the American Public Health Association, the American Industrial Hygiene Association, and the American Conference of Governmental Industrial Hygienists.

She is also active in the Metropolitan Synod Youth Ministry Committee, the Appalachian Mountain Club, and the International Oceanographic Foundation.

ATTITUDES ABOUT AND OF PROFESSIONAL WOMEN: NOW AND THEN

Vera Pless

Research Associate
Project MAC
Massachusetts Institute of Technology, Cambridge, Massachusetts

I received my PhD from Northwestern University at about the same time my first child was born, and we moved to the Boston area because my husband accepted a position at the Massachusetts Institute of Technology. I was a lecturer at Boston University when my two older children were young. This was a part-time teaching position. For those of you planning families and careers, I think you should consider when in your career is a good time to have children, and as much as is possible work full time. In academic areas a continuous career is expected, and it is very difficult to return after an absence. Until this situation is changed, as I think it should be both for women and men, I think you should be aware of it.

After five years at B.U., I felt that I must return to research. The first time I realized that professional life was really different for a woman was when I looked for a job. I received replies like "Don't you know this is a men's college?" (there was a women's college attached to it) and "You don't look tough enough to teach men," or "The last woman we hired here did...," and this was followed by items like how well she computed or she was not innovative, as though all women were alike. In facing these problems, I felt isolated; nobody was concerned, and I knew no one in that position. I accepted a position as research mathematician at the Air Force Cambridge Research Laboratories. It presented me with a good opportunity to do the type of research which I enjoyed very much. This was in the area of error-correcting codes, a mathematical topic with practical electrical engineering applications. I enjoy both active mathematical research and the challenge presented by practical problems. When my laboratory was closed last year I joined the M.I.T. Electrical Engineering Department, working in computer sciences for Project MAC.

The main impediment to a woman's pursuing a professional career is the well-nigh universal assumption that she will not. The assumption is that she will marry and stop her professional activities. If she continues with her career while married it is assumed that the arrival of children will terminate or seriously slow down her activities. I believe that we must all fight these assumptions in every way possible both in ourselves and in others.

The best course for a woman herself to follow is to pursue a career continuously, whether or not she has a family. A man does not need to choose between a career and a family, and a woman should not be faced with such a choice either. A woman should realize that it is important to pursue a career in adult life, that it is much more difficult to resume a career after an extended

interruption (although this latter is more difficult than it needs to be). If she marries, this attitude should be shared by her husband. She should not leave it to chance that things will work themselves out. Thought also should be given to the timing of the birth of children. At certain times, from both professional and economic views, children are less disruptive to a career than at other times. This might involve the postponement of children.

In addition to the woman's awareness of her own career, she should be aware of the attitudes around her toward women. She will have to ignore a great number of signals telling her that certain paths are closed to her. She will have to pursue her goals, on many occasions, on her own initiative and without the encouragement that a man would receive. Men are more often encouraged to present papers at professional meetings than women are; they are more often encouraged to apply for fellowships. They are more often advised to apply for the best possible positions they could occupy. Many times women are advised to make do with second-rate positions because it is felt that they are not serious about a career, or that a woman, whether she is serious or not, just would not be considered.

A woman should not be deterred by all-male institutions. She should attempt to enter them. When she sees predominantly male departments in our universities, she should not take this as a signal that she has no place there. She will be doing herself and all women a service if she can get in. So apply for the best positions and fellowships you can. Some of you will make it and some won't. At least you will have tried, and if many women try, women will get those positions eventually. It is for your own sakes and for the benefit of all women.

I cannot overemphasize the importance of role models for women. If women are present in the sciences at universities, women students will believe they too can be achievers if they work hard and have the ability, the men faculty members will have different expectations for their women students, and the men students will regard women as professional also. If a young woman wants to marry, have children, and pursue a career, she should have examples to pattern herself by. She should have people to go to for guidance and counsel. I doubt that most men faculties could fill that role. Women on the faculty could also act as advocates for women; not all women will, but it is more likely that a woman will. The presence of women will stop the unconscious signals given to women that they cannot succeed. Nothing else will.

Needless to say, women in important positions in industry could be the necessary role models for the younger women in industry. Another impediment to the advancement of women is their absence from the buddy system. People get job offers, positions on important committees and so on, based merely on a phone call from one friend to another. The qualifications of all possible candidates are not weighed; just a name is mentioned in a friendly conversation. This is the buddy system, and unfortunately women are not often mentioned. If there are women in top positions, they can give input to

the nomination of women for good positions. When all things are equal, special efforts by and for women will hopefully not be necessary, but until then we all have to give women all the push we can.

Vera S. Pless

Vera S. Pless is a Research Associate at the Massachusetts Institute of Technology. She received a BhB degree in 1949 and an MS in Mathematics in 1952, both at the University of Chicago, and a PhD in mathematics at Northwestern University in 1957.

In 1957 she joined Boston University as a lecturer. From 1961 to 1972 she was a research mathematician at the Air Force Cambridge Research Laboratories. She received the 1969 Marcus O'Day Award for the best AFCRL research paper of the year and in 1971 the Patricia Kayes Glass Award for the best scientific contribution throughout the Air Force by a woman.

She is married and the mother of three children, ages 6 to 16.

MODEL OUTLINE

Margaret Pritchard

Consulting Industrial Engineer
Portland, Oregon

1. INTRODUCTION

One of the important facts of life to a career-oriented individual is the ever-present resume. A resume, to get the job done and literally "get the job," should tell the important and interesting first -- immediately after your name, rank, and serial-number information. Don't make the mistake I did, early in my career, by trying to impress them first with the fact that I was a high-school newspaper photographer when they were looking for my engineering qualifications (which I had put at the bottom of the page).

Therefore, I am going to record my engineering dossier for you in reverse order. This tells you a bit more than Dr. Matthews did, about my current activities. Taking this as the top of the tree I shall retrace my engineering career to its roots -- my basic characteristics and education.

2. PRESENT SITUATION

As indicated to you, presently I am a self-employed consulting industrial engineer. The current project is ecology-oriented in that I have developed a wastewater treatment system that recycles water for the large commercial laundries and some food service industries. (Other applications are waiting in the wings to see if the system can handle their effluent also.) Earlier I used the word design; to clearly define this term let's say I modified existing hardware and married existing systems to get the job done after I had broken the problem down into components that could be handled by each of the systems that were part of the marriage. The big mistake others have made in the past was attempting to handle the waste in total rather than as components.

As a consultant I work not only in wastewater treatment but also in all other facets of industrial engineering, such as material handling problems, methods analysis, job description and evaluation, and most important -- engineering management and training. At the present, due to its national impact, water pollution solutions are taking the major portion of my time.

My extracurricular activities tend to be engineering-oriented. At present I am cochairman of the 1973 Joint Engineering Management Conference, in St. Petersburg, Florida, October 25 and 26, 1973. This conference is sponsored by the management groups of eleven of the engineering societies. I participate as a member of the American Society of Mechanical Engineers. The conference is for engineering managers and vice-presidents, providing

information and education in up-dating their skills. The theme of the conference is the Impact of Competitive Technology on Engineering Management.

Next year the conference is in Mexico City and I have the dubious honor of being general conference chairman. (Do I hear any offers to help? No, just like the army -- don't volunteer!)

An just in case you are wondering what I do with my spare time, I still play with that camera left over from high school. Then, as a native Oregonian, I enjoy wilderness hiking. And now, if my colleagues promise not to laugh, I enjoy travel -- foreign travel. With that comment I close that portion of my resume which has the heading Present Situation.

3. IMMEDIATE PAST EMPLOYMENT

Prior to hanging out my shingle as a consultant, I was employed as a plant industrial engineer, working for a national chain of large industrial laundries. Before leaving the company I was reporting directly to the chairman of the board of directors and president and carried a business card with the title Corporate Review Engineer. My job in this capacity required that I visit the 12 company plants twice each year and audit the engineering function of each plant, much in the same way you would audit the fiscal/financial function. I'll give you one guess as to who designed the audit system and format. (My one objection to role models is the horn-blowing aspect.) My tenure in this job was three years and I worked with six other engineers -- men, of course! A human interest point about one of those six men: he was a Hindu, so not only did we have to adjust regarding the "He Engineer" versus the "She Engineer," but basic philosophies and attitudes were involved. Our secretary had to explain one shouting match to clients in the foyer. Her comment was "They work well together really!" Ours were just friendly discussions but carried on the higher decibel range of India and femininity.

During this period in my career my extracurricular activities included the Society of Women Engineers with assignments involving science-fair judging and guidance activities with JESSI (Junior Engineers and Scientists Summer Institute, a two-week summer program for high-school juniors and seniors giving them insight into a technically oriented college experience).

Back to the job history. My reasong for leaving this job was that the company closed out its engineering department and went to service by outside engineering consulting firms. So I became a consultant.

4. PRIOR EMPLOYMENT

This category on a resume is a catch-all, with main emphasis on jobs that are applicable to your chosen field of endeavor. Therefore I shall start this brief section with eight years as a valuation and mapping clerk for an electric utility company, designing and mapping transmission and distri-

bution lines for electric power, working with and for engineers. My reason for leaving this job was to return to school to finish my engineering studies. (This point will be covered in detail in the section regarding education.) Other employment included eight years in the stock market as head clerk for a Member Firm in their local office; also three years spent self-employed as a toy designer for therapeutic toys, one summar as a fire lookout, and one summer with a news service; and since this is not a job history for security clearance I'm stopping here. No more boots.

5. EDUCATION

For personal and economic reasons, the education of this engineer is a strange patchwork program.

Point One: Due to polio my first year in high school was limited to 3 hours, but I managed to finish in four years with my class.

Point Two: My mother and I fought and won a victory in getting me enrolled in mechanical engineering preparatory rather than home economics or commercial courses. This is where my natural talents intended me to be. A funny thing is that it was during wartime and the mechanical-drawing teacher was a woman. But we still had a fight.

Point Three: Upon completion of high school, family circumstances forced me into the labor market to become family breadwinner. This meant my engineering education was forced into the night-school channel, with its limited curriculum.

Point Four: During my tenure with the electric utility company I was working with engineers, drawing $2500 less per year. This rankled to the point that I took the lead, quit a $7500-per-year job, and went back to college as a "mature student." In fact, the fellows in class with me called me "Ma." I drew the line, though, when one of the guys' wives had a baby and they wanted to change my nickname.

Point Five: In engineering your education never ceases. Example: In working with wastewater treatment, an industrial engineer had to reeducate herself in sanitary engineering.

Then there is the constant process of up-dating in the fields of new technology. An engineer never quits learning!

6. E.E.O.C. HAPPENINGS

In comparison with some of my friends in engineering, mine has basically been a happy experience. I have already mentioned the one instance of unequal pay which gave me the push to go back to school. In retrospect, the other situations worth mentioning involved two professors: one who used the downgrade route to dissuade me, and another who thought he could drive me out of class with dirty stories; both failed because of my fellow classmates' taking them to task for it.

A final situation many of the girl engineers have run into is inadequate rest-room facilities that prevent hiring a woman. I solved this one for my future employer by asking him to install a signal light over the door. Needless to say, the guys in the office changed the color of the light from white to red within my first week there. Office horseplay doesn't come under E.E.O.C.

7. "PUBLISH OR PERISH"

This - the axiom of the teaching side of the profession - has carry-over in practice to some degree. Therefore it is essential to be able to write and and speak comprehensively. My career to date includes several publications, not of the quality and quantity of my colleagues' here. My problem is I prefer to get my hands dirty with problem solving rather than with a typewriter ribbon.

8. REWARDS

Being an engineer is being a member of one of the world's largest fraternities of like minds and attitudes. This is one of the prime rewards of being an engineer. You can really "plug in" when you're with the engineers.

The other rewards are monetary and a sense of accomplishment. The monetary tends to take third place in this list of prime rewards; challenge and accomplishment are second on my list.

9. BASIC TRAITS

In the introduction to this paper I stated that I would trace my career from the present back to its roots -- my education and basic characteristics. I have covered education briefly, so that leaves basics.

I have often said I was born to engineering as a musician is to music or an artist to painting. My basic engineering talent, was obvious by the time I was four years old. My ability to construct and destruct toys and furniture plus the inquiring "why" and "how come" that kept my mother and grandparents busy supplying the full answers, as I wouldn't settle for half-explanations. Their handling of a four-year-old with a talent, plus 14 more years of moral support, even to my mother taking on the whole school board to get me into high-school shop and graphics, was essential to my becoming an engineer.

Another aspect, regarding my basic talent of an inquiring mind and active hands, is that of teacher cooperation throughout my education (with two exceptions already mentioned). Teachers -- or the word I prefer, educators -- who recognize and nurture a talent to its fruition have much to do with the success or failure of an engineer. In the initial job situation there are also "teachers." In a sense, the individual training you for your position is the 17th-grade teacher in your formal education.

As a student in this 17-year program of education, be vocal in letting your needs be known. The squeaking wheel gets the oil so it can do a better job. As an example, one of the SWE scholarship winners was having trouble with her job situation in one of the country's largest companies. She mentioned it to me in the course of a gossip session. In turn, being the tease that I am, at the next meeting of the JEMC sponsors I was teasing this company's representative about the situation. He got serious with me and asked for details. The outcome was that a computer error in her category number, which had job-rated her into a position with a trainer at the wrong level, had caused her unhappy situation. The situation and the category number were corrected and she is doing a great job for the company. The moral to this story is: when it's going to help the situation, in building your talents, be vocal.

10. CONCLUSION

Even after that last statement the time has come for me to quit talking, so you can be vocal. Engineering has been a happy experience for me.

THE EVOLUTION OF AN ENGINEER

Della M. Roy

Associate Professor of Materials Science
Materials Research Laboratory
The Pennsylvania State University, University Park, Pennsylvania

There are at least two avenues to becoming an engineer: one, to train specifically for this field, and the second to come in by the back door. While most women now selecting this career will probably choose the direct process, still others may come by circuitous routes, and those may find something of interest in my personal experience. My career has not been in any sense typical, but instead has proceeded by an evolutionary process, one which was not at all predictable from my background and past (in my view). But in comparison with the unusual experiences that certain others in the program have had in their professional development, mine may seem rather conventional.

But first a word about what this particular materials scientist or materials engineer does. The field of materials defined some 10 to 12 years ago, and my particular interests within it involve chemistry, preparative aspects, microstructure and related phenomena, basic materials characteristics of inorganic and ceramic materials. My responsibilities include conducting research, supervising graduate student and postdoctoral research in the areas of biomaterials, ceramics, glass, cement and concrete. Also, I organized and edit an international research journal, and do some consulting. It was really highly improbable that from my background I should become an engineer. Born in a rural Eastern Oregon community where even most of the boys didn't go to college and the girls typically got married after graduating from high school, it seems strange that I considered pursuing a career at all. I was turned on by science at an early age and led along by the goal of pursuing this dream, and was encouraged at the right moments so that eventually this was possible. I went to college, where I received a BS in Liberal Arts with a chemistry major (engineering did not exist at the University at that time). Then I went on to graduate school to pursue studies best defined as applied science; and from there my professional orientation evolved and changed as did my research interests and efforts up to the present.

There were certain unique factors which helped shape this evolutionary process. My hope and expectation for the future is that girls will have the possibility much more clearly open to them of following the careers they want, that it will be more natural and accepted, that it will be much less unique -- this direction is clearly evident already. Nevertheless, for a woman the reasons for following a particular career may never be quite the same as for a man, and some factors which shaped the evolution of my career may speak to those present.

It is useful to raise the question: Given equal ability or potential, what factors are responsible for a certain woman's entering an engineering field

while so many others do not? And one may need to step back from this a bit further to raise a second question: A career or not a career? Fortunately, the latter battle is almost won, for a substantial proportion of people now accept as legitimate a woman's desire to pursue a career, but even this does not receive universal acceptance. I think the single most essential factor in answering both questions is for the person to have a deep sense within herself that this is a proper and logical course, that it is somehow right and is the most suitable use of her talents. Secondly, it is important to receive encouragement from the proper persons at critical points in time. Those in guidance will certainly affirm this second factor as vital in enabling persons to shape a career. Thirdly, there is a factor one might call luck, or circumstance, which opens opportunities. And finally a fourth that I call stubbornness, which keeps one at it. Each of you may add your own additional ones to this list.

I have already mentioned my early and persisting fascination with science, but there was not much opportunity to develop this interest during my high-school years. In fact, there was not much challenge, for in a small rural school it was easy to stay at the top of the class, and I used the considerable spare time for reading and pursuing my own interests, music, athletics, drama, debate, etc.; but was slightly bored over all. When it became apparent that by taking extra work I could graduate in three years instead of four, I proceeded to do so (to the Principal's mild consternation!). My biggest administrative battle, however, was to be allowed to take physics instead of shorthand ("But the girls take shorthand, and you will be the only girl in the physics class" -- there I got my first glimpse of the shape of things to come).

Quite important at this stage was the influence of the central people in my life, and I should not go further without mentioning this: First, my good and wise mother, who had not felt highly fulfilled in her own life, since she was able to be only a housewife, and who patiently stood by to encourage me and help make possible my doing what I really wanted to do. She also saved me from a couple of false starts, when I appeared to be set on going in other directions but was doing so through a sense of duty rather than genuine interest and ability. Second, my sister, several years older, who was well on her way to becoming a geologist, and who with much more difficulty and against greater obstacles than I later encountered had been able to surmount them, and had already provided for me a model. And third, my father, who, though he thought that most women's places were in the home, felt that his daughters were rather special and that this advice did not necessarily apply to them; thus, while he did not actually spur me on to greater things, he was able at critical moments to give support or at the very least not oppose.

College days brought new and wondrous experiences, the tree of knowledge with fruit literally waiting to be plucked, the opportunity to explore philosophical ideas, the medium of study in small, intimate classes (and this at a state university!), the latter a by-product of war years and low enrollments. The same circumstances also meant that science classes had about equal enrollments of women and men -- the only time I have experienced this in post-high-school

days -- and that the men professors paid more special attention to us than opportunity ordinarily would have allowed. I have still fond memories of the chemistry professor who convinced me that an intelligent being could make up for lack of background; of the mathematics professor who encouraged me to stretch myself to my utmost mentally; of the small physics laboratory sessions where the students really forgot the time of day; we discussed many things, but learned physics too; of the mineralogy classes where I literally got individual instruction.

All these were privileged experiences and involved special persons. The war years also caused my being recruited while an undergraduate to assist in teaching returning veterans (there were not sufficient graduate assistants), and I came to realize, though somewhat humbly, that even though the men were much more experienced generally, I knew more physics and chemistry and had something to teach them. This probably shaped more than I realized at the time the possibility of working in a so-called man's field.

When I said that my career was an evolutionary process, that was certainly true of graduate school, as advanced training was not conceived as a possibility when I entered college but appeared necessary to me as graduation approached. Jobs open to a BS chemist were not very challenging at that time, and I began to explore available assistantships to support me in graduate school. After I had applied to various chemistry departments and geology departments, and then refused all offers, none of which seemed just right, some information came to me though a professor (with whom I had previously spent many hours talking) about a new "geochemistry" curriculum which seemed to be just the right combination of applied science I was looking for. I would call this a combination of the two factors: influence of the right person, and luck.

The professor with whom I would be working on the assistantship had not expected a woman, but looked at my qualifications and said, why not? This continued to be his attitude as I finished my Master's and looked to a PhD, as long as I worked for him, and was a <u>great</u> asset. Working also for the same professor at that time was the man who was to become my husband (just finishing his PhD as I started graduate school) and a second young man from Georgia. With true Southern gentlemanly consideration the latter insisted that he do everything for me that it wasn't proper for a woman to do, while my future husband was content to show me how to do things and then leave it to me. Somehow he never doubted that I was capable of doing most anything. And this pattern was to carry through in our marriage, later. Thus, again at this stage, the influence of specific persons was strong in encouraging, shaping, making possible.

After my first child was born, I slowed down a bit, taking leaves of absence for three to four months to stay home with the new baby and then working only half-time when I returned. Part-time work provides the happy medium of intellectual and professional stimulation without being too highly demanding. In each case, after a few months' leave I knew it was time to go

back to work again, though I must admit that after our third child was born days were very full. Again, let me emphasize that this pattern seemed for me the right course; I would not want to pretend that it is desirable for everyone. Fortunately, my husband supported me wholeheartedly in this choice; I can imagine how exceedingly difficult it would be if there were only a grudging acceptance from someone so very important and central. In my case it was not only thorough acceptance but the fact that we worked together very closely and shared most interests. He has been a constant source of encouragement, and my best critic.

What are some of the difficulties encountered in pursuing such a career? At the top of the list, and by far the most limiting factor, in my impression, is simply time. In choosing work which is so involving, one simply has to unchoose so many other activities, to be very careful in deciding to take on additional tasks or explore interests, and simply in budgeting the existing time to meet the needs. Perhaps this time factor loomed greater, when the children were small, in comparison with the lives of others, as in those days not many women worked; but now it seems that the anomaly is rather those who don't. There were some rather painful times of reconsidering decisions, typified by the moment when my oldest son, then about age 9, asked rather poignantly, "Mother, why do you work? The other mothers don't seem to have to." Either the age changed, or else it was interpreted to his younger brothers more adequately, as this question was not raised as such by them.

I am convinced that preservation of my own peace of mind was aided in these days through not having a highly responsible position -- I was a research associate, and then senior research associate -- so that if I missed work occasionally the world did not stop turning. But it was there to challenge me again on my return. I shall have to leave it to my children's memoirs to see what they really felt about the succession of nursery schools, babysitters, junior musicums, clubs, and other creative activities designed for them while I was occupied with work (if they can remember that long, or be objective).

There is constantly the problem of working in a segregated society -- being such a small minority in a "man's field" -- but this will become far less with time. Occasionally this has given rise to some embarrassing or amusing situations. In many professional meetings and gatherings I have attended in the past few years I have found myself wincing as the audience was automatically addressed, "Gentlemen"; and have received my share of letters addressed "Dear Sir," and even been tentatively offered an academic position (by letter) by someone who thought I must be a man. In professional dealings any number of times I would speculate whether someone knew I was a woman, and if not would he change his impression after he realized the fact. More than once I have been introduced to a colleague who knew me by name only, to meet the incredulous but apparently pleased response, "But, you're a lady." In the journal which I edit, the 25-member international board of associate editors

is all male (invited by me), and I have jokingly been accused by some of the board members of being anti-female! The basic fact is that there simply weren't obviously suitable female candidates (although presently I am negotiating for one particular woman from overseas).

When I was younger, in a professional situation a number of men did not really take me seriously at first; but I remember very few examples of what could be called obvious direct discrimination because I was a woman. Generally, personal contact and working together erases suspicion and theoretical doubts along these lines even from the skeptic. People sometimes raise the question, Do men like to take orders from a woman? (Maybe we should ask as well the question, Do women like taking orders from a woman?) I do not have, nor have I ever had large numbers of men working for me, because of the particular nature of my work, and cannot give statistically significant data. But I remember well the occasion when my first graduate-student thesis advisee had taken his final PhD exam; afterward I found a bouquet of roses on my desk. This erased some doubts that I had in my own mind at that time.

In closing, I do not want to paint such a rosy picture that it glosses over all difficulties, and hope I have not done that. By my expectations for the future based on the present and reasonable extrapolation are that the job situation for women engineers will continue steadily to open up, that there will be a lessening of direct pressures and opposition to those girls who seek to follow this profession. Employment opportunities right now, as others have indicated, are good in engineering, and the greatest future difficulties may be expected in the eventuality that all jobs are drastically cut back and the competitiveness becomes much greater. For a particular situation the individual must be aware of subtleties which may be present in an immediate employer's attitude, of which even the employer may not be aware. If married and desiring to have a family, she should consider carefully what is her husband's attitude, and the couple should discuss thoroughly how they hope to manage and share the responsibilities. I still see considerable value for part-time professions, where possibly both husband and wife could have half- or three-quarter-time jobs, allowing each the opportunity for outside pursuits.

I would like to say a word here also about equal rights for men, since I don't feel that we should go overboard the other way, to the point where a married woman is automatically guaranteed security and thereby is able to do anything she pleases. One good example which I am pleased to report is the situation where a wife, after her family was nearly grown, went back to college, took a job which she finds very fulfilling, and at the same time has made it possible for her husband to pursue a lifelong interest -- to be a freelance artist. I hope we will see more such examples as well. Finally, from my own limited experience, I feel that there are plenty of opportunities for women in engineering, and would like to help spread the word that those who really have an interest in this area should not hold back because of past images or imaginations of others.

Della M. Roy

Dr. Della M. Roy is a senior member of the Graduate Faculty of the Pennsylvania State University. An Associate Professor of Materials Science, she also consults with cement manufacturing companies on special diagnostic problems, effects of chemical and temperature changes, and problems in accelerated curing of concrete.

Dr. Roy's research has included general materials preparation and characterization, with special emphasis on the area of cement -- chemistry and temperature and pressure reactions; crystal synthesis and growth; and mineralogy.

She received her BS degree in chemistry from the University of Oregon in 1947 and her MS and PhD in mineralogy at the Pennsylvania State University in 1949 and 1952, respectively. She came to the Materials Research Laboratory in 1962 as a senior research associate, having previously served as senior research associate in geochemistry and a research assistant in mineralogy, all at Penn State.

Author herself of many technical papers and articles, Dr. Roy is editor-in-chief of Cement and Concrete Research, an international journal. A participant in numerous international professional meetings and symposia, she is a Fellow of the Mineralogical Society of America, a Fellow of the American Society for the Advancement of Science, and a member of the Geochemical Society, the American Society of Engineering Education, the National Academy of Science (Highway Research Board, Committee A2EO-6 on basic research in cement and concrete), the International Mineralogical Association, the American Concrete Institute, the American Ceramic Society, the Concrete Society, and the American Society for Testing and Materials. Her honor society memberships are in Phi Beta Kappa, Sigma Xi, Sigma Delta Epsilon, and Pi Mu Epsilon.

Dr. Roy includes among her outside activities speaking to civic, church, and college groups on the subject of marriage and family relations. Her husband, Dr. Rustum Roy, Professor of the Solid State at Pennsylvania State University, is Director of the Materials Research Laboratory. They have three sons.

INFLUENCE OF SECONDARY EDUCATION ON WOMEN'S CAREER SELECTION

J.E. Sabadell

Assistant Professor
Department of Chemical Engineering
and Center for Environmental Studies
Princeton University, Princeton, New Jersey

This presentation will consist of: a concise description of the secondary education in some European countries, and the American counterpart, during the 19th and 20th centuries. Along with this, some data on the role women play in higher education today in Western societies will be presented, and a correlation between the selection of careers women make and the influence these diverse educational systems may have on this critical step they take will be established.

NINETEENTH CENTURY EDUCATION

It was during the 1800's that the western world was swept by ideological currents and countercurrents; when strong nationalisms emerged and when the industrial revolution made its full impact. The new nations emerging and the old ones that were changing modes and rulers, sometimes explosively, needed to instill national and moral feelings in their people; their economy, through industrialization, needed workers with some special skills. To attain all this, popular education was the key.

GENERAL CONSIDERATIONS

The educational system of any given country at any given time is shaped and affected by interacting historical, social, economical, and political factors. Also, in the history of humanity an event does not occur in a vacuum; on the contrary, there are precise causes for it to happen, and always its consequences will influence the following occurrences. Thus, before entering into the women s side of the educational process, let us review in general what happened in this field during the last two centuries.

It can be seen, then, beginning with Prussia and the Scandinavian countries in the first half of the 19th century; the establishment, in more or less successful ways, of compulsory elementary systems. Many circumstances helped: concentration of population in urban areas where schools could reach more children easily; industry's economic support, through taxation, of national systems; strong ideologies like liberalism, socialism, etc. that sought the enforcement of universal education. But still on both sides of the ocean only the sons of the upper classes attended secondary schools and universities.

The important distinction that appears is the centralized, state-controlled educational programs implemented in continental Europe and the laissez-faire concept that prevails in the English, and subsequently American, education.

The general picture that emerged in Europe by the end of the 1800's was the lower classes attending elementary primary, followed by higher primary, vocational and continuation schools, with structured programs, supported by the state, and compulsory attendance up to age 13 to 16. On the other hand, for the children of the upper classes, highly selective secondary systems were still the norm, with strong classical curricula in the gymnasiums, lycees, or grammar schools. But already children of the middle classes were beginning to "infiltrate" the system. Nevertheless, through screening, examinations (eleven-plus) and demanding standards, secondary and higher education were kept quite exclusive and always very much structured.

In the United States, instead, education was not a national prerogative and it was left to each state (usually with variations within a state) to establish programs and to enforce support. This decentralization is in sharp contrast with the European systems.

Up to the 1860's, private secondary schools educated the gentry's sons (in Latin grammar schools, military academies, religious schools); it was after the Civil War that public high schools began to appear and they had a unique system, as we have today. The German influence at this stage was very strong up to the time of World War I.

It is only at the beginning of this century that efforts in standardizing the high-school curriculum were set in motion. At the higher education level, any intent to establish a national university failed even though men like Washington, Jefferson, and Madison were enthusiastic about the idea.

One very important point, for the purpose of this Conference, is to realize that women in any significant number did not enter the higher educational stratum until the end of the 19th century. Through all the educational processes described, the formal instruction of women was incidental: and as far as secondary or higher education is concerned, it was not considered necessary but almost unsuitable.

TWENTIETH CENTURY EDUCATION

What we find in the western world today in the field of education, after two world wars, the Communist Revolution, with changes in forms of government, traditional values, social and family structures, and with the flourishing of strong technocracies, is a trend towards universal literacy and the development of scientific and technological élites.

The main thrust into achieving this purpose is the "democratization" of education (or the possibility for any individual to participate in the cultural experience) together with the modernization of educational methods.

In Europe the dual system still is in effect, and so we find in England the highly selective grammar school, the technical and vocational high schools, and the modern High School.

In Germany, youngsters attend four different kinds of secondary schools: the gymnasium (classic), the real-gymnasium, the ober-real-schule (strong in sciences), and the Aufbauschule that seeks to give advanced basic education to children of rural communities.

In France, the first educational phase is from six to eleven years old. After an "eleven-plus" exam, different secondary possibilities, according to performance, from age 11 to 15 and from age 15 to 18, the academically inclined students attend the preparatoires aux grandes écoles. The other youngsters are provided with vocational training programs.

In Russia, where a tremendous effort was accomplished in the last fifty years (from a 75 percent illiteracy in 1917 to a very high literacy rate today) a classless, centralized, and strongly scientific and technologically oriented educational system has been developed. After eight years of elementary instruction, two types of high schools are in function: a) the regular general, four years, that offer mixed humanistic and scientific disciplines; and b) the technical school, four years also, training nonscholastically oriented students for practical, technical, and manual labors.

In Sweden, the upper secondary school is divided into what is called "lines": the liberal arts line, the social sciences line, the economics line, the natural sciences line, and the technical line, each with two- to four-year programs. In all cases there are certain subjects that have to be studied, for a longer or shorter period, by all the students: the national language, another language -- usually English, history, mathematics, general sciences, civics, psychology, and others.

Other countries of the Americas, where educational systems were shaped after European models, follow similar paths of dual secondary education. For example, in Argentina, after seven years of elementary compulsory instruction, the student can attend any of the following four types of high schools (after an entrance examination): a) the lyceum or national school, a five-year, completely structured program for academically oriented students; b) the normal school, five years of for teachers' preparation, followed by two to four years of special programs in specific subjects; c) the commercial school, five years of business and economics programs; d) industrial schools, six to seven years of technological programs. The a), c), and d) degrees, together with entrance examinations, qualify the students to enter colleges and universities; these again are centralized and highly structured. The philosophy behind these formal educational systems, with compulsory programs and few or no elective courses, is that:

1. The academically oriented student needs a broad education in humanities and sciences, so that when he-she enters a specific discipline in higher education this person has more than a basic knowledge of subjects not pertaining to his-her postsecondary studies. This is the encyclopedic concept of culture.

2. The nonacademically oriented student can acquire technical or manual skills along with some broadening in the education already received during elementary school.

3. Some fields of studies need to be treated specially, beginning at the secondary level, as in business, technological, or normal schools. Along with the specific subjects, general ones are also covered.

This organization of the secondary education is in contrast with the ladder system in the United States, which gives to the high-school student a large freedom of choice.

INFLUENCE OF SECONDARY SYSTEMS ON WOMEN'S HIGHER EDUCATION CHOICES

The proposition of this paper is that: along with many other reasons that we will not enter here to discuss, the emphasis and relevance of secondary school's curriculum, together with stronger requirements in mathematics and sciences, would improve the chances of academically oriented women in entering scientific and technological fields.

The demonstration of this theorem lies in the figures presented in Tables 1, 2, and 3, and in studies performed in the United States on primary- and secondary-level students. It was found that girls are "turned off" on sciences and math as early as the 5th grade, though performing equally with or better than the boys up to the 8th grade. At the high-school level the attendance of girls in mathematics and science courses decreases sharply after the minimum college requirements are covered. The contention here is that during all the four years of high-school education, sciences and mathematics should be not only encouraged but required, at least for the students with scholastic aptitudes.

A reform of this kind would be not an easy task to perform and probably quite unpopular with some students. It would also be against what C.S. Lewis in his "Screw Tape Proposes a Toast" calls "the basic principle of the new education," which says "that dunces and idlers must not be made to feel inferior to intelligent and industrious pupils. That would be undemocratic" ... "in a word, we may reasonably hope for the virtual abolition of education when I'm as good as you has fully had its way." Taking this last sentence and giving it a twist, let us say that: "education will better serve society when I (woman) am as good as you (man) has fully had its way."

Table 1

STUDENTS ATTENDING UNIVERSITIES AND INSTITUTES OF TECHNOLOGY -- 1971-1972

Disciplines	France			Germany			Italy			Sweden		
	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women
Engineering schools	21,549	4,671	21.67				82,823	745	0.9	14,861	1,259	8
Mathematics				23,920	4,459	18.6	19,197	8,372	43.7			
Physics and geophysics	100,124	33,991	33.94	14,160	840	5.9	11,687	1,787	15.3			
Chemistry				17,555	3,074	16.4	6,241	963	15.4	12,987	2,877	22.2
Biology				13,291	5,146	38.7	32,477	16,562	51.0			
Other natural sciences				6,138	2,843	46.3						
Medicine	68,171	21,162	30.90	44,749	10,166	23.2	98,148	18,829	19.2	7,361	2,048	26.8
Law	109,477	36,841	33.64									
Total				461,598	147,419	31.9				122,867	122,744	38.0

Table 2

TOTAL NUMBER OF DEGREES AWARDED BY UNIVERSITIES AND INSTITUTES OF TECHNOLOGY

Disciplines	France (1969-1970)			Germany (1969-1970)			Italy (1969-1970)			Sweden (1969-1970)			United States (1969-1970)		
	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women
Engineering schools	6,780	328	1.84	1,508	146	3.18	29,410	124	0.4	1,935	112	5.84	64,050	534	0.83
Mathematics	2,854	1,160	10.64	615	33	5.36	8,282	4,933	59.6				31,453	11,029	35.63
Physics and geophysics	2,766	886	12.03	1,741	31	1.90	5,317	1,449	29.1				5,963	324	5.84
Chemistry				1,736	95	5.47	5,903	1,457	24.7	2,297	624	22.16	15,503	2,519	1.73
Biology	6,980	2,825	40.4				8,980	6,494	72.3						
Other physical and natural sciences				753	117	15.54							45,600	12,824	27.41
Medicine	5,871	1,581	26.95	11,009	3,352	30.45	29,265	3,625	12.4	1,640	425	25.97	8,374	713	8.51
Law	27,581	7,364	26.89	4,120	384	9.32				714	138	19.33	17,424	57	.03
Total				47,892	12,941	27.02	352,882	135,562	38.4	20,911	8,273	39.56	1,062,581	429,594	40.42

Table 3

DOCTORATES EARNED BY WOMEN

Disciplines	United States* (1960-1969)			Germany (1965-1970)			France (1970)		
	Total	Women	Percent Women	Total	Women	Percent Women	Total	Women	Percent Women
Engineering	15,972	62	0.44	3,311	10	0.30	296	10	3.27
Mathematics	6,166	401	6.50	838	33	3.94	69	8	10.39
Physics	8,415	168	2.00	2,436	23	0.94	528	66	11.11
Chemistry	13,963	884	6.32	3,875	128	3.30			
Biology	17,708	2,448	13.82						
Other physical and natural sciences	4,356	127	2.91	1,982	287	13.82	199	83	41.43
Medicine	3,813	153	4.01	18,002	3,734	20.80	2,504	544	21.71
Law	478	12	4.48	3,180	174	4.88	321	71	22.12
Total	74,111	17,929	11.63	67,517	11,504	17.04			

*Source: U.S. Office of Education, Education and Welfare

J.E. Sabadell

Josefina E. Sabadell is a research staff member and lecturer with the rank of Assistant Professor of the Department of Chemical Engineering and Center for Environmental Studies at Princeton University. She joined the Department of Chemical Engineering as a research associate in 1967 and, in collaboration with the late Professor Richard H. Wilhelm, developed the PH Parametric Pumping System.

She obtained her BS and Licentiate degrees in Chemistry at the National University of Buenos Aires (Argentina) School of Physical and Exact Sciences in 1954. She was a research staff member and later Director of the Research Laboratories of EQUIA Ind., Buenos Aires. From 1958 to 1966 she was Professor of Quantitative and Electro Chemistry at the Technological Institute Luis A. Huergo, also in Buenos Aires.

Dr. Sabadell is a member of the American Institute of Chemical Engineering, the American Society of Engineering Education, the Society of Women Engineers, and Sigma Xi. She is a counselor of the Students SWE Princeton Chapter.

ON BEING A WOMAN ENGINEER

Irene W. Sharpe

General Engineer
Engineering and Research Center, Bureau of Reclamation
U.S. Department of the Interior, Denver, Colorado

When I was invited to make a presentation before this group, it never occurred to me to declind the invitation. Once I learned what I was in for -- writing a speech -- you c. n't imagine how I wished I had declined. You might say, "What's so bad about writing a speech?" Well, nothing, unless you happen to be one who talks incoherently but can't stand the sight of something written that way.

Of course, by now we all know we're here to share our ideas and experiences on being women engineers. During the next few minutes, I'm going to tell you some of my beliefs and what it's been like for me as a woman who works a 40-hour week as an engineer, has a husband, two children, and numerous other interests.

I have spoken to high-school and junior-high groups some three to five times per year for the past six years about engineering as a career. Not once did I write a speech; I was generally able to gear my talk to the interest of the group after getting up before them. Usually, I could just say, "I'm an engineer," and that alone would provoke enough questions to use up the remaining time.

This past December, I went to speak during Career Day at one of the local high schools; a teacher made the introduction; the students asked no questions, and I had to come up with something fast for the first time. And having to write out this speech has caused me to have to come up with something a second time, though not quite as fast.

I didn't always want to be an engineer. I wanted to be a math teacher until I was in the ninth grade. I decided that I didn't want to be a teacher, with no idea of what I did want to be. Once I decided on engineering, I pursued it with extreme determination. And I must say that I was not always happy with my engineering studies. I found my junior year extremely uninteresting and became quite bored. But my senior year I was back to courses that I felt were useful for what I expected to do with my engineering education, and I was very happy that I had stuck with it.

Concerning my desire to become an engineer, of course my mother was against it. She didn't know what it was, she probably still doesn't, but she knew what teachers were and she fully approved of my being a teacher. When I told her I would not go to the State College, that I wanted to go to an engineering school, that I'd finance my own way even if it meant going to school longer,

I think she became aware of my definite intentions. She asked my sister, a math teacher, what she thought; she said she wished she had become something other than a teacher. That ended that difference, and I went through with my plans.

During my four years in college, I was very active in campus life and activities. I found having participated in such activities an asset when I joined the work world. I think perhaps you gain experience in teamwork from such participation.

I joined the Society of Women Engineers as a student in 1962. I occasionally attended a Section meeting from then until 1968, when I attended the National Convention in Los Angeles. I'm ashamed to say what attracted me to the 1968 Convention. I have now been to four SWE National Conventions, and this is my third Engineering Foundation Conference dealing with women in engineering.

At one of the National Conventions, someone stated, "I wouldn't miss one of these things for anything. At these Conventions, lasting friendships are made, leadership potentials are developed, and self-confidence is tremendously increased." I have found those words to be incredibly true.

I graduated in June 1963 and went to work in the Chief Engineer's Office of the Bureau of Reclamation, located in Denver, Colorado. My job for one week to a month there was to be photographed, talk to news reporters, and tell any employee who asked why I studied to be an electrical engineer. As a participant in the Rotation Program for new engineers and other professionals, I was given four 13-week assignments in various areas of the Bureau to learn how my job related to the overall mission of the Bureau and to eventually settle in one of the four areas as a permanent employee.

One of my assignments was a field assignment to a regional office, which wasn't approved until about halfway through my second assignment. The field assignment had been denied me by a personnel department employee within two hours of the time I first reported to work.... because "you're a woman," he said. During my second 13-week assignment, I asked my supervisor why I couldn't go on a field assignment. That was the first time anyone working with me knew of the denial. Within a matter of several hours, what the personnel employee had told me was out of the window and I was scheduled to go to a field office.

Having experienced that, I soon concluded that asking naive questions sometimes brings quick and desirable results. I also feel that opportunities to travel and remote training assignments should not be turned down without very sound reasons after having been seriously thought about.

I was married in October of the same year that I graduated from college, and though I was one who used to set goals years ahead and work toward them, I've found myself altering many of my goals as the situation required.

So far as a workable solution to career, marriage, and family are concerned, I've found almost every goal that I set altered. For instance, upon graduation I had an immediate goal to work two years before getting married. So you can see how I flubbed that one. Being married led to my leaving engineering for a little more than two years (January 1965 to March 1967), during which time I worked as an instructor, counselor, and/or examiner for the U.S. Armed Forces Institute at the Army Education Center in Verdun, France. I have considered going into teaching, but it isn't in the very near future of the goals I've set. My most immediate goal is to go back to college.

I never wanted to go to graduate school as soon as I finished my BS. I had professors who suggested that no engineer should do that, and I am personally glad that I couldn't afford to do it; finances forced me to go to work. The professors reasoned that you needed to find your "area" so you'd know what to study in graduate school. A former Chief Engineer where I work once suggested that five years of experience working as an engineer be a prerequisite for admission to engineering graduate school. I've learned through work experience that I'd prefer a second BS degree rather than an MS in engineering. I do think, however, that I would like to pursue graduate work in something like engineering management, public administration, personnel management, or the likes.

I believe that an undergraduate background in engineering is probably the best springboard one could have for entering any one of a number of careers. I have known individuals with engineering backgrounds to become sales personnel, medical doctors, attorneys, pilots, mayors.

Of the many goals I've set and then changed, another was to cease working when I had my first child. That goal was changed primarily because I needed to return to work for 16 weeks to obtain career status, after which I could leave Federal Service and request reinstatement at any time.

When I had worked the 16 weeks, things were going so great and I liked my work so well that I didn't even consider quitting. With my second child, I had reached a point of boredom on my job and was seriously considering using my child's birth as a "valid" reason to retire, at least temporarily, from the work world. But it seems somewhere along the line someone decided that I was worth keeping, and I was given a reassignment in which I worked only seven weeks before I went on maternity leave. I found during that seven weeks that the job offered a challenge that I wanted to undertake, and I've remained in it ever since. I plan to spend at least another year in that job. Because I know I have a goal to stay where I am another year, I'm not doing any hard looking; however, I have been approached by several government agencies

from time to time, as many private companies, and two universities for possible employment. Just to know that employers are looking for women engineers gives me a certain amount of satisfaction in knowing that I'm in an area of work where the supply isn't greater than the demand.

All in all, I feel that the success of a woman as an engineer will depend a lot on the four keys to the executive powder room presented at last year's Engineering Foundation Conference on "Women in Engineering and Management": 1) Know the territory, 2) Know thyself, 3) Know the law (and I might add, use it if need be), and 4) Know your stuff (subject field/continuing education). You know better than anyone whether you're lacking in any of those areas; if you are, set goals to achieve strengthening where needed.

As a woman engineer, I'm convinced that on the job one should spend little time dwelling on the fact that she's a woman engineer. The more time s spent just being an engineer, the better. There is competition even between the men for recognition and higher positions, and a woman can be left far behind if she spends her time daydreaming about being a woman engineer.

I'm not saying you should not dress feminine and maintain a feminine air; I'm saying that thinking and using your brain isn't peculiar to either sex. If you have the appearance of a woman, you will on first sight be viewed in the same light as every other woman, anyway. Then it will be up to you as an individual to show your individuality and that you are indeed different. There are many aspects of being a woman that I think we each desire, or at least accept, but being paid less and being denied opportunities in our chosen work aren't among them.

I currently work as a general engineer, and my job consists mostly of technical editing. It is extremely interesting to me because of contacts with so many authors. I find much satisfaction in completing one of these projects but an awful lot of frustration in not receiving a serious word from my immediate supervisors about whether the job was good, bad, or indifferent. Many of the authors and their superiors have thanked me and said they were pleased that I did a good job. This falls in the category of "knowing thyself." Do you want to know if you did a good job? If your immediate bosses won't comment, is what you hear from others sufficient? This may be a case of having to "accept that which you cannot change or having the courage to change that which should be changed," and that might mean changing jobs, or at least supervisors. I once heard a woman luncheon speaker admonish, "Be careful how you choose your supervisors."

Though I've stayed with the same employer for more than eight years, I have spent approximately three years in each of three different areas of work. Personally, I have found each of them rewarding in different ways. I think that one, whether engineer or not, should be happy in his or her work, no matter what the work is. This can be achieved in many ways. Sometimes one is

unhappy in one's work because the person, in my opinion, chooses to be unhappy. If such were not the case, I think the person could and would take the risk, loss in pay, and seek additional training or whatever is required to make a switch. If you are a grouch who would be unhappy no matter what you are doing, then you are the problem and not the job. Sometimes, it may require changing jobs several times to learn this. But once you learn it, then you can start working on the real problem -- yourself; your attitude towards yourself.

Because women make up such a small percentage of the engineers in this country, I think for years to come we'll find ourselves working within an environment predominantly male. If you have a chip on your shoulder about being either inferior or superior to these men, get it off, because you will waste vast amounts of time and energy thinking about the environment rather than the job at hand.

It's my understanding that you are all engineers or contemplating becoming engineers. So I'm sure we've all had the experience of being the only girl in a class or one of only two or three. For this reason, to end up as the only woman engineer in a company or the only one working in a particular area within a company isn't going to be traumatic from the standpoint of being the only woman amidst an ocean of men. If you're husband-hunting, that may be an ideal situation, provided, of course, that the husband you're hunting isn't already someone else's. However, I do think that you may sense a difference of satisfaction in being treated equally and fairly. In school, your professors for the most part will evaluate you in much the same way they evaluate the gents in your class. On the job you may find yourself being watched more closely and a "big deal" being made, or you may be razzed, about any error you might make, with little if anything said about things done well.

I'm afraid many of my associates placed me in a different light than they placed my male counterparts. I was young (21) when I was hired; I was expected to get married, which I did after working only five months. I was expected to become pregnant, which I did after working more than five years; I was expected to stop working, and that I haven't done.

Because I was expected to quit work, I'm convinced that training (on-the-job as well as other types) was denied me until some six to eight months ago. There are two possible reasons why this is no longer the case: 1) I've convinced the "powers that be" that I am going to work indefinitely, whether at the Bureau or elsewhere, and 2) I finally got the courage to start squawking about it. I think probably the latter is the real reason for the change.

I've done so much talking about me, my beliefs, experiences, and goals, I'll bet some of you are out there thinking, What about her poor husband and her poor little children? I have never been able to put any of the three (career, husband, and children) in numerical order of importance. I somehow feel that they are all on the same level and that one adds to the importance or significance of the others. Whichever needs attention at a particular time is usually

the one dealt with just then. I don't think that my husband will ever demand that I stop working, because he lived with me those five months that I didn't work. I have since learned that I was next to impossible to live with then.

I've had a hard time taking my husband seriously about some of his career goals. He wants to retire at age 45. At that age, we'll have a 13-year-old son and an 11-year-old daughter. I can't believe he's serious. He apparently likes the military and, except for me and now the children, would probably spend the next 10 years on active duty, and then he could retire at age 45. I'm afraid it would just be military retirement and he'd be back in some work force within months to meet the financial obligations of our young family.

I enjoy my kids immensely when I am home, and they appreciate me. I also watch very closely to see that my being away isn't affecting them adversely I honestly believe that my kids are better off with me working, and by working as an engineer I'm able to pay fair wages to someone to look after them. I believe that in baby-sitters, like anything else, you pay for what you get. The sitter in my opinion is apt to do a good job if she feels she's being paid a fair wage. She must also be one who likes working with children.

Some of you might have reservations about getting into such an apparently demanding field as engineering, with hopes to marry and raise a family. There are so many aspects to engineering that one should not rule out engineering in total just because one or two of the aspects don't fit your plans.

I think that the most one can get out of gatherings like this conference is the self-confidence one gains after learning there are others who started out with the same weird ideas, encountered the same obstacles, but somehow managed to get along. I have a friend, who was in my college class and sorority and whose children are five years older than mine, who upon learning of my intentions to start a family had nothing but encouragement, and ended with a chuckle that "misery just loves company."

So if you feel miserable in your job as a woman engineer or in your contemplation of becoming one, don't feel alone; and I should hope that certainly the reverse is also true. I'm sure you'll find that you have much company no matter how you feel, if you'll just get to know other women engineers. I know of no better way than to become involved in the activities of SWE; somehow that led me to become involved in Engineering Foundation Conferences on women engineers. I also took part in the Federal Women's Program Committee of the Denver Federal Executive Board, and a local Association of Federal Professional and Administrative Women whose goals were to dispel notions that all women who work for the Federal government are clerk-typists.

It was these types of involvement that kept me going when the job was not challenging but these activities were. I have in the past year dropped some of these activities, and I find that no sooner do I drop any of them than I pick up something else just as demanding.

My husband, who is here, finally did the same thing to me concerning these involvements that I did to him concerning week-end football before we had children; that is ... if you can't beat 'em, join 'em. I couldn't get him away from the TV set on weekends, so I started sitting there staring at the boob tube all week end, too. Of course, when the kids came along that was changed.

He couldn't get me to not get involved in SWE and similar activities, so he is attending his second Engineering Foundation Conference on Women in Engineering as a guest, and he has already indicated to me that he wants to go to next year's SWE Convention. There is only one thing wrong with all this togetherness; he used to be my built-in baby-sitter. The kids are almost 4 and 2 now, and in about two more years my guess is that they will be as excited about going on trips with me as my husband is. Last year, the kids attended the SWE Convention in Cambridge with me, but I'm sure they don't remember it.

I'm saying all this to say, a career woman with a family must have a family who is interested in her and in her career; if her husband fears her successes rather than encouraging them, she'll have additional domestic problems. If her kids are more demanding than her job will allow her to be attending, again there are problems.

I have in my career experienced some unpleasantries, but I don't believe anyone goes through life with absolutely no unpleasantries. Life just isn't a bed of roses, and neither is being a woman engineer.

If I had it to do over, what would I change? Well, very little, I'm afraid. Looking back to the time when I chose to enter engineering, the one thing that stands out most significantly in my mind is not having spent some time in the military. Benefits derived from having served in the military, particularly for Federal government employees, are unmeasureable. I would also take my professors' advice and take the Engineer-in-Training examination while still a student.

Irene W. Sharpe

Irene W. Sharpe was born in Campbell County, Virginia, the sixth of nine children of self-employed farmers. She was valedictorian of the Campbell County public school system in June 1959 and received a BS degree in electrical engineering at Howard University in 1963. During her stay at Howard, she met the scholastic (but not sex) requirements for Tau Beta Pi and met her future husband.

Upon her graduation she joined the U.S. Department of the Interior, Bureau of Reclamation, Office of the Chief Engineer, at Denver, Colorado, where she has held engineering positions in the Power and Pumping Plant

Design Section, Electrical Branch, and the Buildings and Utilities Design Section, Structural and Architectural Branch, specializing in lighting and low-voltage distribution system design. Since 1971, she has been with the Technical Liaison and Documents Section, Technical Services Branch. (During her husband's two-year service in France, she worked part-time as a U. S. Armed Forces Institute instructor, counselor, and examiner.)

Mrs. Sharpe has participated in the Association of Federal Professional and Administrative Women, has served on the Federal Women's Program Committee of the Denver Federal Executive Board, and is a senior member of the Society of Women Engineers, in which she has been active since 1962. She is also associated with the Colorado Coordinating Council of Women's Organizations and is a charter member of the Virginia Neal Blue Center for Colorado women. The mother of two small children, she also works with high-school students in her church, keeps up a regular schedule of family sports, and is an avid bridge player.

Part III

GENERAL STATUS OF THE WOMEN'S RIGHTS MOVEMENT

ENGINEERING TODAY AND TOMORROW – WOMEN NEEDED TOO

Arleen D. Winfield

Social Science Adviser
Division of Economic Status and Opportunities, Women's Bureau
U. S. Department of Labor, Washington, D. C.

I have been asked to discuss the status of the employment of women in general and more specifically of the employment of women in engineering and science. The Women's Bureau has long been concerned with expanding women's occupational and educational opportunities. It provides the basic information as to how women are faring in the work force, what needs to be done to improve their status, and shares this information with congresswomen and men, business and industry leaders, individuals from schools, colleges, and universities, the media, groups like the ones participating in this conference, and others. The Bureau advises women of their rights under the law in an effort to eliminate discrimination on the basis of sex and race, so as to help make Federal policy a reality in practice.

It goes without saying that most women in our democratic society have faced discrimination of some kind or other with respect to education and employment, but not always overtly. And that is why it has been so hard to make headway in this area. Much of the discrimination encountered by women is based on outmoded attitudes and misconceptions about their needs, desires, and abilities in the world of work. In the Bureau, we most often call these myths, and we're trying to explode them with the facts. These myths are perpetuated by employers, educators, parents, and women themselves. Of course, some changes are coming about. We read about breakthroughs by women in many nontraditional fields today. However, the old saying "You've come a long way, Baby, but you've still got a long way to go" is still too true for far too many females. And with the small number of women in engineering, the saying is probably more true than for most fields.

So for those who quickly point out the breakthroughs and subtly ask, "Well, just what do those women want now? They've gotten into everything these days," we only ask that they look at the facts concerning the status of women. Perhaps these will stand alone as reasons why we need "Career Guidance for Women Entering Engineering" and for some other occupations also. After I have given you some facts, I'll focus on the Federal and other remedies women have at their disposal to help change the status quo of their position in the work force.

In recent years there have been sharp increases in the number of women workers, rising from 23 million in 1960 to nearly 35 million in June 1973, an increase of more than 50 percent. Furthermore, the increases have been in large part among married women, and among young women, those 20 to 34

years of age, which are the child bearing and rearing years. Today three out of every five women 20 to 24 years of age and nearly half of all women 25 to 34 years of age are in the labor force. Only about one-fifth of these women are working on voluntary part-time schedules. Most of them are full-time workers. I think these facts go far in exploding the old myth that women are not seriously attached to the labor force -- in other words, that working just fills a short span of time between school and the first child after marriage or is something to fill the void for older women once the children have become independent.

The facts concerning women's worklife patterns present a picture far different from the notion that women as a class are secondary wage earners. To the contrary, evidence strongly supports the fact that women's reasons for working outside the home are basically the same as men's. Women work for economic reasons. We have a chart that depicts this very vividly. It's entitled "Most Women Work Because of Economic Need." Accordingly, 42 percent of women workers in March 1971, were single, widowed, divorced, or separated from their husbands. These women must support themselves and in many cases children and/or other dependents. If we add to that the 23 percent of all women workers who were married to men who earned less than $7000 a year in 1970 (which is less than the $7200 that the Bureau of Labor Statistics says is needed by an urban family of four for a low standard of living), we find that nearly two-thirds (65 percent) of all women workers were either supporting themselves or families or helping to support a family that would otherwise not have sufficient means for even a low standard of living. In these high-cost-of-living days, a two-paycheck family is increasingly necessary for adequate food, clothing, medical and dental care, and a good education. These facts certainly dispute another long-standing myth, that women work only for spending change and a few luxuries.

A related myth that women's training is costly and largely wasted because they don't work as long as their male counterparts is exploded in the revelation that the average single woman worker has a worklife expectancy of 45 years in the labor force, while the average male worker has 43 years in the labor force. Even the married woman who quits to rear her family and reenters the labor force at the age of 35 has a remaining worklife expectancy of 24 years; she certainly seems worthy of hiring and training. The full returns of any investment may be only delayed for a while -- not entirely lost.

Despite the evidence that so many women need desperately to work, we find a rather gloomy picture when we look at women's earnings compared to men's. For example, women who work at full-time jobs the year round earn, on the average, only $3 for every $5 earned by fully employed men. This gap in earnings is shown by a chart that depicts the earnings of white and minority men and women in 1960 and 1970. As you can see, the picture was pretty much the same in 1970 as in 1960 on the relative earnings of men and women. Now some of you may be thinking that with Federal equal-pay legislation there should be no such gap in earnings. But there is more to the story than appears

in these figures (white men $9373, minority men $6598, white women $5490, minority women $4674 in 1970). We can look at another chart for part of the explanation: "Women are Underrepresented as Managers and Skilled Craftsmen." Here we see the major occupation categories, and find that women make up 3 percent of the craftsmen, 17 percent of the managers and administrators, 40 percent of professional workers, 57 percent of service workers, 61 percent of retail sales workers, 76 percent of clerical workers, and 97 percent of the private household workers.

The earnings gap is not so much an indication that women are receiving unequal pay for equal work; rather they are concentrated in those jobs that pay the lower wages. Those jobs reserved for men are the better paying ones.

Let's look more closely at the category of professional workers. We're about even here with the percentage we are of the work force. But let's not be too illusioned, for many of the professional women are nurses rather than physicians; they are teachers in elementary and secondary schools rather than the principals and superintendents; women are the librarians and social workers rather than the engineers. Women are only 3 percent of the dentists, 4 percent of the physicists, 5 percent of the veterinarians, 9 percent of the physicians, and 12 percent of the chemists.

Another look at the category of craftsmen shows that even the name implies "no women allowed," and this is true for some of the specific job titles within the group (repairman, etc.). Only the stout-hearted females have bucked the tide to make up this small percentage. I am pleased we are now engaged in some research to change some of the outdated labels.

Now, how have these inequities been justified? Well, some put forth another myth that women just aren't as capable. But this too is shattered, based on tests revealing that girls show as much aptitude as boys for fields thought of as man's domain. When the Johnson O'Connor Research Foundation's Human Engineering Laboratory measured 22 inherent aptitude and knowledge areas among men and women, it found that there was no sex difference in 14, women excelled in six, and men excelled in only two. Those aptitude areas which showed no sex difference were: analytical reasoning, foresight, inductive reasoning, memory for design, number memory, objective personality, tweezer dexterity, and others. In fact, there is no job for which all men are suited or are able to perform, as there is no job which at least some women can't perform.

A bright spot on the horizon is seen from a study by Dr. Frank Endicott of Northwestern University. Of the jobs and salaries expected to be offered by 186 companies to June 1973 college graduates, there was a marked reduction in the spread between salaries for women and men trained in the same field. For example, in 1970 the monthly gap ranged from $86 down to $18; in 1973 the gap ranged from $35 in accounting down to a $9 advantage for

women in engineering. These figures do not indicate that different salaries are being offered to women and men hired by the same company for the same job, but are averages of offers by all companies planning to employ graduates in a particular field. Dr. Endicott's survey speaks very well for the field of engineering. Not only does this occupation show an advantage for women in monthly starting salary, but it is listed as the one with the highest starting salary compared to six other major fields in which women are expected to be hired (accounting $867; science $830; data processing-mathematics $823; liberal arts $715; general business $729; and marketing-retailing $715). But it's a little too much to expect to find a large number of women available to compete in the job market when they've been told from junior high school or earlier that girls needn't bother with or can't learn math and science.

Action from a variety of sources is needed to overcome the one-sided thinking that has produced these and other inequitable situations and attitudes in our society. I am reminded of an incident that occurred at one of our sessions in the Labor Department last year. It was a minicourse, designed to provide Wage-Hour Compliance Officers with some background on the range of discriminatory practices women faced in employment. It was thought that if they were more sensitive to the problems, they might be able to counsel the women as well as advise the employers and keep them within the law. In the course of a discussion, we asked the officers to give some reasons why they felt employers might not want to hire women. Of course we got many of the usual myths, but one intrigued me the most. One man said that in offices where women had not been employed in the past, the employer felt it would be bad for him to have to break with tradition and hire women because when they came in, with their short skirts and dresses, it would upset and distract the men. Now, I was rather surprised at this, because the way I had always heard it was that women were the overly emotional creatures and couldn't hold a trend of thought. But apparently we've been wrong -- if men, who've been nurtured over years by women, can get so upset at the sight of a leg or thigh, then the emotional issue is a toss up.

Fortunately, not withstanding the personal whims, the Federal government is striving to set examples in promoting full equality of opportunity for women within both the public and the private sectors. Miss Markoff will tell you about what's going on in the Federal government; I'll discuss briefly the policies affecting the private sector. Several laws and regulations are being used and enforced.

The Equal Pay Act of 1963 (to which I referred earlier), requires employers to compensate women and men in the same establishment equally for work of substantially equal skill, effort, and responsibility. As of July 1, 1972, the Act was extended to executive, administrative, and professional employees (including academic administrative personnel and teachers in elementary and secondary schools) and outside sales persons. Although a number of men have won back wages as a result of equal-pay litigation or conciliation, women

have been the prime beneficiaries. One of the largest settlements involved a glass manufacturing company in the East; nearly $1 million in back pay was awarded to some 2000 women employees. The Equal Pay Act is enforced by the Wage-Hour Division of the U. S. Department of Labor.

Title VII of the Civil Rights Act of 1964, enforced by the Equal Employment Opportunity Commission (EEOC), prohibits discrimination in private employment based on sex as well as race, color, religion, and national origin in industries affecting commerce. The law also applies to labor organizations and to employment agencies, including the Federal-State employment service system. The Equal Employment Opportunity Act of 1972 extended coverage of Title VII to state and local governments, to educational institutions that had formerly been excluded, and to smaller employers and unions; that is, those with at least 15 or more employees or members. It also gave the EEOC enforcement power through the courts.

Executive Order 11246, as amended by Executive Order 11375 on October 13, 1967, requires a nondiscrimination clause in every Federal contract of more than $10,000 and "affirmative action" to assure full employment opportunity regardless of race, color, religion, sex, or national origin. Order No. 4, under the Executive Order, which had not applied to women in the beginning, was revised in December 1971, establishing guidelines for employers to set goals and timetables for hiring women. This Order, effective April 1972, is the responsibility of the Office of Federal Contract Compliance of the U. S. Department of Labor.

Title IX of the Education Amendments of 1972 prohibits discrimination in educational programs or activities on the basis of sex, and is enforced by the U. S. Department of Health, Education, and Welfare. Further information on the Education Amendments and other legislation affecting female students and staff in schools and colleges is contained in the article "Education and Women's Rights: What the Law Now Says," prepared by HEW for AMERICAN EDUCATION magazine. Reprints are available from the U. S. Government Printing Office.

These laws are definitely on the side of women, as well as all other people, but we must use them and see, too, that they are corrected in areas where they might fall short as we put them to the test. It has been said by a member of the EEOC that legislation plays a vital role because "people change their attitudes when they are forced to change their behavior." Now, it is fine to speak of attitudes of employers and school officials, to which the legislation is directed in helping them carry out their responsibilities for the equal opportunity of females in employment and education. But we must look at all sides of the issue of attitudes, including areas where legislation does not reach. What about the attitudes of parents and females themselves -- the "hang-ups" these two groups have been conditioned to accept regarding "femininity" and "masculinity"? Of course, it has not as yet been adequately ex-

plained, as far as I'm concerned, what these terms mean when it comes to who is best qualified to do the job that needs doing, and when it comes to money in the pocket and bread on the table.

We need to look at the roles we reinforce for girls long before we get to the doors of our schools and places of employment, or our courts where laws are enforced. Will we continue to give girls only dolls, dishes, and make-up kits, while we give boys the trains, doctor's kits and erector sets? For women who want to enter engineering, it is a fine profession and I think the future is bright indeed. The November 4, 1972 issue of BUSINESS WEEK magazine stated that the supply of engineers was heading for another famine. The article, based on information from the Engineers Joint Council's Engineering Manpower Commission, indicated that the drop in total undergraduate enrollment in engineering freshman classes would cause a shortage in the supply of engineers that will fall far below the demands through the end of the decade.

A release by the Engineers Joint Council, dated May 29, 1973, indicates that industrial research organizations are experiencing a pick-up in demand for engineers and scientists. After reading this, I compared it with information the Women's Bureau had tabulated, namely the detailed occupations of employed women based on Census Bureau data of 1970. I found that of 11 engineering specialties listed, the proportion of women was highest in industrial engineering, 3.0 percent; in chemical, civil, and metallurgical engineering women were 1.3 percent; in petroleum 1.4, aeronautical 1.6, and in electrical and electronic engineering 1.7. Women's less than one-tenth of one percent representation in mechanical and sales engineering (0.9 and 0.7 percent, respectively) pulled down the average so that women overall were 1.6 percent of employed engineers.

Finally, with respect to enrollments, I found of interest another survey report of the Engineers Joint Council, published in June 1973, and I quote: "With regard to the fall freshman class, the respondents (165 engineering schools returning their survey forms) anticipate a net increase of 2.6 percent over Fall 1972. If this materializes, it will represent a break in the sharp downward trend in entering enrollments that has prevailed since 1969. However, the magnitude of the projected increase is not great enough to produce cheers on the average campus, nor is it prounouced enough to produce as many new engineering graduates in 1977 as the U.S. Office of Education has projected."

A highlight of this report is that the Engineering Manpower Commission made a special follow-up survey to obtain more complete data on women and blacks. For women, figures for both surveys of engineering degrees awarded during the school year ending in June 1972 are:

	BS	MS	PhD
Originally reported	493	271	27
New estimated total	519	297	35
Percent women of all degrees	1.2	1.7	0.9

Somewhere in those figures there is perhaps a young woman named Helene Cole. She was cited in an article in THE ATLANTA JOURNAL of June 19, 1973, captioned "Timing is Right for Women To Enter Engineering Field." A little of the story about her says that she played with erector sets instead of dolls. She said, "As far as I'm concerned, there's nothing in the world as beautiful as a new machine that functions perfectly." She certainly expresses my sentiments. Frankly, I don't have enough fingers and toes to count the times I have honestly wished I had some engineering knowledge of any kind about a lot of things. When I see highway design that's all too confusing for apparently many drivers, and when I use household equipment that defies the imagination as to how and why it's made the way it is and works the way it does (and very often it does not work properly), I just feel that there has to be a better way and maybe my ideas would work if I knew more of the principles.

Just last week my husband, in performing a tune-up on his sports car, said "Sure wish I knew an automotive engineer so I could figure out how to change the sway bar to a stiffer one in order to decrease the roll on cornering, because this is not easy to do without adversely affecting the steering geometry." Incidentally, he has wondered about some other automotive principles and practices when doing some of his own mechanical work. In fact, he's said some unprintable things as to why "they" made the car so that one has to take the fender or wheel off to get to a spark plug. I know that many of us have had similar experiences in dealing with our world of technology. There is perhaps no single field that so greatly touches our lives -- particularly our comfort and well-being -- as does engineering. For women, this is important from two points of view: 1) women as consumers, demanding ever more of the goods and services that an economy based on scientific and technological innovation can produce; and 2) women as workers, contributing to an expanding economy, one from which we expect increased efficiency and convenience from science, technology, and engineering.

In the way of suggestions as to how we all can help fulfill the theme of this conference, I'm sure my thinking probably differs little from that of others, but as I read more of the article about Helene Cole, a few things came through with a special twist. I was appalled at the part that "when she presented that belief (about the perfectly functioning machine) to a male high-school counselor she was told to forget about her hopes of studying engineering in college. He said nursing would be more 'appropriate' for her." Now most of us here know that this is not an isolated case. Last year we received a letter in the Bureau from a high-school girl with a similar complaint -- the counselor told her and other girls with A's in chemistry to go into nursing, while he told the boys to go into chemical engineering and so forth. So one suggestion I would make

is that we must work not only to see that girls get better counseling but that perhaps we need to look at the way counselors are trained and bring them into the 20th century.

Concerning Ms. Cole again, a senior in the University of Michigan Department of Mechanical Engineering (she lasted one semester in nursing school then followed the urgings of her interest) who was eight months pregnant when the article was written, she said her major obstacle was fitting in the space-saving classroom chairs. This reminds me of another suggestion. We must stop penalizing women and discouraging them from going into nontraditional fields because they happen to be gifted with the biological function of bearing the offspring. We would do better to advise girls that most of them will work (9 out of 10) at some time during their lives and that they should follow their best aptitudes; then if they care not to work when their children are young, we should find ways to help them keep abreast of their professions, and if they choose to continue to work (and many do), we must arrange for proper child care. Some of the women appearing in our leaflet Why Not Be An Engineer are married and have families. We want a realistic portrayal, and to date we have distributed 134,000 copies of this leaflet to help guide young women into a rewarding profession.

Finally, as we all help fulfill the theme of this conference for those interested in "Career Guidance for Women Entering Engineering," I think we can go one step further in our work of the future. This is a special and somewhat expensive conference for those already interested in engineering. Let's make a special effort in our daily work, community gatherings, and school career days to inform girls about what engineering is and what it can do. Engineering just might be that one profession that at least a few girls never knew existed as a possibility. We can let them all know that engineering today and tomorrow needs females too.

Arleen D. Winfield

Arleen D. Winfield's primary responsibilities as a Social Science Advisor in the U. S. Department of Labor involve programs to promote career opportunities for women and girls of all ages. She served as the occupational outlook and employment opportunities workshop leader for Women's Bureau consultations held in Atlanta, Georgia and Baltimore, Maryland in 1972. She was a member of the steering committee that planned and executed the National Conference on Career Education for Minorities held in Washington, D.C. in February 1973. She serves on the Bureau's Youth Development and other task forces, and is the author of Careers for Women in the Seventies.

Mrs. Winfield has a BS degree (with a major in biology and a minor in mathematics) in secondary education from Hampton Institute, Hampton, Virginia. Before joining the Bureau she taught in Prince George's County, Mary-

land junior high schools and was a scientific intelligence analyst for the Department of the Army. She is doing graduate work in the social sciences and business administration at the University of Maryland.

Mrs. Winfield is married to Emeile I. Winfield, Jr., Chief of Graphics for the Office of the Secretary, Department of Health, Education and Welfare; they have one daughter, Tawana, who is a junior at Howard University, Washington, D.C.

THE FEDERAL GOVERNMENT REVISITED: OPPORTUNITIES FOR ENGINEERS

Helene S. Markoff

Director
Federal Women's Program
U. S. Civil Service Commission, Washington, D. C.

Thank you, engineers and future engineers of the U. S. A., for this opportunity to address you. As you know, I represent the United States Civil Service Commission. Our representative at your 1971 conference was a very fine gentleman by the name of Mr. Harold Leich, from the Commission's Bureau of Policies and Standards. Some of you in this workshop might remember him.

Mr. Leich has since retired from Federal service and achieved new fame. Several weeks ago, the WASHINGTON POST editorial section featured an article written by him entitled "The Terrible Toilet." In spite of the unlikely name, it was a serious article discussing new methods of solid-waste disposal. Mr. Leich, who incidentally is an engineer, wants to do away with the water closet, and his article presents compelling reasons for this position. I wish I had saved the article to share with you, but, unfortunately, when I read it I did not know I would be here this evening. If any of you are particularly interested in water conservation you might wish to write Mr. Leich or the WASHINGTON POST for a copy of the article. I am not an engineer nor an expert on solid-waste disposal, so this evening my priorities for discussion are somewhat different.

I took the time to review the proceedings of your outstanding conference, "Women in Engineering," that was held here at Henniker in 1971. After perusing the excellent papers, the wealth of information, the problems discussed during the workshops, the comprehensive statistics, I pondered about what I could share with you this evening that might be new, refreshing, inspirational, and challenging. And believe it or not, I came up with something.

First of all, I gleaned from the last Conference report that little is really known about the Federal government as an employer.

Well, we are big ... you might even say enormous. There are 2,865,000 civilian employees in Federal agencies. Yet we are actually smaller than the combined work forces of all the state governments (2,921,000 employees) and the combined work forces of local governments (7,804,000 employees). Federal civilian employees, including full-time, part-time, temporary, and intermittent employees, make up 3.3 percent of the nation's work force.

With the exception of a very small percentage (less than 9 percent of the total Federal work force, which is excepted by statute), Federal employment

is covered by merit systems where race, color, religion, sex, national origin, age, physical handicap, and politics are irrelevant.

Within this structure, the Federal government employs 152,319 engineers, of whom 19,558 are in the District of Columbia metropolitan area and 130,571 in the United States other than the D.C. metropolitan area. Women represent 1.1 percent of the engineering group as a whole, but about 0.5 percent in the professional categories. As you know, this compares to their general availability in the nation.

Of all scientists, engineers, and technicians employed by the Federal government, 90 percent work for the following 11 agencies:

Agency	Total Engineering Group	Percent of Women	Number of Women
Department of Agriculture	7,849	1.4	112
Department of the Air Force	15,245	0.9	144
Department of the Army	33,025	1.4	475
Department of Commerce	2,276	0.6	13
Department of Health, Education and Welfare	1,110	1.6	18
Department of the Interior	8,909	1.5	134
Department of the Navy	39,363	1.0	386
U.S. Atomic Energy Commission	1,369	0.7	9
Department of Transportation	14,864	0.5	72
National Aeronautics and Space Administration	14,193	0.8	110
Veterans Administration	1,096	1.6	18

Engineers in the Federal service are engaged in a wide variety of activities which challenge the skills, imagination, and knowledge of engineers in all fields. They design missiles, aircraft, rockets, powerplants, bridges, drydocks, buildings, machinery, and electronic equipment; construct dams, highways, ships, and power-transmission lines; conduct research in electronics, aerodynamics, hydraulics, soil mechanics, and on structural materials; and perform many other engineering functions.

Now I would like to tell you a little about my position. As Director of the Federal Women's Program, I am responsible for providing guidance and direction to Federal agencies to enhance both employment and advancement

opportunities for women. While women have been employed in public service since before the Constitution was signed, their employment history in the Federal government is much like their employment history in the nation. Although we had a Civil Service Act of 1883 that established a Merit System of employment, a Classification Act of 1923 that established the concept of "equal pay for equal work," and a great number of Executive Orders on Equal Employment Opportunity along the way, the fact remained that women were employed in large numbers but were not fully utilized up to their maximum potential, especially in key policy-level positions. Yes, there were exceptions. Yes, many outstanding women achieved professional status and contributed to major program accomplishments. But they were, in the past, the exceptions and not the rule.

It would be great to stand here and tell you that those Bad Old Days are gone forever. No one can promise you that. When you scan the history of women in the United States you see changing trends in both education and employment. The strength and direction the feminist movement is taking; the growing awareness by men and women of women's role in society; and the rapidly changing laws affecting employment, education, and civil rights would all seem to convince us that we are, this time, here to stay. And in the Federal government, we do now have a Public Law that says we are equal! Public Law 92-261, the Equal Employment Opportunity Act of 1972, brings the Federal government under the Civil Rights Act of 1964 as amended. This law requires that personnel actions be free from discrimination based on race, color, religion, sex, or national origin and that Federal agencies develop Affirmative Action Plans to assure equal opportunity for all persons in recruitment, promotion, training, and upward mobility.

Agencies are also required to appoint Federal Women's Program Coordinators. There is a system for processing discrimination complaints of employees or applicants for Federal employment. Within the context of the Merit System, Federal agencies are using goals and timetables when a problem area has been identified. These goals and timetables, of course, must be implemented in a competitive system of employment and with consideration to skills available in the recruiting area.

Can you see what this means to women trained in engineering? Here we have an occupational group that is 99 percent male and the recruitment area for engineers is usually national regardless of where the job location might be. At this time the demand for engineers exceeds the supply.

More specifically, a recent issue (April 1973) of our Civil Service Commission's College Placement Newsletter TRENDS IN FEDERAL HIRING states the following:

> "In engineering, hiring is virtually the same as last year but applicants are down. With the exception of some (but not all) specialties in New England, the aerospace field in

the Great Plains and Rocky Mountain areas, and the electrical and electronic options for Hawaii, applicant surpluses in CSC talent banks have virtually disappeared. In many geographic areas hiring needs are exceeding the supply of candidates. This varies with the specialty.

"Best opportunities nationwide are in civil, sanitary, electrical, electronic, and industrial, with demand for civils particularly favorable in the South. Mechanical engineering is only slightly less favorable for applicants. Chemical engineers are in less demand nationally, with the best opportunities in the Middle-Atlantic, Midwest, South and Rocky Mountain regions. In general, CSC talent banks for Washington, D. C., and the Northwest currently have larger numbers of applicants in most categories in relation to needs than in other parts of the country but the picture is volatile, especially in Washington. The Rocky Mountain area has fairly strong competition for jobs in most categories in the major metro areas but more favorable opportunities at isolated locales.

"Agencies currently recruiting engineers include:

- Navy -- Excellent opportunities in mechanical and electrical/electronic, some needs in the aerospace, industrial, and other options nationwide, and especially in California and the Washington, D.C. area. Puget Sound Naval Shipyard, Bremerton, Washington, is seeking mechanical and nuclear engineers.
- Environmental Protection Agency -- Strong need at regional offices for mechanical and sanitary engineers with specialized courses in environment-related curricula and for chemical engineers with pesticide experience. EPA's facility in Ann Arbor, Michigan is seeking mechanical engineers with engine and emissions control background. (Note: EPA requests that applicants and employment correspondence be directed to its regional offices -- or contact CSC Job Information Centers. Hiring is decentralized, and inquiries to Washington headquarters merely delay hiring decisions.)
- Commerce -- Patent Office seeks about 75 mechanical and chemical engineers interested in patent examining for GS-5 trainee positions.
- Transportation -- Federal Highway Administration's highway engineer training program (civil specialty) is

staffing this year at about normal levels and FAA is seeking some trainees in the electronic and aerospace disciplines.

- Air Force -- Opportunities are good at the GS-5/7 level for aerospace, electronic, and mechanical engineers at Wright-Patterson AFB, Dayton (AFSC, Aeronautical Systems Division). Edwards AFB, California, seeking some aeronautical, electrical and mechanical engineers.

- Army -- Corps of Engineers: Civil and mechanical, particularly good opportunities in the South. Environmental Hygiene Agency, Edgewood, Maryland: Needs GS-9 (master's degree or experience) mechanical, chemical, and electronic with environmental background.

- Interior -- Bureau of Reclamation. Recruiting for Western states with especially good opportunities for civils at remote project sites.

- Agriculture -- Forest Service: Limited hiring this year but Southwestern (Albuquerque, New Mexico) and Northern (Missoula, Montana) regions recruiting some civil engineers.

- National Security Agency -- An intelligence activity located at Fort Meade, Maryland. Opportunities for a limited number of electrical and electronic engineers with an interest in communications and backgrounds in computer systems procedures and analysis and/or operations research.

"Architects are in short supply in all areas except Washington, D.C., New England, and the Northwest. Opportunities are particularly favorable in the Southeast. Hiring nationwide at entry levels averages less than 100 annually, but applicants may expect reasonably good appointment chances because of the low application volume."

The Federal government is not the only employer actively searching for engineers, especially female beginners. Any firm or contractor doing business with the Federal government is also required to have an affirmative action plan for equal opportunity. Major corporations are establishing goals and timetables to show evidence of a positive action-oriented equal-opportunity program. According to various studies, there is hard evidence that starting salaries for women in engineering exceed those for all other professions.

So what have I said so far?

- The Federal government needs you.

- The Nation needs you.
- The pay is good.
- The opportunities are there for employment and advancement, and
- There are laws to protect your rights, should you run into any chauvinism (male and/or female) along the way.

A funny thing about "chauvinism" -- whether it is male or female chauvinism, it is not limited to one occupational category. And the chances are, if you are prepared for a profession in a shortage category the possibility of discrimination based on sex is minimal. Much of the problem surrounding the employment and advancement of women relates to choices in educational curriculum. We are still, in spite of warnings to the contrary, majoring in areas where the employment outlook is bleak.

I do not encourage women to go into engineering just to improve our appalling statistics. And I am not unaware of the problems you can expect to face, other than the possibilities of sex discrimination, such as: 1) combining a career in engineering with raising a family, 2) geographic mobility, and 3) keeping up with changes in technology. There are various alternatives to alleviate such problems, such as flexible work hours, continued education programs, child-care centers, and other innovative approaches to meeting individual needs. What stand out mostly in my mind at this point are the young women I have met in my travels throughout the country. The young women -- college-trained, career-oriented and, yes, married too -- who tell me this: "If my husband gets a job offer we talk about it and if I get a job offer we talk about it."

There are 33 million women working in the United States today, most of whom work because they have to for economic reasons. We represent 40 percent of the nation's work force. Half of all women between 18 years and 64 years of age are now in the work force. At least three out of every five married women work, and 12.7 million women workers are mothers. Marriage and motherhood in this generation does not indicate an end to a career

Before I left Washington I telephoned the Civil Service Commission official who handles the Engineering Announcements and has responsibility for certifying qualified applicants to Federal agencies. I asked him what he would say to a group of female engineers if he had the chance. He responded, "Stick with it," and I think that's great advice. For those of you already in the field, you know more about engineering than I do. But I would take this opportunity to remind you of two things.

Firstly, for yourselves. Be aware that there is a law governing equal opportunity and equal pay for the work you are presently performing; that young female engineers are entering the field at salary rates commensurate with (and sometimes better than) those of their male counterparts; that affirm-

ative action plans call for training and advancement of individuals based on merit, not sex; and that the executive conference rooms can no longer be labeled "Men Only."

Secondly, I think we all share a responsibility to encourage young women to enter a profession which can be so rewarding, challenging, and responsive to our nation's needs. Hopefully, the newcomers will not experience some of the traumas you have because the world is changing. But should they, like we did, run into obstacle courses, perhaps we can provide our counsel from years of figuring out how to do so.

Recently, I was a judge at a contest for a Business and Professional Women's Club's young career women of the year. One brilliant young legislative assistant from a large national corporation, who was married and had a child, said what she really needed was a chance to talk to other women about some of the problems she faced as a working mother in a responsible position. Perhaps those of you in engineering can be good "listeners" for those about to take the plunge.

When I was a young child (100 years ago) I used to say "If I were a man, I would like to be an engineer," because, like other little girls, I was programmed into that kind of thinking. I hope you and your daughters eliminate the first part of that phrase and become our future engineers who will contribute to new technological advances for the benefit of man(woman)kind.

Helene S. Markoff

Helene S. Markoff has served as Director of the Federal Women's Program, U.S. Civil Service Commission, since May 1970. She has overall responsibility for providing guidance and direction to Federal agencies to enhance employment and advancement opportunities for women.

Her Federal career spanned a 20-year period with the Department of the Navy in Rhode Island, Washington, D.C., Spain and Morocco. Her experience, at both field installation and headquarters level, included position classification and wage administration, employee-management relations, personnel staffing, equal employment opportunity, and special emphasis programs. Since May 1970 she has served as the Director of the Federal Women's Program.

Miss Markoff received her degree from Bryant College, Providence, Rhode Island in 1949. She completed additional study at the University of Rhode Island.

Miss Markoff received a Superior Accomplishment Award in 1965 for her work in conducting a wage survey in Southern Spain. In 1970 she received

the Navy Civilian Meritorious Award for her efforts in developing the Department of the Navy Equal Employment Opportunity Program. In 1971, she was nominated by the Civil Service Commission for the Federal Women's Award.

WHAT HAPPENED TO PROGRESS?

Irene Tinker*

Presiding Officer
Federation of Organizations for Professional Women

The idea of progress is a fairly recent belief, as theories of history go. It is intimately bound up with optimism generated by the success of science over religion during the last three hundred years. As a political scientist I seldom have had the opportunity of talking to scientists, or would-be scientists and engineers. I assume that physical scientists would be even stronger supporters of the idea of progress than those of us from the softer scientists

Progress is basically the belief that things get better and better. It is ironic that Condorcet, the rather obscure French writer who is credited with the original articulation of this theory, wrote his Historical Tableau of the Progress of the Human Spirit while hiding from the excesses of the French Revolution in 1793. He subsequently died in prison. Even as he wrote, concealed in a garret, he maintained his optimism that science and logic could solve all human problems, that the path to Utopia was lined with educational institutions.

Does that sound familiar? How different the idea of history expressed in the Bible: Eden is the paradise we can never hope to achieve again on earth -- the golden age was long ago, not somewhere in the future. The United States, a country without tradition, embraced and celebrated the idea of progress. The economic abundance which flowed both from the felicitous environment and the imaginative technology indeed created a People of Plenty, as David Potter has written. The very wealth of natural resources on this continent beguiled us into the expectation that tomorrow things would always be bigger and better. And should conditions become crowded where you were, there was always the frontier.

Today there is no frontier. We are all aware that plenty may no longer be an accurate way to describe the state of depletion of our natural resources, of our air, and water, and forests, to say nothing of our oil and gas. We must must stop wasting our precious resources, especially our women. We must realize that the changing status of women in the two hundred years of our history has NOT been one of progress. However optimistic we may be about the future of ourselves as women, we cannot assume some sort of automatic improvement. We must secure our own opportunities, and unite to keep our outposts.

That is what we professional women from many disciplines had in mind when we formed the Federation of Organizations for Professional Women. The

*Dr. Tinker is at present a Research Fellow at the Bureau of Social Science Research in Washington, D.C. Her current study deals with the adverse impact of development on the status of women around the world.

name, though long, says exactly what we are: a coordinating, umbrella group for organizations concerned with equal rights for women. That means that women should have equality in everything . . . in the choice of a career or the choice of college. It also means that the man should have equality . . . to enjoy his children by caring for them, to share the vast burdens of providing for the family with his wife and so be allowed more freedom in his career. Such equality means the woman is no longer a second-class person, a servant in disguise. It means that her status is equal to that of a man.

As our country has changed and developed, the status of women relative to that of men has not consistently progressed. Let me make it clear that I am speaking of status as an attribute of the woman, not the reflective status of the man she may marry . . . since he may not be a permanent factor in her life. Nor do I mean the ascriptive status of her family, for in the United States neither age nor extended family play much of a role in an individual's existence. So status is what a woman herself has, because of education, occupation, or activity. Of these three attributes, the most important is clearly occupation, for one needs income to live.

There are no occupations, aside from the actual bearing of children, which are better suited to one sex than the other. The women's movement has spent considerable time refuting male claims that because they are generally taller and stronger they should naturally be the dominant sex in everything. Not all men are taller or stronger. Studies in concentration camps show that women survived longer, their minds and bodies had more endurance . . . another type of strength. Dr. Estelle Ramey, president of American Women in Science, one of the Federation's first affiliates, has given many speeches challenging the claims by men of innate superiority because they possess the hormone testosterone. Since I am not a medical doctor I can only give you a lay version of her point. Some girls can be born with a deformity which suggests a penis; this leads their parents to raise them as males. In puberty the error becomes apparent. It has been found that it is easier to correct the physical defect than the psychological one. These girls portray every masculine trait: aggressiveness, dominance, athletic skill. Social conditioning, then, is primarily responsible for most of our behavior.

So when you want to be an engineer, and a teacher or a boyfriend chides you "That is not appropriate for a pretty girl like you," they are victims of social conditioning. There is absolutely no reason you should not become an engineer if you want to and are diligent in your studies. Role stereotypes have always been with us, but in America today the predominant role assigned to women robs them of any economic role.

In preindustrial agrarian societies, occupations are usually stereotyped by sex. These role stereotypes are by no means the same in every society. But everywhere the male and female roles are interdependent and equally necessary. In the early New England days in the United States a widow or widower almost immediately remarried; both man and woman were necessary

to the enterprise of existence. The frontier women has long been celebrated; even today, on small farms, the role of the women is essential to their survival.

Cottage industries grew out of the activity of the farm woman in many parts of the world; elsewhere women themselves went to market to sell surplus produce. Neither of these opportunities was widely available to American women: rapid industrialization outdistanced cottage industry, while role stereotypes -- still held today -- tend to exclude women from entrepreneurial activities. Economic specialization and large bureaucratic industries made little room for women except in that motherly and wifely role of personal secretary. Thus, as the country developed, woman's role in economic affairs diminished. While agrarian societies generally view woman-as-resource, modern middle-class societies tend to see woman-as-ornament.

This transition of woman from a useful resource to a possession happens not only over time as a society changes, but within a society as her circumstances change from working class to middle class. The process of Sanskritization, or the emulating of persons a step up on the caste ladder in order to elevate ones own posttion, is not confined to India. In Latin America the peasant or lower-class woman works, and is relatively independent of her husband, if she marries at all. But the middle class severely limits the freedom of its ornamental women.

Yet, conversely, stratification can also liberate the elite woman. Uninhibited by a single stereotype of the appropriate female role, the ornamental quality of the elite woman can include education and high-level jobs, if her husband acquiesces. Nor need she fear that such activity might endanger her marriage, for in most highly stratified societies, marriage is a function of the extended family with all the protection that entails.

Marriage in the United States is a personal matter, a matter of whim and preference that results in divorce in one of every three marriages. Further, over 30 percent of American women of marriageable age are single: never married, widowed, or divorced. These statistics do not agree with the image of the American woman projected by the cinema or television: the glamorous young woman who geets her returning husband with martini in hand, children in bed, and kitchen floor shining like a mirror. Where is her security? One in three are divorced. Less than 10 percent of divorces grant even temporary alimony, while less than 2 percent of divorced women receive permanent alimony payments. Child-care payments, according to a national survey, seldom cover more than half the costs of maintaining a child. Even then, only 40 percent of the men ever make even one such payment.

Because women, according to national stereotypes, are not supposed to work, they are generally confined to "women's work," which pays little. One quarter of all women work in service jobs, for example. Should women seek a career they are seldom taken seriously and almost never paid fairly. Indeed, faculty women are paid $3500 less than male colleagues for the same work

American women work for the same reasons men work. They need the money. One-third are the sole breadwinners; another 40 percent contribute to a family income below $10,000 a year. Thus today 42 percent of American women work; nearly half of these women who work have children at home, and most generally work to feed them or choose to go on welfare. It should be no surprise to learn that one in five American women of 16 years or older live in poverty or that one-third of all households headed by women live below the poverty line. But it should surprise you, because education is everywhere looked to as the path to better jobs, that a woman must be a college graduate to earn as much as an eighth-grade educated male, or that despite the legitimate complaints concerning blacks, women whether black or white, earn less than men of either ethnic background. (In 1967 the median income for white males was $7264, for black men $5179; for white women $4144, and for black women $3020.)

Worse, the disparity between men and women is increasing, not decreasing. In 1955 the median wage of women was 64 percent of men's. It fell to 60 percent in 1969. In 1945, as a result of more opportunities during the war, 45 percent of all professional and technical jobs were held by women. Today that percentage has fallen to 38 percent. At the university level, there are fewer women by percentage of the population who hold faculty or staff positions today than there were in 1930. This is partly related to a reduction in women with advanced degrees (see Figure 1). Although 42 percent of the graduates of four-year colleges are women, only 11.7 percent of the doctorates awarded in the last decade were to women. Compare this with 15.3 percent of the doctorates going to women in the period from 1920 to 1929. This is not development; this is retardation.

What happened?

Let us review the education system in the United States from the earliest days. The Bay Colony founded Harvard University to provide ministers for the people, and required all settlements of fifty homes to provide an elementary school -- for boys. Education was for the male professional; the students were upper middle class. Girls in New England were admitted to the elementary school after the revolution, but not until 1824 were public high schools available to them. Women quickly flocked to high schools, and since national statistics have been kept, women have outnumbered men in graduating from high school. The first women attended Oberlin College in 1837; by 1900 women were nearly 20 percent of the university graduates. This doubled by 1930, but fell back again in the post World War II years to 24 percent, and has only recently again attained the 1930 level at the undergraduate level.

Why were women in the professions better off in 1930 than today?

Two related phenomena of the twentieth century retarded the flow of women into the professions: first, the explosion of higher education in the United States. In 1900 only some 2 percent of the people completed college; even so, that was 30 percent of those graduating from high school.

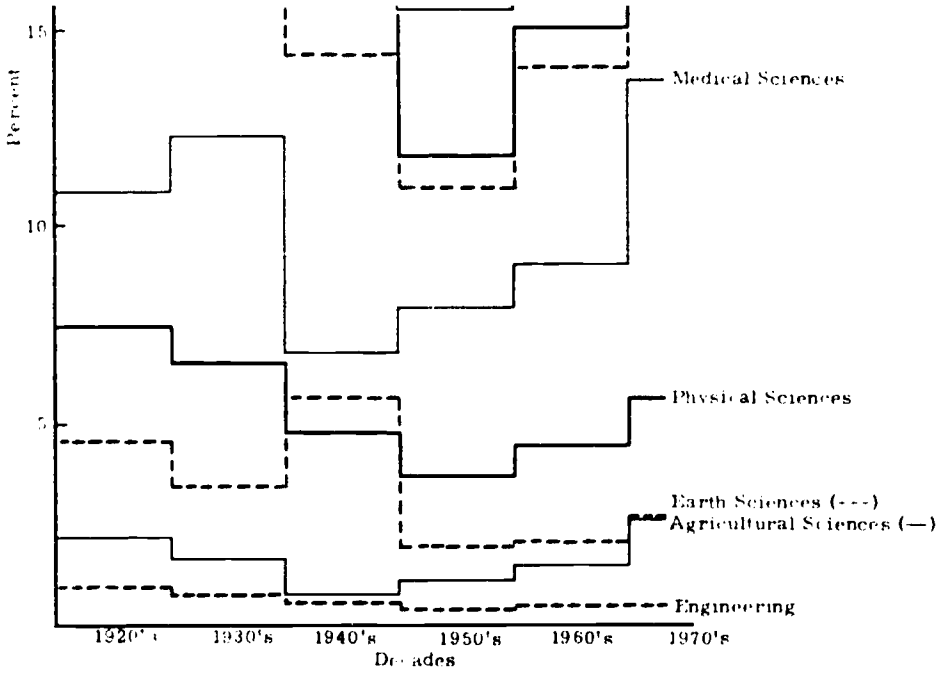

Figure 1. Percentage of PhD Degrees Received by Women in Selected Fields, by Decade (Source: National Research Council, Doctorate Records File)

Today 80 percent of our youth graduate from high school while 20 percent graduate from college, but the percentage of women falls from a slim majority of high-school graduates to 43 percent of college graduates and 11 percent of doctoral degrees. Clearly, many talented women drop out of the education system. With the restricted rewards available, who can blame them? They get no support from their parents, who believe that college is a mating ground rather than an educational institution; since woman's place is in the home, further investment in education is uneconomic.

Such an attitude to woman's place has been reinforced by the communication explosion. The advent of radio, and more so of television, has tended to project a simplified stereotype of the ideal American woman: her role and as-

that, in talks with students about what they can do with their education, now that it is practically completed in a field where there is no demand, they have told me that their high-school counselor told them to just enroll in liberal arts and decide later what they wanted to do. How can anyone call this counseling?

[illegible] the United States has one of the lowest representations of women in the United Nations. Only Mauritius and Saudi Arabia have fewer women at the United Nations by percentage of the population.

From the first picture-book, American women are discouraged from becoming professionals; from their first job they fall further and further behind men of equivalent training. Until role stereotypes, self-limitations on occupations, and institutional discrimination is ended, the training of professionals is preparing them for frustration and second-class citizenship.

You women have a unique opportunity: you are qualified to enter a profession in which there is great receptivity to women. Of course, there is still institutional discrimination, but the flow of greater numbers of qualified women into the profession should put an end to the familiar pattern of women at the bottom and men at the top, women paid so much less than men for similar types of work.

The Federation has joined with its affiliates and other women's groups to survey the effectiveness of governmental regulations which require federal contractors to hire qualified persons regardless of race, religion, or sex. You did not think this rush to hire women engineers came about without pressure, did you? These regulations are based on Executive Order 11246, which was amended in 1967 to include a prohibition against discrimination because of sex. Thus, if an industry or a university, in its total employment, has fewer women than are available in the pool of qualified persons, that industry or university can be said to show a pattern of discrimination. Proving the existence of such a pattern is clearly easier than proving individual cases of discrimination. Our Federation can advise groups of women on the ways to file pattern complaints, how to collect statistics, what to look for in the Affirmative Action plans each industry with a Federal contract is required to file.

More subtle is the career conditioning which has kept the pool of talent low in many professions, particularly in the engineering profession. The Federation is suggesting a revamping of the educational system to try to get rid of the built-in biases of the elite male images conveyed from kindergarten up. You can help. You can become the role models of the next generation. It is

chapters in the school area a letter to the national office of the organization should secure some excellent information.

5. Plan a "Career Showcase Day" and have persons from many different occupations bring displays and make themselves available to talk to any student about their special fields.

important that you stay visible, that you do not hide in your laboratory or arrogantly assume that because you made it other women can too. Support other women, and seek support from sympathetic men. We'll all have a better, more equal tomorrow.

Irene Tinker

Irene Tinker is at present a Research Fellow at the Bureau of Social Science Research, in Washington, D.C. She taught for a decade and has done research on topics concerned with comparative urban and regional development, planning administration, governance, cultural change, education policy, ethnic minorities, and women in development. She has studied and lectured in South and Southeast Asia, and Africa as well as the United States, as professor, college administrator, curriculum developer, researcher, consultant, and lecturer.

A graduate of Radcliffe College with an AB (magna cum laude) in 1949, and Phi Beta Kappa membership, Dr. Tinker earned her PhD from the London School of Economics and Political Science in 1954. Her academic experience (extending back from 1973 to 1954) has been as convenor of seminars at American University, associate and professional lecturer at the University of Maryland, Assistant Provost for Curriculum Development and Professor of Political Science at Federal City College, adjunct professor at Johns Hopkins University School of Advanced International Studies, Assistant Professor of Government at Howard University, and as a reader and lecturer at the University of California at Berkeley.

Dr. Tinker has written or coauthored numerous papers and articles in the areas of government, education, and development. She is currently president of the Federal Organizations for Professional Women and director of the Educational Policy Center and a member of the American Political Science Association, the Association of Asian Studies, the Society for International Development, the American Association for the Advancement of Science, IX International Congress of Anthropological and Ethnological Sciences, and the Asia Society.

WOMEN'S PERSONAL ISSUES -- A BEGINNING LOOK AT SOME BEHAVIOR PATTERNS IN WOMEN DUE TO STEREOTYPING

Carol Pierce*

Chair'n, New Hampshire Commission on the Status of Women
and
Member of the New Hampshire State Legislature

Women have had and still do have a stereotype in our society that to be the "good woman," one must be passive and dependent. It does not mean that all or even most women actually fit this stereotype. It merely means that there is such an image that is constantly held up to women through our educational systems, families, the media, in business -- everywhere -- that this is the right way to be.

Each woman has had to react to this image, sometimes consciously, but maybe unconsciously, throughout her life. She may have overreacted or underreacted, but she has reacted, just because she is alive.

Because of the subtleness of this reaction, a woman is most often not aware of how this has influenced her behavior: limiting her in many ways that she does not understand or perceive, and keeping her from fully using her own inner creativity.

To be more specific as to how one's behavior is influenced, when the whole feeling tone of life is that one should be passive and dependent, life is experienced as lacking freedom for full expression, and one does not have many choices about how to be. This closed-in, rather than out-going feeling is expressed in some identifiable personality characteristics.

In this context, a list of women's personal issues has been developed to describe behaviorally what is frequently present to varying degrees in women's behavior. Women's personal issues might be better understood if compared with women's social issues. Both are important, but they represent two different areas of concern for women. Women's social issues refer to such social problems as day care, abortion, employment, equality, and so forth. Women's personal issues refer to behavioral characteristics evidenced by individual women as a result of reacting to a passive, dependent stereotype.

(Men who have experienced life as being "boxed in" and repressed, resulting in passive and dependent personality characteristics, might find that

*The concepts of women's personal issues have been worked out over a period of a year and a half of small group experiences with women by NEW DYNAMICS ASSOCIATES: Judith Palmer, Carol Pierce, Janice Sanfacon, and Karen Terninko, Box 92, RFD 5, Laconia, New Hampshire 03246. Mrs. Pierce is a partner in this, a consulting firm in the woman's field.

the following personal issues are a part of their personality also. In fact, all men might say that they too feel these personal issues; however, the difference, which makes all the difference, is that each man comes to them in the context of the male stereotype, which is to be aggressive, strong, bold, outgoing. Because of this male stereotype, the style of expression and the resulting patterns of behavior are different.)

WOMEN'S PERSONAL ISSUES

Failure Orientation

Women are apt to be failure-oriented in the way tasks are undertaken, because of a lack of success experience. Frequently, with little positive behavior reinforcement given in childhood toward outgoing task-oriented behavior, a woman does not learn how to accomplish tasks, and a cycle of failure develops in the way tasks are approached. Failure is built into the task from the very beginning with no recognition that this is so.

When group action is needed, the kind of task assumed is often ill-defined or of such a broad nature for the particular group to take on that in reality no one could expect the group to succeed at the task. An example would be a women's organization that has taken on a specific project requiring community involvement. The actual project is organized well, but enough publicity is never done to make it a success. Or -- the task is ill-defined or of too large a nature to be actually accomplished.

When failure comes and the goals are not met, little "outs" and excuses are always ready. Excuses usually focus on one's family and wifely duties that everyone "understands" come first. These responsibilities, in reality, may or may not have interfered, but in any case are only a cover-up for a feeling of inadequacy and a feeling that no matter what the task was, it wasn't important anyway.

Success Avoidance

Success avoidance frequently occurs in the woman who is task-oriented and does not find failure orientation an extensive part of herself. Success is often almost impossible for the woman who has accepted and adopted a passive, dependent behavior. To be successful means that one must stand out in front publicly to some degree. To be successful also means one must have been aggressive at some point to have accomplished a task. To be public and aggressive are both complete opposites to the passive, dependent syndrome.

When a man is successful, his whole being and maleness is enhanced. When Joe receives a promotion, his whole feeling of self-worth has increased (whether this is actually true or not is not the question). In the male image Joe, as a man, is a better person.

However, when a woman is successful, an entirely different syndrome may be present. Unlike a man's masculinity being enhanced by success, a woman's femininity is in question when she is successful. She must define herself in terms of being a better person, not a better woman. She must downgrade her femaleness, resulting in guilt feelings and tension within her new role.

Many times an employer will say that he knows a woman can do a certain job involving a promotion, but in no way can he convince her to take the job. By listening to the woman as she begins to understand her reactions better, one often hears her admit that if she accepted the promotion, she feels her whole femininity would be in question.

To be successful means public recognition. As the task approaches completion, the woman will frequently give the task to someone else -- a man or a stronger woman -- so they stand out in front to receive the public attention while the woman, who has done most, if not all, of the work, assumes a "power behind the throne" stance.

Another facet of woman's experience with success is that she is not judged on the task alone that has been accomplished. If she has been a successful executive her success as an executive also includes answering such questions as: Has she had many dates? Is she a good cook? Does she have a husband? Is she working to make up for a "lack" in her life? For many women, it involves pure exhaustion to play all the roles demanded, including the career one, so that the energy is not available or, if one must work, one lives in a state of near exhaustion.

Conflict Avoidance

Women are the "peacemakers" of the world. Within the family a woman's role has been to keep harmony at all cost. Her handling of conflict is usually to separate those who are disagreeing -- separate them physically ("To your rooms, and don't come out until you apologize") or separate them emotionally ("I won't love you any more if you don't stop"). Both sides do not sit down to talk about undercover or direct conflict issues, so that conflict is not resolved but left to fester.

With this background, conflict becomes more and more a frightening experience to handle. In this context, when one is weary and tired of conflict, happy, peaceful relationships are looked for outside the home. If one is to take on tasks outside the home (community or job involvement), conflict is an inevitable part of it and cannot be avoided. Therefore, the problem is that intellectually women seek community involvement, where conflict is inevitable, while at the same time emotionally looking for sustaining, comfortable personal relationships. Along with these two opposites, women are so set up to avoid conflict in both personal and community relationships that they will often come to feel very guilty about causing any kind of conflict at all.

These guilt feelings are a very painful part of many women's lives, and govern most of their flight from conflict.

Even if an individual woman has not played peacemaker within a home -- if she is single, childless -- she has probably had that role model given to her generally by society and/or specifically by her mother. Therefore, she too is unlikely to look at conflict as something that can result in positive growth and new directions attained, but rather as a shattering experience to be avoided. To be "successful' and not avoid success means a knowledge of the handling of conflict.

Approval Needs

From the earliest age, women are taught to need male approval. As a small child a girl looks to her father for approval of how she looks -- it means more than any approval from her mother. In her teen-age years approval in her peer group means a date with a young man. Any attention from girl friends takes second place to attention from a young man. From father to date to lover to husband seems to be a common sequence of where approval needs are met.

There is a difference between the approval that every person needs and thrives on and the approval women learn to need as a basic support for every action. This particular variety involves a constant checking out for support before any action can be taken. The difference can best be explained by the example of a woman who after supper makes a comment to her husband as he reads the paper. "I think I'll plan to volunteer some time for the new school aide program." The husband doesn't really hear her and gives a nondescript answer. The dynamics of the situation is that his lack of response colors her reaction to the idea, so that in all probability it just evaporates from her mind. Because she was looking for his approval and has a need to always check out her ideas before she acts, the whole concept of volunteering just slips away. The husband may actually have thought it a good idea, but just didn't happen to respond, and has no idea how much he controls her actions. In other words, many women are becoming aware of the fact that male approval is needed before one can act, rather than approval being something that is appreciated when given. This syndrome shows up in the business world, where a woman given supervisory responsibilities will do more checking out with a superior (a man) on every action than a man would.

The need for male approval is so strong in some women that they report they just don't feel "whole" or complete unless a man is around to continually confirm their femininity. It can be an actual physical feeling of incompleteness (not to be confused with sexual needs).

Competition

Because of the approval needs women have in relation to men, woman is set in competition against woman for the attention of men. Involved in this

There also is the fact that power in this society has been synonymous with masculinity for many women. When one's life seems powerless in itself, one is then drawn to where the power is.

A syndrome that is set up for any class or group of people who are defined as "second class" is that the most important lines of communication are those that go from the "second-class" person to the "first-class" person, and not the lines from "second-class" person to another "second-class" person. Some black people have experienced this fully and are relooking at their relationships. Black people had to keep their own lines to the white people open, because that was where the power was to help their primary needs. Therefore, if one was too friendly with another black person and they were dependent on the same white person, who had only one favor (job), one might out of friendship have to give in to the other black person, causing real suffering on the first black person's part. The result is that many friendships were blocked between blacks by the competition for white favors; and a disliking for one's own kind develops out of frustration. Black persons have had to step aside and say "black is beautiful" and "buy out" of the power lines.

Similarly, women have been put into competition for man's attention. The woman who says "but I prefer men's company, it is more interesting," is experiencing a dislike for her own kind, feeling self-hatred, and responding to where approval is perceived. When men's company is better than a woman's, but you are a woman, the acceptance of your personhood (i.e., womanhood) is in question. Many women are learning for the first time to enjoy other women's friendships at a meaningful level expressed in the term "sisterhood" (comparable to "black is beautiful").

Women have also been put into competition with each other by the advertising industry, particularly the beauty culture section. In vying for beauty-queen status, woman is pitted against woman in a one-upmanship game. Beauty comes to be the way to interest and "keep" men, but each woman, with with age, finds she can only lose the game. Hopefully, a new sense of identity will redefine a "beauty" for women of all ages that has more to do with character, sense of worth, loving, and an active mind.

Manipulation

When a woman has lived a life based on these personal issues, the result is that she has not learned to ask directly for her own needs to be met. Since asking directly for a specific need to be fulfilled is an aggressive action itself and since women are encouraged to be humble, self-sacrificing, quiet, pleasing, helpful, one learns not to ask for her own needs to be met and others do not learn to expect her to ask and have it responded to.

Some of these needs might be defined as: the needs to be heard, the need to have creative stimulation, the need to have privacy, the need to have intellectual growth. When needs such as these are not met openly and honestly,

each woman must find other ways to have them met. (To have no needs met could be seen as death.)

It is through manipulation that women have learned to satisfy their needs. (Manipulation is used here as a neutral term, neither good nor bad. The manner in which manipulation is used gives it these qualities.) The particular style of manipulation used is passive-aggressive; "aggressive" because an act was actually performed to have a need met, and "passive" because the act was covered up and directed in a roundabout way so that the need that was satisfied is not directly known.

An example of passive-aggressive manipulation would be in order to satisfy a need for privacy. A mother might go to great lengths and expense to plan activities that would take her family away from the house for certain periods of time -- all under the pretext that the experiences are educational and character-building for the children (which could be true), and of course the children would want to do them. She does all the arranging; the children have little choice. Her need is to have time for herself. If she could say that as a mother she needed time for herself and everyone agreed that she was still a "good" mother even though she wasn't with her children every minute, all involved might sit down and plan how each person could have his or her need for privacy and socializing fulfilled. She would not need to manipulate in the background.

Women frequently find that much of their time and conversation is actually involved in passive-aggressive manipulations with much underlying hostility and anger involved. Passive-aggressive manipulation can become a whole style of life in itself, permeating almost every action. Such manipulation can be at either the conscious or the unconscious level. Always coming late to a meeting could be a passive-aggressive manipulation against not wanting to go at all, because no one listens to your ideas. Constantly losing the car keys or burning the supper in the oven might be acts against a husband who is insensitive to needs and there is no level of communication where they can be openly discussed. Having a headache, real or pretended, to avoid sex could be a defense against a feeling that a woman never has the choice to say "no."

It should be understood that passive-aggressive manipulation is a reaction against situations over which one feels no control. That is, it is a survival reaction to someone who will not openly communicate. One passive-aggressive manipulation frequently brings back another one, though, from the person who was the receiver.

Self-Limiting Behavior

Women often develop certain behavioral characteristics that limit their own personal expression. These are characteristics that grow out of all the

other aforementioned personal issues. Many kinds of self-limiting behavior could be listed, but only three will be mentioned here. Self-limiting behavior might be described as behavior that limits the range of personal potential and variety of choices in one's life.

Body language. Whether one has an open or closed body language affects all relationships. Men have always been allowed to sit, stand, and walk in more "free" and open ways. The result is that attention is more freely drawn to them. These same actions when done by a woman are seen as "unladylike." Without copying male body language, many women are finding that a more "open" body language results in more awareness of their presence, as opposed to the "invisible woman" syndrome. Their body also seems more integrated into a wholeness of being.

Qualifying language expressions. If one is unsure of oneself when expressing ideas, all sorts of qualifying phrases are apt to be used at the beginning and ending of sentences. "I know this isn't important, but..." "I know Jane could say this better, but...", or "I'm sorry to take so much time, but..." Each of these phrases detracts from really listening to the content that follows and keeps a cycle going of the woman feeling insecure because she isn't responded to, while she sets up an expectation that she needn't be listened to.

Laughing and smiling. Laughing and smiling excessively can be a response to a childhood learning of "smile, you look so pretty." Where women's role is usually to be the relaxing, friendly, conversationalist in personal relationships, laughing and smiling easily becomes the stock-in-trade of behavior that always seems appropriate. However, the result can be that no one takes the woman seriously or perceives her to have needs.

Frequently, laughing and smiling is used to reduce tension. For a "strong" woman, in particular, she may feel all sorts of tension or energy levels rising as she speaks. As a "strong" woman she is probably asserting herself and coming across in an aggressive way; that is, unfeminine to others around her. Therefore, as she sees the tension rise after she has spoken, she will give a little laugh -- needed, from her point of view, to reduce the tension. However, for those listening it has neutralized what she has said. One might say, tied up in the act of laughing would be personal issues such as conflict avoidance and success avoidance, resulting in the "invisible woman" feeling many women experience. She has put herself down, so that she can't be heard.

It should not be assumed that all laughing and smiling is to be avoided. Rather, it is important to be aware of how it is perceived.

CONCLUSION

The result of many or all of these personal women's issues present in varying degrees in an individual woman is role insecurity. A sense of well-

being is difficult to establish when so much negative or inadequate behavior is a part of one's self. The personal issues listed here are some of the more important ones to consider, but they should not be considered as the only ones. Fear of rejection might be another one.

On the positive side, it is good to see all the fine, strong women that do live in our society, in spite of these issues. It is possible to be a good role model; more and more women are "getting it together" these days and have in the past. The spirit of these words is not hopelessness, but reality; the recognition that until we look at what our problems really are, we cannot understand what our work is.

COUNSELING – ITS VALUES AND ITS FAULTS

Pauline V. Chapman

Director of Placement
College of Engineering
University of Illinois, Urbana-Champaign Campus, Illinois

The opportunities for women in engineering are now so great that we cannot possibly satisfy the demand. Every year more women enter engineering. There has been a 1000-percent increase in the number of women graduating from the College of Engineering at the University of Illinois from 1957 until 1973, from one in 1957 to ten in 1973. The problem seems to be to keep them in engineering once they have enrolled. During the 1972-73 school year there were 34 freshmen, 13 sophomores, 15 juniors, and 10 seniors registered in the College of Engineering. Since the interest in women is so new in the engineering field, we have not kept records on the number who drop out, but in the years 1957 through 1963 one woman graduated at the BS degree level each year. In 1964, 1965, and 1966 there were three; in 1967, four; 1968, six; 1970, eight; 1971, two; 1972, six; and ten in 1973. This is progress, but not enough. We are hoping that all of the 34 freshmen who are now registered will complete their engineering degree.

With the same exposure to all fields, I see no reason why more women will not become interested in some type of engineering. I think the problem is not only how to get more women into engineering but how to keep from discouraging women from going into the field or into other fields which they have not considered in the past. Now that the demand for women engineers is so great, those who are accepting positions have a great responsibility. By proving themselves as reliable, dependable, productive employees they can break down the past discriminations and pave the way for those who will follow them.

I am firmly convinced that counseling, for both men and women, is the weakest chain in the present educational system. By poor counseling, we are wasting our greatest national resource, the potential productivity of the young. If a young person can settle on a career at twenty rather than flounder around until thirty or forty he can use the very productive years between twenty and thirty for personal growth.

Counseling is not something that can be done at one particular time, when a student appears before a counselor and says "I want some career counseling." Real career counseling should, ideally, start in the home at as early an age as possible, by investigation. Children have wonderful imaginations, a great curiosity, and the ability to ask a million questions. I have often seen parents showing their children the fire engines which are stationed directly behind my office. What an opportunity to begin career counseling. How, and of what, is the fire engine made, who makes what, what does the fireman need

to know, how does the fire alarm work, how and by whom is it made, and how does it make the noise that excites all children? This type of investigation can be carried to everything that the child sees as he matures until, by the time he is ready to make some type of educational-career decision, he has some idea about many fields. At least he has a much better chance of understanding, at whatever point in his education the first attempt at career counseling is presented to him.

I realize, however, that many parents are not able to give this type of information to their children and it must come from other sources. Television cartoons miss a great opportunity in not somehow weaving into their shows bits of this type of information that can unconsciously be assimilated by children in spite of their short interest span. "Sesame Street" does some very educational things, and "Mr. Wizard" was a very thought-provoking program for the young (I understand that it is again being aired). There is much more that can be done by all media. If school children, at an early age, can be made to understand why it is important to learn to add and subtract and what can be done with this learning, the subject can be made much more interesting to them. I remember that when missiles were in their infancy, the General Electric Company prepared a comic book, to be used by children in the primary grades, which tied arithmetic to the building of a missile. I think this was excellent because it tied a school subject to something of which they were aware.

Counseling, at all levels, should be the same for men and women. Both should be exposed to all possibilities. In this area, women have been handicapped in the past because there has been a preconceived idea of where a woman's interests lie. When a little girl is born, one of the first things she receives as a gift is a doll. This begins the wife-mother-housewife image that has been the standard for women for many years. There is nothing wrong with this career; it is a wonderful and honorable one. To raise a family of productive children must be one of the most satisfying careers in the world. I see nothing wrong with being "only a wife, a mother, and a housewife."

I grew up with this idea, and even though I went to college it was incidental. During my time in high school and in college, no one ever spoke to me about a career of any kind. It was graduate from high school, then go to college. Then it was not even important to watch your grades in high school, because almost anyone could get into college. Somewhere along the line I decided that I would be a teacher, principally because I had an aunt of whom I was very fond who was a teacher. This never materialized, however, since my father had a good friend who was in business and he asked me to work for him. I became very interested in the field of business and gave teaching no further thought. My parents, as many parents, wanted me to do as I wanted to do, believing, I am sure, that I would marry and have a family. I was married, but when it appeared that a family was not part of the automatic plan I went back into business and from there to the University.

I have been in a man's field for almost thirty years and I have never felt one moment of discrimination in salary, promotion, responsibility, or recognition. In fact, I have always felt that any discrimination has been in my favor. I know that many women have been discriminated against in the past, but I also know many who feel as I do. My career has turned out to be the most satisfying one that I could have imagined, but it was purely by chance. Chance worked for me, but everyone is not so fortunate. I was interested in reading Mrs. Fitzroy's discussion of how she became an engineer.

In my tenure of employment as Placement Director, in the College of Commerce and Business Administration and in the College of Engineering, at the University of Illinois I have talked to thousands of students about their career plans, but I am sorry to say that this is always "after the fact." The point at which I see students is job placement counseling -- what can they do with what they have? I do not come into contact with students until they are at least juniors, when they are looking for summer work. By the time a student is a senior in college the counseling is entirely different from true career investigation and counseling, which must be done at a much lower level. I have talked to hundreds of students who should never have been in their particular fields, and in talking about why they chose it the greater number indicate that counseling had little to do with their decision to enter a particular college.

Even though I am in Engineering, I often have liberal arts students come to me as seniors, asking what kind of jobs they can find in business or industry. They come to me as the result of having talked to engineering students who suggest that I might be of help to them and because we have many companies visiting the College of Engineering to interview our graduates. They feel that, in some capacity, companies can use liberal arts majors. When I ask them why they are in their particular field, the almost standard answer is "I liked it." I then usually ask them what they would like to do in the way of work if it were not necessary to consider educational qualifications. The answers usually bring out some very interesting ideas on the part of the students. The next question is usually: "During your time at the University have you ever thought of how you could use the knowledge you are acquiring to earn a living?" I am always amazed when the answer is usually "No." After my talking to these students for some time about how business is organized and what knowledge is needed in the various fields, they say "Why didn't someone talk to me about this before now?" It is an excellent question, for which I have no answer.

Most career counseling must be done at the high-school level. By the time students apply for entrance to a university they must apply for entrance to particular colleges within the university. From their first day on campus, they are committed to a curriculum and its requirements within that college until such time as they either request a transfer to another college or are dropped for scholastic reasons. Often the high-school counselor is not qualified to be a counselor nor does he have any special interest in doing the job, but for an addition to his salary he takes on the responsibility. I cannot count the times

that, in talks with students about what they can do with their education, now that it is practically completed in a field where there is no demand, they have told me that their high-school counselor told them to just enroll in liberal arts and decide later what they wanted to do. How can anyone call this counseling?

There is nothing wrong with a strictly liberal arts education in any field. In fact, the ideal would probably be for everyone to have an undergraduate liberal arts degree and then choose a career field at the graduate level. At that time the student would have matured, would have been exposed to many fields, and would have a better basis for deciding what he wanted to do with his life. This, however, is not always possible, especially for the students who attend a state university. They must use the four years both to gain a cultural background and also to prepare themselves, in some way, to earn a living. We have very few "millionaire playboys" at the University of Illinois. I try to encourage every student to whom I talk to continue his education after he leaves the campus. Education after college is just the beginning of learning, and that is the time to take courses for only one reason: because you have a personal desire to know more about a particular subject.

Every high school should have a career program completely independent from academic counseling. There should be a library set aside from the regular library, for reading material covering all occupations. Many companies have displays which depict their products and which they are very glad to send to schools. Such exhibits could be made a part of this library. The room should be a place where students could discuss different career possibilities among themselves. It should be staffed with people who have had wide experience outside the academic area and who are willing to delve into the demands of occupations about which they know nothing. One publication which would be very helpful to have in this area is the government publication Dictionary of Occupational Titles. It is "mind-boggling" to realize how many different occupations there are for a student to consider. This publication would start students thinking beyond getting out of high school with the least possible effort, and direct their thinking to what comes after and what they will need to do to get where they think they might want to go. The entire atmosphere of this particular area should be career-oriented.

Other ideas that could be incorporated into such a program could be:

1. Offer information on work-study programs.
2. Invite willing alumni to come in and discuss their professions with the students. Form an alumni committee to plan such discussions.
3. If a student appears to be particularly interested in a certain field have an adult in that field take him for a day and let him see what someone involved in it actually does.
4. Contact the presidents of professional societies, including the NSPE, and request their help in providing information. If there are no

chapters in the school area a letter to the national office of the organization should secure some excellent information.

5. Plan a "Career Showcase Day" and have persons from many different occupations bring displays and make themselves available to talk to any student about their special fields.

Not all students will take advantage of an opportunity, no matter how much work and thought is put into its planning, but for those who do take advantage of such a program the benefits would be invaluable. Many young people, at a very early age, appear to know exactly what they want to do and follow through. Others have no idea whatsoever, and these are the ones who need counseling so desperately. It does not necessarily follow that a decision a student makes before he leaves high school will be the right one for him for the rest of his life or even for his university years, but at least he has a basis for understanding himself.

Every young person has some potential, each has the same basic curiosity, but each boy and each girl has different desires and abilities. It is the duty of any counselor to help the student develop and direct his special ability. The parents can be of great help. If the parents can become involved in the process at least by the high-school freshman year, the job can be much more successful. Parents often tell me that they want their child to do what he wants to do. This is as it should be: but without any idea of what there is to do, how can a student make a sound decision.

The greatest fault with counseling bureaus at the university level is, I believe, their failure to separate academic, pshychological, and career counseling. No one is qualified to do all three, but that, in most cases, is what they attempt to do. I can speak only for the University of Illinois at Urbana-Champaign. When a student enters as a freshman he is given mathematics and rhetoric placement tests as well as a battery of aptitude tests. All these are given by the Student Counseling Bureau, which is primarily a psychological counseling service. They hesitate to suggest more than where the student's strong aptitudes appear to lie. These counselors, as a group, are not qualified to do career counseling, as the Bureau is primarily staffed with psychologists. Counseling in all of these three areas is important. All students need academic counseling once they have made up their minds which college to enter, and most colleges at our University have some sort of advisory system, some more successful than others. Some students need, or will need during their academic career, some psychological counseling: but where can they go for this career counseling which is so very important?

Each year I do a report on the progress of the graduates of the College of Engineering both five and ten years out of school. The following statement, relating his experience with the Student Counseling Bureau, was included with the form that a student completed regarding his progess during the ten years since his graduation.

> "Computer dating should be applied to making the best match between the student and his desired field of study and his counselor. I'll never forget that ... a music teacher tried to explain why I would fail as an engineer and succeed as a social worker. His credibility with me was 'nil.' He had no background in either field. I still don't agree that I could be a social worker but today I can see what an electrical engineer could probably have explained what took one year to happen. My math aptitude was poor and I obviously needed to shift to a field requiring less math."

In addition to a student's assigned advisor in the College of Engineering there are some professors who are very willing to talk to students who appear to be lost in engineering. Many of them, however, are not knowledgeable enough in many fields to be of complete help to a student. Since this is not their primary responsibility, they do not have the time that should be spent with a student. How much time a faculty member is willing to give a student outside his primary fields of teaching, research, and helping his students with their course work entirely depends upon the personality of the professor. Last year the students in the College of Engineering conducted a survey to assess the value of the College Advisory System. They reported that "no more than one-half of the students felt that their advisors were well equipped to handle their problems, and very few students had consulted advisors for more than two hours during the entire semester."

Somewhere I read a definition of a career as being "a set of life activities which the individual relishes, finds meaningful, and enters with great vigor." I like that definition. How great it would be if everyone could find such a career.

In placement counseling of potential women engineering graduates, they may apply the same criteria for job selection as the male graduate in the same field. The most important factor is self-evaluation. I am amazed to find how few of the students have asked themselves these questions:

- What can I do
- What will I do
- Do I prefer to work with people, ideas, products, or services
- Do I prefer a large or a small company
- Do I prefer a large or small community
- Is location important
- Is constant contact with family important or necessary for some special reason
- What motivates me

- Special interests -- how important are activities other than work
- What are my own personal values
- What limitations do I have
- What about travel

While much can be done, should be done, and hopefully will be done to improve counseling at all levels, the placement counselor has a great responsibility to help the graduate evaluate himself once he is ready to accept employment. What types of employment are available where the particular engineering discipline can be used?

The women in engineering to whom I talk have problems that their male counterparts do not share. Men are interested in a job because they like the work, they see opportunity for advancement, it is in their particular location preference, the salary is high, or for many other specific reasons. The woman has some different problems:

- She has a husband who is continuing in graduate school and she wants a job locally to help finance his further education.
- She has a favorite boyfriend and sometimes vague marriage plans, and she prefers to wait until he has accepted a position and then look for a job in the geographical area that he has chosen.
- She is about to start a family and must defer her employment for the immediate present.

It is important to encourage these women, in case they accept less than professional engineering employment in the beginning, to continue to search the community for a position where their engineering will be of some value. If this is impossible they should, by all means, continue to remain current in their fields of engineering by taking additional courses at night if possible, by participating in professional society activities, and by reading of the advances in technical journals so that when their personal situations are such that they can accept employment without reservations they will be current and able to compete in their fields.

All young engineers, male or female, must compete with others when they join the work force. They must, as they progress, be careful that they are not stuck in an activity where their talents are not being used to the best advantage. Women must realize that they must prove themselves on the same basis as a man and work at being a good engineer. They should not expect special handling and they should not cry discrimination at the first disappointment or criticism. They must realize that to the employer they are, first engineers and second, women and must compete on that basis. If, after a reasonable length of time, there is a legitimate complaint, it should be brought to the attention of the proper supervisor. Attitude is important

in any employee and I am convinced that the more a person expects to be discriminated against the more he will believe he is. A positive attitude toward work, fellow workers, and supervisors should be developed. This is excellent advice for anyone.

Some positive things are being done to expose more high-school girls to the field of engineering. At the University of Illinois there are three summer programs for high-school students who are recommended by their high-school counselors or principals:

- National Science Foundation Summer Program -- six weeks in duration. It is usually composed of those students who are in the top 5 percent of their high-school junior class. This summer there were three women in the 25 participants. The students came from throughout the United States.
- JETS Program -- two weeks in duration. This group is composed of students in the upper 10 percent of their high-school junior class. This summer, six women were included in the group. The participants were primarily from Illinois.
- Black [illegible] Program -- two weeks in duration. This group is composed of students in the upper 25 percent of their high-school junior class. This summer 7 women were included in the group of 37 participants from the Chicago area.

The number of [illegible] in this year's programs was far greater than in the past, when there have been only one or two. The JETS Programs are financed by company contributions.

During the time these students are at Illinois they are housed in a University dormitory as a group, with an advisor who is responsible for their well-being. He sees that they study at the proper time and that they have enough recreational activities to keep them from feeling overworked. The program is designed to expose these young people to engineering as a career. Faculty from all departments within the College of Engineering teach the various classes arranged for the program and at the end of the sessions give a final examination that is graded and returned to students before they leave the campus. This year, I understand the girls received the highest grades in the group.

For the past three years I have talked to the JETS students at their "Commencement Dinner" and have presented their diplomas. I have talked to them individually, and, to a student, they are enthusiastic and feel that the program has been interesting, intellectually stimulating, and very worthwhile.

While the women in these programs were on campus, the Society of Women Engineers arranged for picnics and evening get-togethers with local

women engineers where they discussed the field of engineering for women in an informal way. In addition to this, Professor Grace Wilson, the Society advisor, had the group at her home for dinner. She also invited other women engineering-faculty members and the evening was devoted to having fun but, again, discussing the field of women in engineering.

Professor David O'Bryant, who is in charge of these programs, reports that in publicizing them, high-school counseling again breaks down. He contacts every high school in the State of Illinois, gives details of the programs, and requests nominees. Many of the students who attend a program report that their counselors never mentioned it to them but they heard about it through a student who had attended the year before; they then requested that the counselor recommend them for the program. Professor O'Bryant says that his best salesmen are former participants, and he find a remarkable lack of interest on the part of some counselors.

An excellent way to expose more high-school girls to the field of engineering would be to have a Women's JETS Program. During this program successful women engineers could be brought in to meet with the girls and discuss their personal experiences. The problem, I understand, is financing, but Professor O'Bryant is willing to attempt to secure funds for such a program.

More work must also be done to secure scholarships for women in engineering. I believe that this situation will improve as companies, if for no other reason than to comply with the new Federal laws, will do everything possible to help more women to prepare for employment as engineers.

The demand for engineers is again on the increase and engineering enrollments are down. This means that very soon the demand will far exceed the supply and the shortage of engineers will again be as great as it was in the late 1960's. More women are entering college, and if more can somehow be encouraged to enter and to graduate in engineering, it will help to keep the supply somewhere near the demand.

Counseling, at all levels, is a wonderful field for those of us who have been fortunate enough to be in it. I believe that I have had the most satisfying job in the world. I have been in it long enough to have seen graduates become company presidents, controllers, and directors of research. It is a great satisfaction to feel even a small part in their success.

Much work needs to be done in the field of counseling at all levels. Conferences such as this can do much to advance the state of the art. At least people are talking about the subject; and I find that when there is enough talk, action usually follows.

Pauline V. Chapman

Mrs. Pauline V. Chapman retired in August 1973 after eight years as Director of Placement in the College of Engineering of the University of Illinois. She was the first woman to hold that position in a U. S. engineering college.

A graduate of Millikin University, Decatur, Illinois, she began as an expediter and buyer for the Caterpillar Company, entering the field of college placement in 1955 as Assistant Placement Director in the College of Commerce and Business Administration of the University of Illinois.

Mrs. Chapman was a member of the first elected assembly of the College Placement Council. Upon her retirement she was honored by more than 200 leading U. S. corporations for "outstanding contributions to engineering and industry," and was presented with the award of merit by the West Coast Aircraft and Aerospace Industry Council.

THE VIEWS OF LEADING ENGINEERING SCHOOLS

John B. Parrish

Professor of Economics
College of Commerce and Business Administration
University of Illinois, Urbana-Champaign Campus, Illinois

This conference has been concerned with many questions about career guidance for women entering engineering. Among the many questions are the following:

1. What is the major deficiency in current career guidance for women?
2. How may these deficiencies best be overcome insofar as engineering is concerned?
3. Do engineering schools have ongoing programs with secondary schools to acquaint talented girls with the potentials of engineering as a career choice?
4. Have engineering schools assigned faculty to assume major responsibility for counseling prospective or entering women engineering students?
5. To what extent have engineering schools developed literature designed to interest women in engineering and to assist them after enrollment?
6. What aspects of career guidance for women entering engineering need to be given priority in any conference organized to study this subject?

In order to give this conference the views of administrators and faculty of leading engineering schools, these six questions were submitted to 30 top schools for comment and evaluation. What follows is a summary of their replies.

QUESTION 1: WHAT IS THE MAJOR DEFICIENCY IN CURRENT CAREER GUIDANCE FOR WOMEN?

On this question there was almost unanimous judgment. The major deficiency occurs far back down the educational ladder at the secondary and elementary levels. The deficiency is not a simplistic one; unfortunately, it is compounded of many factors that turn talented young women away from engineering.

First, there is the "social conditioning" process. Boys play with trains and construction sets. Girls play with dolls. Parents and the community support this stereotyping of roles. It is reinforced in junior high school. Boys take shop work. Girls take sewing and cooking. This is repeated in high school and reinforced on television and in the press.

Second is the educational background of faculties in junior and senior high schools. They may be trained and knowledgeable in literature, language, mathematics, chemistry, and dramatics, but engineering is not taught in our public secondary schools. Faculty know nothing about it. The blank for the teachers becomes a blank for the students.

Third is the nature of counseling. Almost all counselors have backgrounds in educational psychology. They know nothing about engineering and they reflect the "social conditioning" of society. Many are not just neutral. They are negative. They persuade talented high-school girls not to consider engineering as a career. Much of the time of high-school counselors is taken up with efforts to guide students into college. There is a strong tendency for counselors to say: Don't worry about selecting a career now. You will have plenty of time later. Go to college, and then you can decide." This is a major mistake of secondary-school counseling. Talented girls arriving at college with little or no training in mathematics or the sciences are not apt to make up the deficiencies in college. They have been trained "out" of engineering, not in.

Fourth is the lack of good engineering-careers literature for women. Most of the career literature in engineering is male-oriented. In some materials women are not even mentioned. The few materials about women in engineering are usually so brief, so dry, so uninteresting as not to arouse the the curiosity of even the brightest girls. It is ironic that many high-school students are excited and challenged with our current environmental clean-up problems, without ever realizing that solutions will come primarily through technology.

QUESTION 2: HOW MAY THESE DEFICIENCIES BEST BE OVERCOME SO FAR AS ENGINEERING IS CONCERNED?

On this question there was a general consensus that the answer must be a multifaceted approach, using a wide variety of strategies and tools.

One suggestion is for engineering schools to start with their own institutions and clean house, as it were. One dean put it this way:

> "On many a campus the engineering school is trying to interest more women in engineering, while on the same campus an education school is turning out career counselors who still know nothing about engineering. So, they are going out to high schools to perpetuate the same old stereotypes. We should get our own house in order before criticizing the secondary school."

A second recommendation is to arrange for upper-class women engineering students to visit high schools and talk to both girls and boys about the challenges of engineering. This strategy, combined with visits by practicing

women engineers, will do more than anything else to break the negative social conditioning and the stereotyping. Secondary students like and will follow personal contacts.

A third recommendation is to break the "counseling barrier" in secondary schools which turn so many women away from engineering. This could be done in several ways. One would be to pull in the counselors for a "Counselors' Career Day" on campus. Let the high-school counselors see women engineering students at work or study, discuss their reasons for selecting engineering. Let the engineering faculty discuss with the counselors the excellent outlook for women engineers in industry, teaching, government. The other approach would be "engineering outreach," through which engineering schools would establish and maintain personal contact between faculty and counselors, providing them with information, discussion, to change the stereotype.

A fourth recommendation is to improve career literature about women in engineering and get it distributed to more counselors and students. Several engineering schools reported they had sent their brochures about women in engineering to every one of the 10,000 high schools in the country. But some engineering heads raised serious doubts about this approach. How much of this literature is put in a folder in a career file and never read? Can literature alone break the stereotype? If a talented girl is turned off of engineering, would she be apt to read it? Apparently a few, but only a few. The question remains: how to get more mileage out of existing literature?

QUESTION 3: DO ENGINEERING SCHOOLS HAVE ONGOING PROGRAMS WITH SECONDARY SCHOOLS TO ACQUAINT TALENTED GIRLS WITH THE POTENTIALS OF ENGINEERING AS A CAREER CHOICE?

The answer to this is a very strong "yes." Engineering schools have developed and are developing many, many programs to reach more students in the secondary schools. This outreach effort appears to have emerged particularly in the last three years. Let me cite a few of these developments.

From Pennsylvania State University, Dean N. J. Palladino reported:

> "At Penn State we started a program of national advertising on Women in Engineering approximately one year ago. We have produced five, 60-second radio spot announcements which have been distributed to approximately 200 radio stations in Pennsylvania. In addition, a 60-second television spot announcement has been prepared and will be released in the next few weeks."

The School of Engineering at Stanford, as reported earlier, has sent out its brochure to 10,000 high schools throughout the country.

Associate Dean C.E. Work of the Michigan Technological University described their efforts as follows:

> "We have an annual Engineering Awareness Program, sending engineering faculty members into high schools -- about 50 to 60 visits a year for both boys and girls -- to talk about careers in engineering and science."

Professor Mil[illegible] Dresselhaus reported for the Massachusetts Institute of Technology on two recent programs as follows:

> "A Careers Day Program in the Spring brought in about 200 girls from a 100-mile radius of Boston. The Program consisted of a two-hour panel discussion followed by tours ... our women engineering students held an open house for 50 freshmen women who had shown interest in engineering."

Ohio State University's Dean Harold A. Bolz reported:

> "At Ohio State we have been making special efforts through periodic high-school-day programs on the campuses and visits to high schools and junior high schools by engineering students and faculty to inform girls in the secondary schools of the career opportunities for them in engineering."

Assistant Dean Helen B. O'Bannon, replying for Carnegie-Mellon University, submitted this account:

> "Carnegie-Mellon is actively trying to attract more women into engineering, science, and management. We have made two television spots: one on materials which has been well received by stations, and one on women in engineering which features one of CMU's female students...this has been extremely well received. Carnegie-Mellon is also developing a career information program for women this Fall. We will ask local industries to send women engineers and scientists...we are also designing a program for secondary-school women who have demonstrated strong math and science aptitude..."

Still another approach is to design curricula in such a way as to particularly appeal to women. Dean James A. Luker described what Syracuse University has done in this regard:

> "One of the programs is in environmental engineering, which is a very flexible, open-ended program and allows the students, male or female, to more or less develop

their own programs with specific career objectives." (It also has a large elective portion, so it allows time for a better general education.)

"The second is a program in bioengineering which tends to apply engineering methodology to the application of the life sciences as well as physical sciences. This program ...is particularly attractive to women because of their interests in working in health and medical-related areas rather than being industrial-related.

"A third program is a dual-degree program, where students may register in the College of Liberal Arts and Sciences and the College of Engineering. As such, candidates in this program receive a BS degree from the College of Engineering in a five-year period. This is an excellent program for women. It allows them more freedom and many opportunities to obtain a better general and cultural education at the same time they are pursuing an engineering degree."

These are only a few examples of what engineering schools are doing. There are many others. More are planned.

I think it is a fair summary to conclude that leading engineering schools are now making strenuous efforts to develop special programs to reach more women in secondary schools and to give them assistance when they arrive on campus. Most of the individual school efforts have come in just the last year. And some programs are to be initiated for the first time this fall. This is a "new era" in engineering education.

QUESTION 4: HAVE ENGINEERING SCHOOLS ASSIGNED FACULTY TO ASSUME MAJOR RESPONSIBILITY FOR COUNSELING PROSPECTIVE OR ENTERING WOMEN ENGINEERING STUDENTS?

Of the 30 schools questioned on this matter about half said they had assigned faculty with specialized responsibility for counseling and assisting women. Almost all of the assignees were women. Almost all had been appointed or assigned in the last three years. This once again emphasizes the recency of positive and widespread efforts to interest more women in engineering. The real payoff obviously lies in the future.

Let me illustrate this development in terms of what Pennsylvania State University has been doing. Dean N. J. Palladino wrote as follows:

"Professor Mary Kummer... has been given the major responsibility for recruiting women engineering students ... Recently she wrote to each girl who responded to our

radio spot announcements, and she is now in the process of writing follow-up letters to these girls. The members of the Society of Women Engineers are also writing personal letters to each girl who has been accepted for admission to engineering next fall. Professor Kummer is also writing to each of these girls offering to meet them when they come to University Park for counseling. Incidentally, these efforts have increased the number of women accepted to engineering from 11 in Fall 1972 to 39 in Fall 1973. We are hopeful that this will be the beginning of an even more substantial increase."

QUESTION 5: TO WHAT EXTENT HAVE ENGINEERING SCHOOLS DEVELOPED LITERATURE DESIGNED TO INTEREST WOMEN IN ENGINEERING AND TO ASSIST THEM AFTER ENROLLMENT?

About one-half of the leading engineering schools queried have developed brochures or catalogs emphasizing women in engineering. Several that have quarterly publications have devoted special issues to this subject. Several schools reported their first publications aimed at attracting more women in engineering will be published this Fall. A binder containing the publications of 15 schools is on exhibit in Colby Hall for all members of the conference who might like to see what other schools are doing.

So, in summary, to the question: Are engineering schools developing specialized literature about women? -- the answer is "Yes, and very rapidly."

QUESTION 6: WHAT ASPECTS OF CAREER GUIDANCE FOR WOMEN ENTERING ENGINEERING NEED TO BE GIVEN PRIORITY AND SPECIAL EMPHASIS IN ANY CONFERENCE ORGANIZED TO CONSIDER THIS SUBJECT?

This question elicited a very wide range of questions and suggestions, as one might expect.

Let me summarize first the questions. They include:

1. How do you overcome years of social conditioning that alienates young women from engineering?
2. How do you convince high-school and junior-high guidance counselors that engineering is an appropriate, rewarding, and satisfying profession for women? How to you convince the parents?
3. What steps may be taken to encourage more college freshmen to consider engineering as a career?
4. How much support is necessary to produce academically successful women engineering graduates?

5. How can we marshal the talent and interests of industry in this guidance problem?

6. What are the key factors that cause women students to stay in or leave engineering, once they have enrolled?

7. What can or should engineering schools do to help minority women prepare for their "pioneering" role after graduation?

8. How can the professional engineering societies be moved to do a better job of reaching talented women and men in junior and senior high schools about the potentials in engineering?

9. How can the image of women in engineering be put across as the "new stereotype" to children in the elementary grades as well as to students in junior and senior high schools?

10. What arrangements are required to get more members of professional societies and leading women engineers, in industry and government, to meet with secondary students and explain the opportunities for engineering careers?

Some of the suggestions may be summarized as follows:

1. Your conference should go on record as recommending that the Engineering Foundation underwrite a half-hour television program to do for engineering what Marcus Welby does for medicine -- "Engineering Center" instead of "Medical Center." Many TV stations would run a 30-minute script gratis. With advance notice to junior- and senior-high-school students, it might shake up both students and their parents.

2. Some organization, as SWE, ECPD, or the Engineering Foundation, should publish a national list of scholarships available for women in engineering and distribute it to all interested high-school students.

3. The conference might recommend that ECPD, Engineering Foundation, or SWE request funding from the National Science Foundation to support an expanded program of "Engineering Days on Campus" for junior- and senior-high-school students. This fund could pay the expenses of students and counselors, especially if there are overnight stays for two-day conferences.

4. The conference might want to consider the fact that training in engineering is not only engineering training, it is good basic education as well, providing excellent preparation for careers in management, administration, etc.

5. Why not compile a master list of all women engineers who would be willing to talk to secondary students individually, or to groups of women students, about engineering. The list could then be sent to high-school counselors with a letter urging them to take advantage of this professional counseling available to them.

6. We have found the best missionaries to prospective women students still in secondary school are our own women engineering students. Your conference should urge every engineering school to arrange for their women engineering students to meet with these prospective students, either on campus or at their hometown schools.

7. We need more literature on "what women are doing in various engineering fields." This literature needs to emphasize not just what women engineers do, but provide answers to such common questions as: "Can I combine an engineering career with marriage?" "Can I combine an engineering career and children?" We also need more and better literature for secondary students on the exciting new horizons in engineering, the relationship of engineering to a changing world, the key role of engineering in environment clean-up, the expanding role of engineering in medicine, etc.

LIVE YOUR OWN DREAM!

Josephine B. Hayslip

Educational Consultant
Career and Vocational Guidance
New Hampshire State Department of Education, Concord, New Hampshire

Because this research paper -- intended to be used as a resource for the Friday, August 24, 1973 session of the conference on Career Guidance for Women Entering Engineering -- was written six weeks ahead of the conference, handed in in manuscript form at the beginning of the conference, and, hopefully, read by the participants before Friday morning, the last day of the conference, it is obviously not the text of the presentation. The participants' involvement throughout the week with role models in engineering careers should enhance and modify this research so that after some brief introductory autobiographical remarks by those on the panel, the participants may react to the concepts described in this research.

LIVE YOUR OWN DREAM!

One is not born a woman; one becomes a woman. As preschool playmates, girls and boys are equally energetic, curious, interested in competing, achievement-motivated, and intelligent. In other words, the brain has no sex, nor does the heart, or whatever it is that directs an individual as that individual chooses a life-style. What is it, then, that determines whether an individual will be an engineer? a nurse? a homemaker? a counselor? Certainly it is not the nature of the person's genitals! Therefore, that which determines a life-style must be cultural.

Counselors and teachers have an opportunity to help young women examine careers in the light of their interests and abilities, if they indeed will take advantage of this opportunity. However, my sense of what is indeed happening, at least in this state, is that we have as much sex role stereotyping (or as much harm avoidance/turf protection, call it what you will) among counselors and teachers as we do among any other sector of the population.

However, the demand for change is coming from some of the women's movements, and those counselors who are in tune with career education from an awareness, exploration, preparation model are beginning to deal with themselves and their attitudes toward, for example, women in engineering careers.

In The Feminine Mystique[2]*, Betty Friedan takes counselors to task for not encouraging bright young high-school girls to undertake challenging subjects in high school that would, in turn, lead to challenging careers.

*Further information on the numbered references is included in the Bibliography at the end of this paper, where they are listed alphabetically by author, rather than in the order mentioned.

Check this against your own experience. A young girl, gifted in mathematics and in drawing skills, wants to apply to a school of architecture. Her counselor strongly advises her not to, for women are rare in that profession. Against this advice she does apply and is accepted. Then she is advised not to attend, for there is really no future for women in architecture and she would probably transfer to an art program and get married eventually, anyway. Please note that I have deliberately not indicated the sex of the counselor.

Perhaps your experience has been more fortunate; perhaps your counselor has been "tuned in" to the fact that, married or not, most women will spend most of their time outside of their home. We should then be educating them, counseling them to the fact that "woman's place is in the world."

The New Hampshire Commission on the Status of Women, although it started late, has caught up under the leadership of Carol Pierce. (Incidentally, Carol has since been elected to the state legislature and is continuing to keep women's issues visible.) Among other testimonies received at some very revealing hearings in 1970 and 1971, guidance counselors were shown as lacking interest toward assisting individual girls. Time preference, if given to individuals on the part of high-school counselors, was given to males entering college, secondly to females entering college, next to males entering the job market or in for other counseling, and finally, if given at all, to girls. "Because 90 percent of all women will at some time during their life enter the job market (often under extremely disadvantageous conditions) all girls should receive adequate counseling to strengthen their role in society and job opportunities in particular."[18]

At a recent Drug Management Problems Conference held in New Hampshire, we again heard the students, especially the girls, say that unless you were straight college prep with no problems, you didn't take to your counselor. Yet these very counselors must provide young girls, and the younger the better -- grade school is not too soon -- with every opportunity to understand their personal strengths and to relate them to their future education and their future careers. Indeed appropriate to <u>this</u> conference, placement officials at Carnegie-Mellon University, Pittsburgh, Pennsylvania, report:

> "Stiff competition is developing among companies for women engineering graduates. Because there are not many women engineers, the demand is especially great. Minority students are also facing the same recruiting rushes.
>
> "Reports of the College Placement Council indicate that the average starting salary offered a woman engineering graduate is about $893 per month, slightly higher than the average offered her male counterpart.
>
> "While women today constitute less than one percent of the active engineers in this country, the proportion of women engineering graduates has increased five times from what it was in the 1950's.

"J. Stanford Smith, senior vice-president of the General Electric Company, told a summer education conference that: 'Unless we can start producing not four hundred, but four thousand to six thousand minority engineers a year within the decade, industry will not be able to achieve its goals of equality and the nation is going to face social problems of unmanageable dimensions . . . It would be truly unforgivable if, with this timely gap in the supply of engineers, we failed to fill a large part of it with minorities and women.'"[12]

If we can overlook that we are being lumped in with minorities, for women in this country do outnumber [illegible] can we indeed determine whether a girl's career choices are determined by stereotyping and cultural tradition and how much outright discrimination? For example, women receive under five percent of the professional degrees in fields like law, architecture, and engineering. Only two percent of the engineers in the United States are women, compared to about 30 percent in Russia. Yet tests have shown that 40 percent of those with an aptitude for engineering are women. Unfortunately, if a girl does not think engineering is 'a job for males,' chances are that the admissions officer at the engineering school does.[13]

The source continues (if you are not yet completely discouraged) with some extraordinary statistics and is emphatic about the need for "role models" throughout a woman's decision-making process. And yet only 22 percent of college teachers are women -- less than in 1930. And, which sex do you think of when you say college president? business administrator? corporate executive? secretary? nurse? saleslerk? engineer?

So far this paper has attempted to define the problem. We have yet to deal with the solutions. I would like to try to propose ways in which counselors, teachers, and students working in concert can change attitudes, life-styles, and future goals right now.

Be Aware of Your Strengths

Remember, we talked about preschool boys and girls as being equally energetic, and so forth? At least two decades ago, Simone de Beauvoir wrote "...up to the age of twelve the little girl is as strong as her brothers, and she shows the same mental powers; there is no field where she is debarred from engaging in rivalry with them. If, well before puberty and sometimes from early infancy, she seems to us to be already sexually determined, this is not because mysterious instincts irrevocably doom her to passivity, coquetry, maternity; it is because the influence of others upon the child is a factor almost from the start, and thus she is indoctrinated with her vocation from her earliest years."[1]

Be Aware of Your Own Sexuality

Women owe Sigmund Freud no thanks at all for his concepts of the masculine libido, feminine narcissism, and penis envy. On the other hand, his dis-

ciple, Helen Deutsch, has modified his concepts of sexuality, referring to them as an essential feminine core around which are wrapped layers and layers of equally genuine elements of the feminine soul. "If we follow the developments of these elements, we find that they stem from the active, sometimes masculine components that, even though always more or less present in woman, originate in the masculine part of the bisexual disposition. These wrappings are continuations of elements present in the undifferentiated phase of childhood, identifications with masculine prototypes, survivals of the prepuberty thrust of activity -- in brief, they are sublimations of active currents in women."

My interpretation of this feminine core with its many wrappings is that the psychic structure of woman is not exclusively in the "eternal feminine." Somewhere between the "female eunich" and the "feminine mystique," a girl who is becoming a woman will deal with her sexuality and her energy. She will integrate these positively into her life-style and acknowledge that concepts like resourcefulness, initiative, desire, motivation, excellence are not exclusively masculine or feminine; that aggressive behavior in women need not be unfeminine, and is not considered as unfeminine by those individual men and women who are secure in their own sexuality. Indeed, we cannot document inferiority and superiority; we can document specific differences between the sexes in aptitude, interest, and personality. Again, these must be due to cultural and/or other experiential factors. The overlapping in all psychological factors, sexual characteristics included, is such that we need to regard men and women as unique individuals, not as group stereotypes. When we get into trouble with this concept is when we let pass a remark such as "She plays tennis like a man" or "She's as good a mathematician as any boy in the class." If we're proud when we hear this comment, then we give up a little of our identity as a person, a little of our sexuality, too.

I've become especially sensitive to radio and television advertising lately; I hope you notice that it's changing, too. We are seeing fewer and fewer of the "Mother never told me" and the "does she or doesn't she?" and more asexual or bisexual ads. Not enough yet, but fortunately the pattern is changing and hopefully will continue to change. You can help by noticing and responding. (A personal aside: when I assumed the job of educational consultant, I obtained my own American Express credit card, on which I charge all of my own travel expenses, which are then reimbursed. Each month when I receive my bill, I'm asked, "Isn't it time you bought your wife her own credit card?" As yet, I haven't come up with a proper, or improper, way to deal with that request. Nor, by the way, has my husband, who will have nothing to do with credit cards.)

When a young girl is aware of her sexuality in a healthy manner, she learns to use this sexuality in a positive manner. A study which was done some time ago, and which certainly needs to be restudied, is one in which one hundred teenaged boys were asked if they might like to be girls. Of these only one or two said "maybe," and then only if they could change back. However, of a hundred girls who were asked if they would like to be boys, more than seventy-

five percent said yes. Not "maybe I'd like to try it" but unequivocally "yes." Some reasons: "Boys are better off; they don't have to suffer as women do." "A boy does more interesting work." "They are freer." "They are not bothered by clothes." Let's look at these, one by one.

1. Boys don't have to suffer as women do. I can only conclude that this refers to the menstrual cycle. If a girls sees this as a handicap, it is because of her general, often a cultural, situation and should not serve as an obstacle; indeed, many women athletes, dancers, travelers accommodate themselves to this. Imagine Billy Jean King saying, "I can't play tennis today; I have the Curse."

2. A boy does more interesting work. My sense of this is that girls have not been allowed into some of the more interesting professions. This we know is beginning to change, or women wouldn't be attending conferences like this one on Women in Engineering Careers. Women have a long way to go, but this has got to be the end of the beginning.

3. Boys are freer! Freer to do what? Women are gaining on college campuses, in dormitories, and in classrooms. They may choose when and where to come and go. This is beginning to happen in high schools, but not nearly fast enough for most of us. Girls in automechanics and boys in sewing classes are still somewhat of an oddity, but even in New Hampshire, it's happening.

4. Boys are not bothered by clothes. Women can't use this as an excuse any longer. In fact, I mentioned this to a male colleague recently and he countered with the fact that girls were lucky, because when it's really hot they can wear dresses, and dresses must be cooler. In other works, women can choose their clothes, their careers, their education, their life-styles. They've indeed come a long way.

Be Alive

Be alive all over all of the time. In Don't Fall Off the Mountain, Shirley MacLaine describes an interval in her life in which she says "It didn't seem to be a question of unused potential talent. It was more that I was living at 20-percent capacity." This, by the way, is a woman that I believe Maslow would have included in his list of self-actualized women -- that is, women who have come to terms with their own identity, their own sexuality, who care about other people and give of their talents to those around them. Shirley MacLaine describes her childhood, her fierce competition with her younger brother, her ability to fight with the boys and beat them on their own terms, her struggle against her family's wishes to become an actress, and and the tremendous sharing relationship that she has with her husband and daughter. She describes the process that she went through becoming a person and, along the way, becoming a woman. Since writing her remarkable book, she has continued to be involved and yet has managed to be herself.

In 1969, Englehard[13] surveyed a number of counselors in Minnesota, hypothesizing that a counselor could be characterized as having "traditional" or "emergent" views of girls' life patterns. The traditional stance was viewing the woman's role as nurturer -- home, husband, children. The emergent view is defined as seeing the woman as a generalist, performing many roles, and I might add performing those roles well, including those of wife, mother, home-maker as well as legislator, teacher, engineer, simultaneously throughout her lifetime.

In addition, Englehard found that "the most 'emergent' type of counselor could be described as a married woman, over forty-one years of age, working in a metropolitan-area school, who was childless, or who had one or more children." We need a great deal more research along these lines. My sense of this is that rather than having a girl's career decision influenced from a traditional stance, she would be better off with no career counseling at all.

Be Yourself

One problem with discussing an individual as a role model is that we tend to redesign ourselves along these lines. Here's where we -- counselors, teachers and students -- need to sharpen our communication. We need to break the cultural reinforcement cycle, and we need to offset the notion that one set of personality characteristics and occupational behaviors is better, more desirable, or more normal than another. Counselors, especially, should be aware of self, so that their own values don't get in the way of counseling young girls.

CONCLUSION

Be aware of your strengths. Be aware of your own sexuality. Be alive. Be yourself. Not terribly profound words, but they're mine. I've tried to communicate and interpret some of the research that I've done, intending originally to title this paper "Woman's Place is in the World." This became too much of a parody. Then I remembered a saying I heard from a young singer named Pat Suzuki at the beginning of her career who quoted her father: "Think big, work hard, and have a dream." To this I would add: Live your own dream.

BIBLIOGRAPHY

I've divided this bibliography into three parts. The first six titles are paperback books that I would recommend as very helpful to my personal growth as well as to the development of this paper.

1. de Beauvoir, Simone, The Second Sex, Bantam Books, Alfred A. Knopf, Inc., 201 East 50th Street, New York, New York, 10022, $1.25, p. 249. First published in 1953 in French, a fascinating revelation of the emergence of the liberated woman.

2. Friedan, Betty, The Feminine Mystique, Dell Publishing Company, 750 Third Avenue, New York, New York 10017, 1963, $1.25. The best seller that is credited with igniting women's liberation.

3. Greer, Germaine, The Female Eunuch, McGraw-Hill Book Company, 330 West 42nd Street, New York, New York 10036, $1.95. A challenge to women to take joy in the struggle for sexual freedom.

4. Komisar, Lucy, The New Feminism, Warner Books, Inc., 315 Park Avenue South, New York, 10010, $1.25, p. 43. Advertised as "the first book of its kind: a primer on the women's movement for teenagers."

5. Lair, Jess, PhD, I Ain't Much, Baby, But I'm All I've Got, Doubleday and Company, Inc., Garden City, New York 11530, 1972, $2.95. Enjoyable reading, and though not a women's book, contributed to my personal self-acceptance.

6. MacLaine, Shirley, Don't Fall Off the Mountain, W.W. Norton and Co., 55 Fifth Avenue, New York, New York 10003, $1.50, p. 100. A real surprise from a very sensitive person.

The next five titles are resources which most counselors have read or should have read.

7. Deutsch, Helene, MD, The Psychology of Women, A Psychoanalytic Interpretation, Grune and Stratton, Inc., New York, New York, 1944, p. 141.

8. Isaacson, Lee E., Career Information in Counseling and Teaching, Allyn and Bacon, Inc. 470 Atlantic Avenue, Boston, Massachusetts 02210, 1971.

9. Maslow, Abraham, Motivation and Personality (2d ed.), Harper and Row, 10 East 53rd Street, New York, New York 10022, 1970.

10. Matthews, Esther E. et al., Counseling Girls and Women Over the Life Span, National Vocational Guidance Association, Publication Sales, American Personnel and Guidance Association, 1607 New Hampshire Avenue NW, Washington, D.C. 20009, 1972.

11. May, Rollo, Power and Innocence, W.W. Norton and Co., 55 Fifth Avenue, New York, New York 10003, 1972.

The last five titles are useful articles, monographs, or bulletins.

12. "Engineering; Women in Demand," APGA Guidepost, Spring 1973. American Personnel and Guidance Association, 1607 New Hampshire Avenue NW, Washington, D.C., p. 4.

13. Englehard, P. "A Survey of Counselor Attitudes Toward Women," Minnesota Counselor, 1969.

14. Expanding Opportunities for Girls: Their Special Counseling Needs, U. S. Department of Labor, Women's Bureau, Washington, D. C. 20210, 1971.

15. Handbook on Women Workers, Women's Bureau, Bulletin No. 294, U. S. Department of Labor; available from U. S. Government Printing Office, Washington, D. C. 20402, 1969, $1.50.

16. Report of the Hearings Held by the New Hampshire Commission on the Status of Women, Spring 1971, p. 3.

Josephine B. Hayslip

Josephine B. Hayslip has been associated with the New Hampshire State Department of Education since 1971. She received her BS degree from the University of Vermont in 1951, her Master's in Education from Temple University in 1961, and from 1961 to 1967 attended Boston University's Graduate School.

Her previous experience includes the teaching of English and Reading at Brandywine Heights Joint High School of Topton, Pennsylvania (1958-1962). She was Director of Guidance and English Teacher (1962-1965) at Ashland High School in Ashland, New Hampshire, and from 1966 to 1971 served as Director of Guidance at Littleton High School in Littleton, New Hampshire.

Mrs. Hayslip served as president of the New Hampshire Personnel and Guidance Association for the 1972-73 term.

WOMEN IN ENGINEERING -- A QUESTION OF SUPPLY OR DEMAND?

Michael R. Tuosto
Manager - Equal Opportunity Activities

and

Anne M. Giedlinski
Advanced Systems Planning Engineer

Public Service Electric and Gas Company, Newark, New Jersey

Women in engineering -- a question of supply or demand? This is a subject which the New Jersey Utilities Association attempts to explore in its recently developed affirmative-action program, in cooperation with high-school guidance directors.

The program consists of a series of forums during which women engineers, employed by utility companies in New Jersey, and female engineering college students review the supply-and-demand aspects of the engineering employment picture during the next ten years. This picture, as you will see duri the slide presentation, shows the estimated supply of engineers falling shor. of the projected demand during the latter part of this decade. Although this demand/supply review is brief, misconceptions -- on the part of some members of the audience, especially the guidance counselors -- are corrected. These misconceptions seemed to be rooted in the engineering unemployment problems which have occurred in certain specialized industries.

Following this review, during which the participating panelists utilize charts or slides, a brief description is given of the various major fields of engineering. Such subjects as the required courses in college and the general type of work usually performed by graduates of each engineering specialty are related. Fortunately, we have on our panel at least one E.E., M.E., I.E., and Ch.E.; this allows the students in the audience to receive answers to their questions based on the practical experience of engineers with varied educational backgrounds.

Before moving to the question-and-answer segment of the program, each panelist gives a brief presentation which describes a typical work day in her present job assignment. As I mentioned earlier, all of our panelists are employed in the utilities industry. Consideration, however, is being given to broadening the program by including on the panel female engineers from other industries.

The demand/supply review, the discussion on engineering specialties and the "typical day" segment comprise the formal part of the program. We then move into the question-and-answer session, which extends from 45 minutes to one hour and 15 minutes, depending on the size and inquisitiveness of the

audience. It is rather difficult to accurately describe this question-and-answer session of the program. Perhaps the best method of description would be to relate to you some of the questions asked by the guidance counselors and the high-school students. Questions included:

1. "How much of the talk about women in engineering is really window dressing for industry, which may be under government pressure to employ women in traditionally male positions?"
2. "Does industry really want women engineers?"
3. "I seem to always be reading about unemployed engineers who can't find jobs. You say there are jobs for qualified engineers. Please comment."
4. "Do you have to be good in math to become an engineer?"
5. "What about homework assignments in college? How much?"
6. "What led you to pursue an engineering career?"
7. "What role, if any, did your high-school guidance counselor play in your career selection?"
8. "Were you encouraged by your high-school guidance counselor to pursue engineering as a career?"
9. "How many other women engineers work with you?"
10. "Were there other women in your college engineering courses?"
11. "How were you treated by your college professors? By the male students?"
12. "Did you have dates at college?"
13. "Are you married? What are your views on marriage?"
14. "How does it feel to work in an all-male work environment?"
15. "What can high-school guidance counselors do to assist female high-school students who show an interest in math and science?"
16. "Do you like your job?"
17. "Are you treated any differently than male engineers in your company?"
18. "Are women promoted as readily as men in industry?"
19. "What advice can you give to female school students who are considering engineering as a career?"
20. "How are you treated by men from other companies with whom you deal?"

I think you'll agree that most of the questions were direct and meaningful. They also provided an indication of what was on the minds of both the counselors

and the students. If you are thinking of sponsoring a program similar in format to the "Women In Engineering" program, it would be wise to anticipate many of these questions.

For those of you who may be thinking of sponsoring programs in your localities, I'd like to take a few moments to discuss how we in New Jersey planned and organized our program. In our State, high-school guidance directors are members of the County Guidance Associations. There are 19 such associations in New Jersey. Most of these meet monthly during the school year. There is also a State Guidance Association which communicates regularly with each county group.

Once the Equal Employment Opportunity Committee of our Association had identified the problem on which we wanted to focus attention, we met with the officers of the State Guidance Association to present our plan. We also asked for their comments and input to the program. Their ideas, by the way, were very helpful to us at this stage of the program development. The State Association endorsed the program and communicated the availability of our program to each County Guidance Association. From that point on, our dealings were with the county association officers, who were instrumental in arranging and coordinating our presentation. We found both the state and county guidance officials to be enthusiastic cooperative, and most valuable in our effort.

To give a more vivid re-creation of our program we have prepared a slide presentation which we would like to share with you. Following this presentation Anne and I will be happy to attempt to answer any questions that you may have.

On behalf of the Public Service Electric and Gas Company, Jersey Central/New Jersey Power and Light Company and all other members of the New Jersey Utilities Association, we appreciate the opportunity to participate in this 1973 Engineering Foundation Conference. We hope that through our presentation this evening we have contributed to its success.

Thank you.

Michael R. Tuosto

Michael R. Tuosto, Manager - Equal Opportunity Activities for the Public Service Electric and Gas Company in Newark, New Jersey, is a 1962 graduate of Rutgers University. He received his MBA from Rutgers in 1965. Mr. Tuosto joined the Public Service Electric and Gas Company in 1962 in the company's management training program. Prior to his being appointed to his present position in 1972, he held both line and staff positions in the company.

Named Outstanding Jaycee in New Jersey in 1967, Mr. Tuosto has also served as President of the Rutgers Alumni Federation and of Beta Gamma Sigma Alumni in the Metropolitan New York area.

Anne M. Giedlinski

Anne M. Giedlinski was graduated from Pennsylvania State University with a Bachelor of Science degree in Electrical Engineering, in June 1967. She joined Jersey Central/New Jersey Power and Light Company in 1967 and was appointed Engineer in 1971. She works in the System Planning Department in the utilities' general office in Morristown, where she prepares plans for the orderly and economic development of the distribution system in the northern area of the company and conducts special engineering studies. One of these studies, "Economic Loading of Distribution Transformers," appeared in TRANSMISSION AND DISTRIBUTION.

Part IV

APPENDICES

A -- Conference Program

B -- Roster of Conference Attendees

Appendix A

PROGRAM

Sunday, August 19

3:00 - 9:00 p.m. Registration and Check-In

6:30 - 8:00 p.m. Dinner

8:00 - 10:00 p.m. Social Gathering

Monday, August 20

9:00 a.m. - Noon

WELCOME

Nancy D. Fitzroy
Conference Chair'n

Dr. Jere A. Chase, President
New England College

Dr. Sandford S. Cole, Director
Engineering Foundation Conferences

CONFERENCE OBJECTIVES

The Society of Women Engineers, Past and Present
Naomi McAfee, National President
Society of Women Engineers

A Senior Engineer's Point of View
Nancy D. Fitzroy

A Student's Point of View
Deborah Kaminski
Rensselaer Polytechnic Institute

The "New Era" for Women in the Professions
Dr. John B. Parrish, Professor of Economics
University of Illinois

2:00 - 5:00 p.m. Informal Discussion and/or Recreation

7:30 - 10:00 p.m. THE STATUS OF WOMEN

What Happened to Progress?
Dr. Irene Tinker, Presiding Officer
Federation of Organizations for Professional Women

Women's Personal Issues
Carol Pierce, Chair'n
New Hampshire Commission on the Status of Women
Member, New Hampshire State Legislature

Tuesday, August 21

9:00 a.m. - Noon ROLE MODELS

Session Chair'n - Dr. Alva Matthews

Vice-Chair'n - Lt. Col. Arminta Harness

Dr. Irene Peden, Associate Dean
College of Engineering, University of Washington

Lt. Col. Arminta Harness, Executive Officer
Deputy for Space Communications
Space and Missile Systems Organization, U.S. Air Force

Margaret Pritchard, Consulting Industrial Engineer
Portland, Oregon

Kathryn Anner, Structural Engineer
Weidlinger Associates, New York, New York

2:00 - 5:00 p.m. Informal Discussion and/or Recreation

7:30 - 10:00 p.m. ROLE MODELS

Irene Sharpe, General Engineer
Bureau of Reclamation, Engineering and Research Center
Department of the Interior, Denver, Colorado

Dr. Alva Matthews, Consultant
Weidlinger Associates, New York, New York

Donna Ozern, Engineer
Xerox Corporation, Rochester, New York

Informal Discussion

Wednesday, August 22

9:00 a.m. - Noon ROLE MODELS

Session Chair'n - James A. Mason, Jr.

Vice-Chair'n - Carolyn Phillips

Carolyn Phillips, Senior Engineer
Division of Industrial Hygiene
New York State Department of Labor

Yvonne Clark, Associate Professor
School of Engineering and Technology
Tennessee State University

Dr. Mildred Dresselhaus, Associate Head
Electrical Engineering Department
Massachusetts Institute of Technology

Nancy D. Fitzroy, Manager, Heat Transfer Consulting
Research and Development Center
General Electric Company

2:00 - 5:00 p.m. Informal Discussion and/or Recreation

7:30 - 10:00 p.m. THE STATUS OF WOMEN

Arleen D. Winfield, Social Science Analyst
Women's Bureau, U.S. Department of Labor

Helene S. Markoff, Director
Federal Women's Program, U.S. Civil Service Commission

Informal Discussion

Thursday, August 23

9:00 a.m. - Noon ROLE MODELS

Session Chair'n - Dr. Della Roy
Vice-Chair'n - Martha Beach

Dr. Della Roy, Associate Professor
Materials Research Science, Pennsylvania State University

Martha Beach, Vice President, Secretary-Treasurer
N-CON Systems Company, Inc.
and
Betty A. Rose, Senior Associate, Assistant to President
Gurnham Associates, Inc.

Naomi McAfee, Manager
Engineering, Quality and Reliability Assurance
Westinghouse Electric Corporation

Dr. Vera Pless, Research Associate
Defense and Electronics System Center
Massachusetts Institute of Technology

2:00 - 5:00 p.m. Information Discussion and/or Recreation

7:30 - 10:00 p.m. THE STATUS OF WOMEN

Michael Tuosto, Manager
Equal Opportunities Activities
New Jersey Public Service Electric and Gas Company

Anne Giedlinski, Advanced Systems Planning Engineer
Public Service Electric and Gas Company

Informal Discussion

Friday, August 24

9:00 a.m. - Noon CAREER GUIDANCE

Session Chair'n - Dr. John B. Parrish
Vice-Chair'n - Dr. J.E. Sabadell

Dr. John B. Parrish, Professor of Economics
University of Illinois

Dr. J.E. Sabadell, Professor of Chemical Engineering
Princeton University

Pauline Chapman, Director of Placement
University of Illinois

Josephine Hayslip, Educational Consultant
American Professional Guidance Association

Luncheon

Adjournment

Appendix B

ROSTER OF CONFERENCE ATTENDEES

Linda Aberle (Student)
University of Illinois
1295 Jackson Lane
Florissant, Missouri 63031

Kathryn Anner
Weidlinger Associates
110 East 59th Street
New York, New York 10025

Ms. A. Ashe
Association of Women in Science
South Casco, Maine 04077

Mrs. Martha Beach
Vice-President
N-CON Systems Company Inc.
308 Main Street
New Rochelle, New York 10801

John Beach, Jr. and Family
46 Intervale Place
Rye, New York 10580

Deborah Beard (Student)
Georgia Institute of Technology
Atlanta, Georgia

Bonnie Berger (Student)
University of Michigan
Ann Arbor, Michigan

Sandra K. Bidwell
Engineering Staff
General Motors Corporation
APE-No. Base
Warren, Michigan 48090

Judye Bom
Ohio State University
2070 Neil Avenue
Columbus, Ohio 43210

E.R. Brown, Jr.
Linde Division
Union Carbide Corporation
270 Park Avenue
New York, New York 10017

Barbara Buck
Linde Division
Union Carbide Corporation
Saw Mill River Road, Rte. 100
Tarrytown, New York 10591

Mrs. Pauline V. Chapman
Director of Placement
University of Illinois
109 Engineering Hall
Urbana, Illinois 61801

L.D. Chipman
Western Electric Company, Inc.
222 Broadway
New York, New York 10038

Mr. Christianson
Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, New York 10017

Prof. Yvonne Y. Clark
School of Engineering
Tennessee State University
Nashville, Tennessee 37208

Mrs. Nancy Conrad
University of Illinois - Chicago
Box 4348
Chicago, Illinois 60438

Roy Cowin
JETS
345 East 47th Street
New York, New York 10017

Diana E. Dede (Student)
University of North Dakota
1013 Perkins
Richland, Washington 99352

Sandra Anne Delvin (Student)
Society of Women Engineers,
Student Section
14 Riviera Drive
Latham, New York 12110

Dr. Mildred Dresselhaus
Assoc. Chair'n, Electrical
Engineering Department
Massachusetts Institute of Technology
77 Massachusetts Avenue (Room 4-207)
Cambridge, Massachusetts 02139

Bonnie Dunbar (Student)
American Ceramic Society
University of Washington
17625 Sixth N.W.
Seattle, Washington 98177

Joan F. Etzweiler (Student)
University of Wisconsin
130 N. Breese Terrace (Apt. 1)
Madison, Wisconsin 53705

Katherine T. Faber (Student)
Alfred University
189 Aurora Drive
Buffalo, New York 14215

Nancy D. Fitzroy
Research and Development Center
General Electric Company
P.O. Box 43
Schenectady, New York 12301

Prof. Joseph Frisch
College of Engineering
University of California
Berkeley, California 94720

Mrs. Donna Frohreich
Purdue University
West Lafayette, Indiana 47907

Sandra Gibson (Student)
Michigan Technological University
2236 Lycaste
Detroit, Michican 48214

Anne Giedlinski
Advanced Systems Planning
Engineer
Public Service Electric and Gas
Company
80 Park Place
Newark, New Jersey 07101

Mrs. Dolores Gooding (Student)
University of South Florida
1643 Leisure Drive
Clearwater, Florida 33516

Dr. Helen E. Grenga
Georgia Institute of Technology
Atlanta, Georgia 30332

Lt. Col. Arminta J. Harness
2513 Bayview Drive
Manhattan Beach, California 90266

Carolyn Sue Hauser (Student)
Carnegie-Mellon University
P.O. Box 395
Murrysville, Pennsylvania 15668

Mrs. Josephine Hayslip
American Professional Guidance
Association
64 North Main Street
Concord, New Hampshire 03301

Jaclyn Horsfall (Student)
University of Wisconsin
18 Lathrop Street
Madison, Wisconsin 53705

Noreen J. Irwin
Aerospace Systems Division
Bendix Corporation
8205 Rushton Road
South Lyon, Michigan 48178

Sally L. Jennings
Jefferson Chemical Company, Inc.
P.O. Box 847
Port Neches, Texas 77651

Margaret Johns (Student)
Columbia University
910 No. Riverside Drive
Indialantic, Florida 32903

Pamela Jorgensen (Student)
Massachusetts Institute of Technology
7 Myrtle Street
Boston, Massachusetts 02114

Deborah Kaminski (Student)
Research and Development Center
General Electric Company
P.O. Box 43
Schenectady, New York 12301

Diane M. Krasinski (Student)
Pennsylvania State University
1415 Harvard Avenue
Natrona Heights, Pennsylvania 15065

Karen L. Lafferty
Procter and Gamble Company
6000 Center Hill Road, PISOI
Cincinnati, Ohio 45224

Ellen Leing (Student)
Hunter College High School
21-10 33 Road (Apt. 5D)
Long Island City, New York 11106

Nancy J. Lingel (Student)
Wheaton College
16 Cottage Street
Medfield, Massachusetts 02052

Patricia J. Machmiller
Lockheed Missiles and Space Company
0/84-20
P.O. Box 504
Sunnyvale, California 94088

Judith H. Maddox
Savannah River Laboratory
E.I. du Pont de Nemours
and Company, Inc.
Aiken, South Carolina 29801

Helene Markoff
Director, Federal Women's Program
U.S. Civil Service Commission
1900 E Street
Washington, D.C. 20415

Dr. Alva Matthews
Weidlinger Associates
110 E. 59th Street
New York, New York 10025

Judith Mazria (Student)
Georgia Institute of Technology
Box 33389
Atlanta, Georgia

Mrs. Naomi McAfee
President, Society of Women Engineers
13 Seminole Avenue
Catonsville, Maryland 21228

Margaret Mitchell (Student)
University of Iowa
720 E. Market (Apt. 12)
Iowa City, Iowa 52240

Joan Moi (Student)
Hunter College High School
68-36 Harrow Street, Forest Hills
New York, New York 11375

Anita M. Montelione (Student)
Georgia Institute of Technology
905 Greenwood Avenue (Apt. 4)
Atlanta Georgia 30306

Dr. Edward E. Mueller and Wife
Alfred University
Alfred, New York 14802

Evelyn M. Murray-Lenthall
37 Blanchard Road
Cambridge, Massachusetts 02138

Carol Nemetz (Student)
Carnegie-Mellon University
13 Fairview Drive
E. Hanover, New Jersey 07936

Helen B. O'Bannon
Carnegie-Mellon University
Schenley Park
Pittsburgh, Pennsylvania 15213

Georgia K. Olsen (Student)
Texas A&M University
4311 Old College Road
Bryan, Texas 77801

Donna Ozern
Xerox Corporation
Building 147
Phillips Road
Webster, New York 14580

Prof. John B. Parrish
University of Illinois
1801 Pleasant Circle
Urbana, Illinois 61801

Prof. Irene C. Peden
Associate Dean
Department of Electrical Engineering
University of Washington
367 Loew Hall FH-10
Seattle, Washington 98195

Miss Carolyn F. Phillips
New York State Department of Labor
45 Parkside Drive
Suffern, New York 10901

Mrs. Carol Pierce
Chair'n, New Hampshire
Commission on Status of Women
Member of New Hampshire State
Legislature
Laconia, New Hampshire

Naomi Pless (Student)
38 Outlook Drive
Lexington, Massachusetts 02173

Dr. Vera Pless
Massachusetts Institute of Technology
545 Technology Square
Cambridge, Massachusetts 02139

Judith E. Priddy
Georgia Institute of Technology
Atlanta, Georgia 30332

Margaret Pritchard
2510 S.E. Concord Road
Portland, Oregon 97222

Diane Ragosa (Student)
Newark College of Engineering
13 Greenhill Road
Springfield, New Hampshire 07081

Nancy M. Redgate
New Castle County
2407 Limestone Road
Limestone Gardens
Wilmington, Delaware 19808

Carol Rosen
American Institute of Physics
335 East 45th Street
New York, New York 10017

Prof. Della M. Roy
Pennsylvania State University
217 Materials Research Laboratory
University Park, Pennsylvania 16802

Ellis Rubenstein
Institute of Electrical and Electronics
Engineers
345 East 47th Street
New York, New York 10017

Prof. J.E. Sabadell
Chemical Engineering Department A-325
Princeton University
Princeton New Jersey 08540

Patricia Scott (Student)
Princeton University
65 Peaceable Street
Ridgefield, Connecticut 06877

Mrs. Irene W. Sharpe
Bureau of Reclamation
U.S. Department of the Interior
P.O. Box 25007
Denver, Colorado 80225

Emanuel M. Sharpe, Jr.
2336 So. Zephyr Way
Lakewood, Colorado 80227

Frances N. Smith (Student)
Georgia Institute of Technology
Box 34488
Atlanta, Georgia 30332

Elizabeth J. Stephens
Telecommunications Engineer
424 Pelham Manor Road
Pelham Manor, New York 10803

Julie Stone (Student)
Hunter College High School
750 Kappock Street
Bronx, New York 10463

Paula J. Stone (Student)
Massachusetts Institute of Technology
550 Memorial Drive (Apt.)
Cambridge, Massachusetts 02139

Nancy Ann Sutake (Student)
Michigan State University
1720 E. Grand River (Apt. 16)
East Lansing, Michigan 48823

Linda Tevlin (Student)
University of Missouri - Rolla
7702 Circle Drive
St. Louis, Missouri 63121

Dr. Irene Tinker
Federation of Organizations
for Professional Women
4818 Drummond Avenue
Chevy Chase, Maryland 20015

Janice Tjebben (Student)
University of Minnesota
208 E. 26th Street
Minneapolis, Minnesota 55404

Michael R. Tuosto
Public Service Electric and Gas
Company
80 Park Place
Newark, New Jersey 07101

Carol Vines (Student)
Georgia Institute of Technology
Atlanta, Georgia

Tina Vogler (Student)
Newark College of Engineering
64 Park Place
Irvington, New Jersey 07111

Joanne Wieczorek (Student)
Rochester Institute of Technology
165 Lemoine Avenue
Cheektowago, New York 14227

Ms. Arleen D. Winfield
Women's Bureau
U.S. Department of Labor
Washington, D.C. 20201

Charmaine Wisniewski (Student)
University of Illinois
8120 Escanaba Avenue
Chicago, Illinois 60617

Barbara Wollmershauser (Student)
University of Iowa
1838 B Street
Iowa City, Iowa 52240

Dr. Clyde E. Work
Michigan Technological University
Houghton, Michigan 49931

Danuta K. Woroniecki (Student)
411 Thurston Avenue
Ithaca, New York 14850

Sandra Gay Yulke (Student)
Massachusetts Institute of Technology
111 Bay State Road
Boston, Massachusetts 02215