ENGINEERING AND THE FEMALE MIND

Why women will not become engineers

by Samuel C. Florman

THE CAMPUS OF Smith College in Northampton, Massachusetts, is one of the most pleasant places in the world to be on a sunny afternoon in spring. The setting is so lovely, the academic atmosphere so tranquil, that when I arrrived there on such an afternoon last April I was totally captivated. The spell of the place, however, made me uneasy about my mission, which was to convince a few of the students at this premier, all-female liberal arts college that they ought to become engineers.

The mission, as it turned out, was destined to fail. Most bright young women today do not want to become engineers. At first hearing this might not seem to be a matter of grave consequence, but since engineering is central to the functioning of our society, its rejection as a career option by female students raises the most profound questions about the objectives of the women's movement.

It is not generally recognized that at the same time when women are making their way into every corner of our work-world, only 1 percent of the professional engineers in the nation are female. A generation ago this statistic would have raised no eyebrows, but today it is hard to believe. The engineering schools, reacting to social and governmental pressures, have opened wide their gates and are recruiting women with zeal. The major corporations, reacting to even more intense pressures, are offering attractive employment opportunities to practically all women engineering graduates. According to the College Placement Council, engineering is the only field in which average starting salaries for women are higher than those for men. Tokenism is disappearing, according to the testimony of women engineers themselves. By every reasonable standard one would expect women to be attracted to the profession in large numbers. Yet only 5 percent of last year's 58,000 engineering degrees were awarded to women (compared to 18 percent in medicine, 22 percent in law, and 34 percent in the biological sciences). By 1980 the total may reach 10 percent, still a dismal figure when one realizes that more women than men are enrolled in American colleges. Unless this situation changes dramatically, and soon, the proportion of women engineers in practice, among more than a million males, will remain insignificant for many decades. While women are moving vigorously—assertively, demandingly—toward significant numerical representation in industry, the arts, and the other professions, they are, for reasons that are not at all clear, shying away from engineering.

At Smith I was scheduled to participate in

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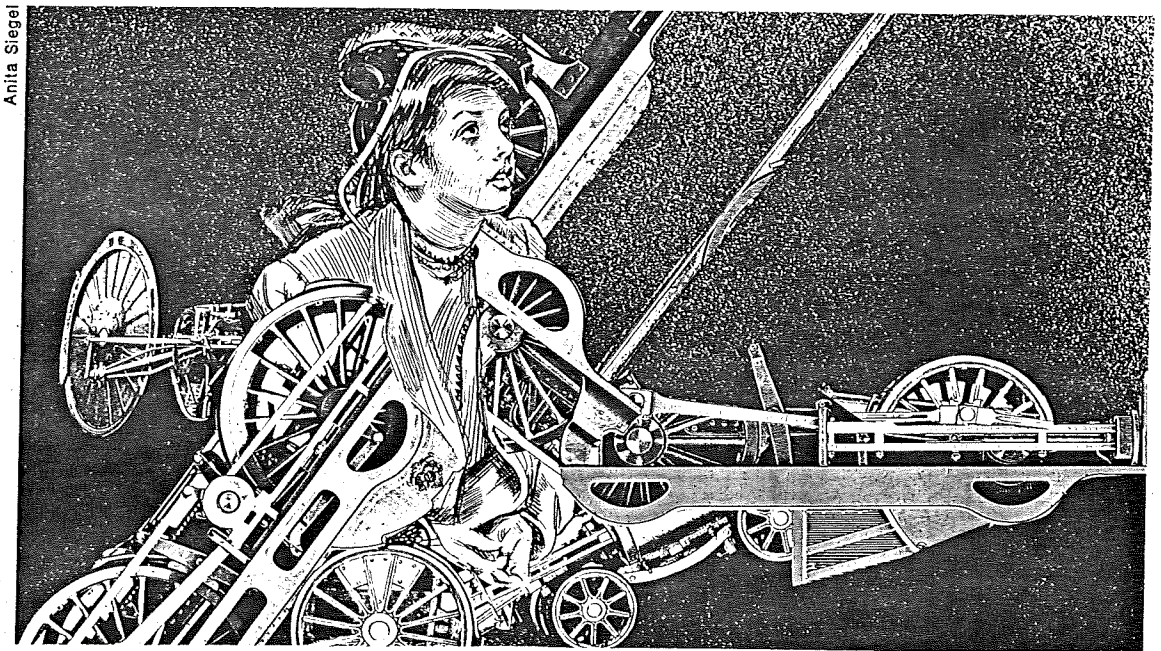

Samuel C. Florman

ENGINEERING AND THE FEMALE MIND

a seminar entitled "The Role of Technology in Modern Society." The program called for a "sherry hour" before dinner, during which the speakers had an opportunity to chat informally with the students. In a stately paneled room the late-afternoon light sparkled on crystal decanters as we sipped our sherry from tiny glasses. The students with whom I conversed were as elegant as the surroundings, so poised, so *ladylike;* I found myself thinking, "These girls are *not* going to become engineers. It's simply not their style." The young women were not vapid in the way of country gentry. Far from it. They were alert and sensible, well trained in mathematics and the sciences. I could imagine them donning white coats and conducting experiments in quiet laboratories. But I could not see them as engineers. It is a hopeless cause, I thought. They will not become engineers because it is "beneath" them to do so. It is a question of *class.*

This was an intuitive feeling of the moment, although the idea, in the abstract, had occurred to me before. It made sociological sense. Traditionally, most American engineers have come from working-class families. In the words of a post-Sputnik National Science Foundation Study, "engineering has a special appeal for bright boys of lower- and lower-middle-class origins." Girls from blue-collar families have been left behind in the women's crusade for equality in education. Therefore, the only young women who have the educational qualifications to become engineers are likely to come from the upper classes. But the upper classes do not esteem a career in engineering: ergo very few women engineers.

Much of our class consciousness we have inherited from England, and so it is with our attitude toward engineering, which the English have always considered rather a "navvy" occupation. Since engineering did not change from a craft to a profession until the mid-nineteenth century, and never shed completely its craftsman's image, it was fair game for the sneers of pretentious social arbiters. Herbert Hoover, a very successful mining engineer before he became President, and something of a scholar who translated Agricola from the Latin, enjoyed telling about an English lady whom he met during the course of an Atlantic crossing. When, near the end of the voyage, Hoover told her that he was an engineer, the lady exclaimed, "Why, I thought you were a gentleman!"

It may not be realistic to expect women to break down class barriers that were created mostly by men. Yet feminists, if they are serious in their avowed purposes, should by now have taken the lead in changing this situation, encouraging the elite among educated young women to reevaluate their social prejudices. For until upper-class aversion to engineering is overcome, or until lower-class women get out of the kitchen and into the university, engineering will remain a male profession. And while this condition prevails, the feminist movement will be stalled, probably without even knowing it. For, in a man-made world, how can women achieve the equality they seek?

MY VIEW, needless to say, is not shared by the feminists of America. Judging by their literature, they seem to attach no particular importance to increasing female enrollment in engineering, perhaps because they are more concerned about battering on closed doors than they are about walking through those that are open. When they do get around to considering the problem, it is not to question or criticize choices being made by women, but only to deplore the effect of external forces.

There is an entire literature devoted to explaining how engineering, and to a lesser degree science and mathematics, has developed a "male image." The terminology of this literature has been ringing in our ears for a long time—"sex role socialization," "undoing sex stereotypes," "self-fulfilling prophecy," and so forth. We know the facts by heart: girls learn early that it is not socially acceptable for them to play with trains and trucks. They learn from teachers that boys perform better than girls in math and science. A condition lately called "math anxiety" is attributed to these social pressures. As girls mature they are persuaded by counselors and family that it is not feminine to enter traditionally male professions. They are afraid to compete with men or to let their intelligence show, lest they seem sexually less desirable. Finally, there is a shortage of "role models" with whom a young girl can identify.

Yes, yes, yes, of course, but these facts, which seemed so interesting and important a decade ago, have become stale. As the sociologists busy themselves collating their data and getting it published, the times invariably pass them by. After all, it is now fifteen years since the publication of *The Feminine Mystique* and passage of the Equal Pay Act by Congress, fifteen years of turbulence during which a major social revolution has taken place. Educated young women know well enough that they can become engineers, just as they know all about orgasms and property rights. Surely the women who are planning to be biologists

Samuel C. Florman

ENGINEERING AND THE FEMALE MIND

and doctors know that they could choose engineering instead, and those who are crowding into the fields of law, business, and journalism know that they could have opted for engineering if they had been willing to take a little calculus and physics. Women's magazines that used to specialize in menus and sewing patterns are now overflowing with advice on how to compete in what used to be a man's world—how to dress, sit, talk, intimidate, and in general "make it." Engineering's purported male image is no longer an adequate explanation for female aversion to the profession.

It has been hypothesized that women avoid engineering because it has to do with technology, an aspect of our culture from which they recoil instinctively. Ruth Cowan, a historian at the State University of New York, has done interesting research on the influence of technology on the self-image of the American woman. The development of household appliances, for example, instead of freeing the housewife for a richer life as advertised, has helped to reduce her to the level of a maidservant whose greatest skill is consumerism. Changing factory technologies have attracted women to the workplace in roles that they have come to dislike. Innovations affecting the most intimate aspects of women's lives, such as the baby bottle and birth-control devices, have been developed almost exclusively by men. Dependent upon technology, but removed from its sources and, paradoxically, enslaved by it, women may well have developed deep-seated resentments that persist even in those who consider themselves liberated.

If this phenomenon does exist, however, we might expect that the feminists would respond to it as a challenge. The brightest and most ambitious women should be eager to bend technology, at long last, to their own will. Obviously this is not happening. The feminists seem content to write articles assuring each other that they have the talent to fix leaky faucets.

Another theory—one which arouses such rancor that I hesitate to bring it up—holds that women are not equipped biologically to excel in engineering. The intellectual factor most closely related to attainment in science is spatial ability, the ability to manipulate objects mentally. Experiments have shown that males are, on average, better at this than females, and that this superiority appears to be related to levels of sex chromosomes and testosterone.

It is a mistake, I think, to argue, as some feminists do, that there is no discernible difference between the male and female brain. It would be more sensible to say that because of substantial overlap in test scores, the differences that do exist are not practically significant when one considers a large group of potential engineers of both sexes. It would be better yet to point out that such differences as there are would serve to enrich the profession, since good engineering requires intuition and verbal imagination as well as mathematical adeptness and spatial ability. In their so-called weakness may be women's hidden strength.

This is considered to be a reactionary view, I learned to my sorrow when I proposed it to Zenith Gross, an executive at RCA whose special interest is the careers of professional women. In response to my remark, Ms. Gross said, "I know that you mean well, but to tell a woman engineer that she has female intuition is like telling a black that he has rhythm."

INEVITABLY IT OCCURRED to me that anyone wondering why women do not become engineers would be well advised to learn something about the few women who *do* become engineers. So I took myself one day to the Engineering Societies Building, a large stone-and-glass structure overlooking the East River near the United Nations in New York City. In this stately edifice are housed most of the major professional societies that represent American engineers. On the third floor, past the imposing offices of the Engineering Foundation and the Engineers Joint Council, there is a single room that serves as the home of the Society of Women Engineers.

The day of my visit, the society's executive secretary, Inez Van Vranken, was alone in the office. She moved about the room answering telephones and pulling papers out of files with enormous energy; energy is what Mrs. Van Vranken exudes, growth and vitality are her themes. The society, founded in 1950 by fifty women engineers, has grown in the past five years from just a few hundred to its present membership of 7,000, half of whom are college students. An organization that looks so pathetically small from the outside, seems about to explode within the confines of its tiny headquarters.

"Look at these inquiries," Mrs. Van Vranken said, pointing to a pile of letters. "The word is getting around. I wish I could answer all of these letters personally, but we're hard pressed to keep up with sending out printed material.

"But here's one I do plan to answer personally," she said, showing me a note from a Princeton freshman who objected to the society

Samuel C. Florman

ENGINEERING AND THE FEMALE MIND

sending out mail addressed "Miss" instead of "Ms." "I just won't have that sort of nonsense. We're too busy to play games."

I browsed through a pile of career-guidance pamphlets, newsletters full of recruiting ads from DuPont, Boeing, Ford, and IBM, and also a booklet telling about the society's Achievement Award, given annually since 1952. The winners of this award are talented women who have made contributions in many fields: solar energy, circuit analysis, metallurgy, missile launchers, rubber reclamation, computers, fluid mechanics, structural design, heat transfer, radio-wave propagation, and so on. Their undeniable ability adds poignancy to the fact that they and their fellow women engineers are so few that their overall contributions to the profession are in essence negligible.

In some of the society's literature I came upon a series of group photos taken at various conferences and luncheons. I do not know what I expected women engineers to look like, but these pictures struck me as slightly incongruous. The ladies in their print dresses looked rather like participants at a pie-baking contest in Dubuque, not at all like the elegantly dressed women I am used to seeing in business magazines. As for the student-chapter members, they appeared to be right out of Andy Hardy's high school yearbook, a different species from the girls I had seen at Smith.

Of course the girls at Smith do not study engineering. Neither do the girls at Harvard or Yale, which venerable institutions closed their professional schools of engineering years ago (although they still have some courses in engineering science), and neither of which deigned to respond to a recent statistical questionnaire from the Society of Women Engineers. Such growth as there is in engineering for women is occurring at places like Purdue, Texas A&M, Georgia Tech, and Ohio State. This middle-America predominance, and the photographs, served to reinforce my ideas about the class origins of the problem. It seemed apparent that these women engineers did not come from homes of wealth or high culture.

Wanting more information, I decided, before leaving the building, to pay a visit to Carl Frey, executive director of the Engineers Joint Council, that organization of organizations to which belong most of the major professional engineering societies. In his position at the top of the organizational pyramid, Frey has long lived with the many discontents and disputes endemic to the sprawling, variegated profession: four-year colleges versus five- and six-year programs (what constitutes a professional education?); state licensing (is an engineer a professional without it?); salaries (why do lawyers make so much more than engineers?); prestige (why do scientists get all the credit for engineering achievements?); leadership (why are there so few engineers in elective office?); conservatism of the self-employed versus radicalism of the hired hands; conscience, responsibility, the environmental crisis. Frey could not survive in his position without a genial disposition and a calm sense of history. From his point of view, women in engineering is just one more problem that the profession will cope with in due time.

"I wouldn't get hung up on any fancy theories about class," Frey said. "It's harder and harder to tell who comes from what class, and things are changing so fast that I wouldn't rely on any old statistics you might have seen about the social origins of engineers."

"Well, how do you explain it?" I asked. "Why aren't more bright young women getting into engineering?"

"I think that it has to do with their perception of power. These kids today—the bright girls particularly—they want to be where the action is, where the sources of power are. They don't see engineers as the ones who have the say in our society. And, let's face it, to a great extent they're right. We may have the know-how, but we don't have the power."

PERCEPTION OF POWER. The phrase kept going through my mind. It had a nice ring to it, and it had the ring of truth, as well. It did not seem to contradict my ideas about class so much as to encompass them; for what is the origin of class if not the desire to perpetuate power?

Every engineer knows that the profession is relatively impotent. Engineers do not make the laws; they do not have the money; they do not set the fashions; they have no voice in the media; they are not even adequately represented in the highest levels of corporate management. It is one of the most irritating ironies of our time that intellectuals, who apparently are too busy pontificating to look around, constantly complain about being in the grip of a technocratic elite that does not exist.

To the extent that today's young women are not fooled by such nonsense, they are deserving of credit. But if intelligent, energetic women reject engineering because of an all-consuming desire to sit on the thrones of power, then woe to us all in the age of feminism.

When the National Organization for Women was formed in 1966, its Statement of Purpose spoke of bringing women "into full participa-

tion in the mainstream of American society *now*, exercising all the privileges and responsibilities thereof in truly equal partnership with men." Yet judging from the way the most advantaged women are selecting their careers, they seem to be a lot more interested in the privileges than in the responsibilities. In this they are following the lead of those males who appear to be in control of our society—the lawyers, writers, politicians, and business managers. This is all very well, but somebody in our society has to design, create, fabricate, build—to *do*. A world full of coordinators, critics, and manipulators would have nothing in it but words. It would be a barren desert, totally devoid of *things*.

Feminist ideology, understandably adopting the values of the extant—i.e., male—Establishment, is founded on a misapprehension of what constitutes privilege. The feminist leaders have made the deplorable mistake of assuming that those who work hard without public recognition, and for modest rewards, are necessarily being exploited. "Man's happiness lies not in freedom but in his acceptance of a duty," André Gide said. When the duty turns out to be work that is creative and absorbing, as well as essential, then those who had been patronized for being the worker bees are seen to be more fortunate than the queen.

Studies have shown that young engineers, women as well as men, pursue their career because it promises "interesting work." This is more important to them than money, security, prestige, or any of the other trappings of power. They seem to recognize that a fulfilling career does not have to consist of a continuous ego trip.

Although power, in the popular imagination, is identified with wealth and domination, there is another kind of power that lies beneath the surface of our petty ambitions, and that is the engineer's in full measure. It is the force that Henry Adams had in mind when he wrote of the dynamo and the Virgin. The power of the Virgin raised the medieval cathedrals, although, as Adams noted, the Virgin had been dead for a millennium, and held no real power even when she lived. For better or for worse, technology lies at the heart of our contemporary culture, and the technologist is akin to a priest who knows the secrets of the temple. In this sense—and in this sense only—those who speak of a technocratic elite are touching on a profound truth. Until women share in the understanding and creation of our technology —which is to say, until large numbers of women become engineers—they will suffer from a cultural alienation that ordinary power cannot cure.

JUDGING FROM ALL current signs, women will not achieve active partnership in our society's technology for at least another generation. There is one statistic, however, that I find heartening. It seems that more than 40 percent of the women who are now becoming engineers started college with a different career in mind. (The comparable figure for males is less than 20 percent.) This indicates that the ranks of women in engineering may be swelled by a large number of belated conversions. I recently had a chance to talk to two young women who are representative of this potentially significant trend.

Jane Brechlin graduated in 1975 from Mount Holyoke, a women's liberal arts college every bit as pristine and alien to engineering as Smith. Having majored in mathematics, she found employment with the Westinghouse Company, working in probability and statistics. Only then did she discover, looking around, that engineers were engaged in tangible projects beside which her own work seemed "pale and abstract." She gave up her job and enrolled in the Thayer School of Engineering at Dartmouth College, where she is concentrating in the field of solar energy. She has a part-time job with a company that installs solar collectors, and plans to continue in that field after she receives her master's degree.

Her roommate at Dartmouth, Diane Knappert, graduated from Allegheny College as a chemist, only to discover that chemistry was "too theoretical" to satisfy her creative instincts. Embarked now on a career in chemical engineering, she has a grant from the National Science Foundation to study the conversion of wastepaper pulp and corn stalks into ethanol fuel.

The prospect of these young women working in the vanguard of the nation's effort to develop new energy sources is something I find exhilarating. In speaking about their careers they make no grandiloquent feminist pronouncements. They seem to be much more interested in the details of their projects than in the cause of women's liberation. They do more to serve the cause, in my estimation, than a hundred militants refighting battles that are already won.

The women's liberation movement means different things to different people. Many of its goals—such as mutual respect and equality before the law—can be achieved even if there are no women engineers. But the ultimate feminist dream will never be realized as long as women would rather supervise the world than help build it. □

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