Association for Women in Mathematics

Volume 17, Number 4 NEWSLETTER July-August 1987

PRESIDENT'S REPORT

In this issue of the *Newsletter*, you will find an interesting article by Neal Koblitz relating the achievements of young Indian women at a school in Madras. The positive atmosphere at the Valliammal School produces young women who are confident of their mathematical abilities and unselfconscious about expressing themselves mathematically. As a product of a mathematics department that treated women and men in pretty much the same way (and, as far as I know, still does) and has always had women on its faculty at all levels, I would like to see AWM play a role in drawing attention to those departments that are exemplary with respect to women and/or minorities. Much of our energy is directed towards negative examples, those institutions that seem unable to hire or promote women. Perhaps those institutions that do *not* have this problem could serve as models for those that do.

I therefore invite you to write to me about your department, or any other you feel is worthy of honorable mention in this *Newsletter*. Please be specific about those factors that contribute to your department's status: is there a particularly effective affirmative action program, an individual on the faculty who has encouraged many women or minority graduate students, or simply an egalitarian atmosphere that precludes an all white male faculty? I offer Neal's article as the first in this series. If selected, your letter or excerpts will appear in this *Newsletter*, anonymously if you wish. If there are no nominations, we shall continue with business as usual.

AWM Events at Salt Lake City. The AWM panel "The Relationship between Gender and Science" will be held on August 6th at 8:30 a.m. The panelists are Martha K. Smith, University of Texas, moderator; Mary Beth Ruskai, University of Lowell; and Patricia Kenschaft, Montclair State College. The focus of the discussion will be how mathematicians are responding to recent research and current theories on the relationship between gender and science; time will be reserved for audience response. The AWM Business Meeting will immediately follow the discussion at 9:30, and the AWM party will be that evening at 8:30 p.m. Please stop by the AWM table, and meet our new Executive Director, Lori Kenschaft. I look forward to seeing you in Salt Lake City.(Party to follow Snowbird Outing.)

Child care at Salt Lake City appears to be much more substantial than at San Antonio. There are several daycare centers near the University willing to accept children. Our investigative team (Barbara Faires, Westminster College) has made several calls, and the centers listed in the *Notices* and *Focus* are able to accommodate our children with two weeks notice. All serve lunch and allow parents to visit and stay with their children. Both the Taylor-Wright Center and Tutor Time Centers are convenient to the University. Ideally, we want a room set aside on the premises, and we are working for such an arrangement at the Atlanta meeting.

News Briefs. *Congratulations to Judith Sunley, who will assume the duties of Director of the Division of Mathematical Sciences at the National Science Foundation. Both John Polking, the present director, and Judy Sunley have appeared in AWM panels and have been very encouraging about various AWM projects. A profile of Judith Sunley appears in this *Newsletter*.

*Congratulations also to AWM Member-at-Large Lisa Goldberg, Brooklyn College, CUNY, who was recently awarded a Fellowship from the Sloan Foundation, and to Marina Ratner of the University of California, Berkeley, who is the recipient of a Guggenheim Fellowship for 1987-88.

*On April 10, I had the pleasure of attending the Women in Geometry conference organized by Lesley Sibner at the University of Pennsylvania. The event was supported by the NSF and attracted

more women mathematicians in one place than I've seen in some time. There were two excellent lectures by Karen Uhlenbeck and Joan Birman.

*Lenore Blum's article "Women in Mathematics: An International Perspective, Eight Years Later" appears in Vol. 9, #2 of the *Mathematical Intelligencer*, reprinted from this *Newsletter*. Having missed the International Congress for reasons of maternity and childbirth, I enjoyed the opportunity to read the details of that exciting meeting. I'm glad to see that the article will be reaching a wider audience.

*Finally, for those of you who have time to watch afternoon television, I strongly recommend Square One on public television. This mathematical program is thoroughly enjoyed by the seven- and eight- year olds I know. The entertainment level is high, but so is the mathematical content. Monday, the capable mathematician/detective is a woman, and females are portrayed in a non-sexist fashion.

Thank you for your messages, via electronic mail and otherwise. I enjoy the opportunity to communicate with you.

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AWM ELECTION

The Nominating Committee (Linda Rothschild, Chair; Cora Sadosky; and Bhama Srinivasan) announces the following slate of nominations. Jill Mesirov, a long-time member of AWM, has agreed to be a candidate for President. Jenny A. Baglivo of Boston College is a candidate for Treasurer. Carol Wood of Wesleyan University and Ruth Rebekka Struik of the University of Colorado at Boulder are candidates for Member-at-Large.

Candidates may also be nominated by petition. A petition bearing 20 signatures of current AWM members in support of the nomination may be sent to the President before September 1, 1987.

JUDITH SUNLEY APPOINTED NSF DIRECTOR

Judith Sunley has been appointed Director of the Division of Mathematical Sciences of the National Science Foundation. She will assume her new duties on July 1, 1987. The first woman to serve as Director for mathematical sciences, she will be one of four women out of between twenty-five and thirty Directors.

Her career at the NSF began in 1980, when she was a rotator for the Algebra and Number Theory program. In May 1984, she became Deputy Division Director of the Division of Mathematical Sciences. During that time, she served on a couple of AWM panels to give information on various NSF programs.

She has been Executive Secretary for the National Science Board Committee on Education and Human Resources for the past two years. The Board operates somewhat like a board of trustees for the NSF; the Committee is one of two major standing committees. One of the Committee's functions is to track programs for women and for minorities.

Sunley earned her B.S. and M.S. in mathematics from the University of Michigan in 1967 and 1968, respectively. She received her Ph.D. from the University of Maryland in 1971; her specialty was analytic number theory.

Her first position, held from 1971-1981, was in the Department of Mathematics, Statistics, and Computer Science at American University. She shared an office with Mary Gray for 6 or 7 years during the infancy of AWM. She worked in the Dean's Office for a period of time and served as Chair of her department from 1979-1980.

Congratulations again to Judith Sunley on her well-deserved appointment.

YOUNG WOMEN OF MADRAS STUDYING COMPUTER SCIENCE AND ENGINEERING

observations during a visit to India by Neil Koblitz

One day during my two-month visit (January-March 1987) to the Mathematical Sciences Research Institute in Madras, India, my friend and colleague P. Vanchinathan asked if I would be interested in visiting a high school which had recently introduced computers into the curriculum. He had taught in the experimental pilot project the year before, and he had maintained his ties with the school and especially with retired mathematics educator Professor S. K. Ekambaram, the guiding force behind the high school's innovative efforts in mathematics.

I was particularly intrigued because Vanchinathan had mentioned in passing that most of the computer students—and all of his best students—had been girls. Just a few months before, an article by my wife, Ann Hibner Koblitz, had appeared in the proceedings of a Tunisia conference on computers in math education in which she reported on U.S. studies that revealed that optional computer training programs for youngsters are heavily dominated by boys. Could it be that underdeveloped India was entering the computer age in a more egalitarian spirit than the U.S.?

The Valliammal School is one of the best in Madras. A private, English-medium school, it was founded by a prominent scholar of Tamilian language and literature, Professor Paramasivanandam. He—and the school—are in some ways socially conservative. The students are required to attend daily prayer services, and the girls wear school uniforms based on traditional Indian dress (rather than Western style, as in most high schools).

Moreover, at first the school's founder wanted to offer only traditional subjects—such as sewing and cooking—to the girls. But, influenced by a trip to America, by the more liberal opinions of his good friend Ekambaram, and by the fact that few of the girls wanted to sign up for sewing or cooking, he changed his mind, and now girls are encouraged to take science and math courses.

I visited the school twice. The first time, Professor Ekambaram, the young computer science teacher Ms. Mahewsari (about to receive her Master's degree in statistics from Madras University), and about two dozen students met with me for almost an hour and a half. Originally the plan had been to meet for only one 45-minute period. But the girls asked to be excused from their second-period class so they could continue our meeting.

They were not yet learning computer languages, but rather were studying basic high school and beginning college math topics which involved algorithms suitable for calculation on the school's three PC's. (In the second year of the computer course—their last year in high school—they were to be taught FORTRAN and BASIC.) I asked them a series of questions to gauge their preparation and interest. The exercises I gave them were based on what I knew they had already studied, but had a somewhat different slant. For example: divide HAPPY by SAD, using base-26 arithmetic with the letters as digits; describe an algorithm (in flowchart form) to find the intersection between a circle and a line in the plane; use the tangent-line approximation to find the error in saying that an $s \times s$ square has area s^2 if the measurement of s is accurate only to $\pm 1\%$.

The girls did well. Of the three questions mentioned above, they saw quickly how to do the first two. They had more difficulty with the third, because their calculus background was still rudimentary, and they had never had applications or word problems.

What impressed me even more than their actual answers was how eager and assertive the 16-18 year olds were. They wanted to show off their knowledge to the foreign professor and needed no prodding to volunteer. Then, after the mathematical discussions were over, they were equally outgoing when questioning me about school and college in America. The schoolgirls' way of relating to me, an older foreign guest, was much more informal and uninhibited than I would have expected—in fact, the Indian girls were more self-confident than most of my freshwomen students in the U.S.

The few boys who were present during the first period did not elect to skip their next class to remain with me. I had praised the class for having so many girls, and this apparently did not sit well with them. It was bad enough being dominated by a bunch of girls in math class, without having to listen to an American professor say that this is the way things ought to be!

I had come to India believing the usual stereotypes about the shy, self-effacing women one would find in a traditionalist society such as India. But, as I learned, the reality is much more complex. At least among the urban educated classes, a large proportion of the young women are rejecting the oppressive caste system, dowry system and patriarchal views of women's role. What I was seeing at the Valliammal School was a microcosm of this.

However, the aptitude and enthusiasm of the students did not necessarily mean that all mathematically oriented careers would be open to them. In the first place, I learned from Vanchinathan that some of his best female students from the pilot project were not continuing with math courses because their parents had placed them in the pre-medical sequence, which in India does not include mathematics.

In the second place, there is a tradition of few women in engineering. I encountered this firsthand not long after my visit to the Valliammal school, when I visited the Indian Institute of Technology, Madras campus. IIT-Madras is one of five branches of what is by far the best funded and most prestigious university in India. I visited in order to give an "Extramural Lecture" on the topic of science in Vietnam. My talk led to a wide-ranging discussion of many subjects, which continued through dinner and into the evening in one of the dormitories.

I was surprised to notice that very few of the students, and none of those who talked with me, were women. The students told me that there is only one female dormitory, but eleven male hostels. The proportion of women students is only about 10%. (On the positive side, they said that the number of women is increasing, and there are plans for expansion of the women's residence.)

Three days after my talk at IIT, I paid a second visit to the Valliammal school. The contrast between the two was stark indeed: overwhelmingly female computer science class at Valliammal, overwhelmingly male student body at IIT. Why the discrepancy? Could it be that for some reason almost all of the bright high school girls had no ambition to go to IIT?

I asked the girls in the computer class about this, and they replied that nearly all of them planned to apply to IIT and very much hoped to get in. However, a little later, during informal discussions after class, I learned about a distressing situation. It seems that admission to IIT is totally dependent upon one's score on the entrance examination. Many thousands receive a decisive extra boost in the competition by attending special preparatory courses which coach them in answering questions of the type on the exam. I further learned that these private courses, lasting several months, are expensive: one girl quoted the figure of Rs. 1750 ($\approx$ \$140), roughly a teacher's monthly salary in India. Most parents would consider making such an investment for a son but not for a daughter. None of the girls present thought that she would be enrolling in those preparatory courses.

In addition, the exam questions include nothing about computer programming or related topics. Thus, the two-year computer science sequence to which the girls were devoting intensive effort would help them hardly at all on the IIT entrance exam. I left with the feeling that these girls, no matter how bright, were probably headed for disappointment in their desire to attend IIT.

Since that time, I discussed my observations, especially the whole issue of IIT admissions, with several colleagues. I also wrote a letter to the editor of one of the main newspapers, in which I asked: "Is there any way the system of admission to IIT could be made less rigid, and less biased against the girls? Could the admissions process include consideration of letters from teachers and others familiar with the applicant's work? Could an applicant be given credit for special courses leading to technical skills not measured by the exam? for high-quality extracurricular projects? for independent work that shows creativity and ingenuity? Could applicants from under-represented groups (such as girls, the poor, etc.) be given special consideration because of the extra social and material obstacles they had to overcome to attain their present level of knowledge?... A country cannot realize its scientific and technological potential if it fails to fully develop and utilize the talents of half of its population." I left Madras a week later and do not know whether the letter was printed.

When I left India, it turned out that I had some rupees remaining from what the Math Institute had paid me—about \$180 worth. These could not be changed to dollars. So I did the obvious thing—I sent the money to the Valliammal school to use to give grants to selected girls for the private preparatory courses for the IIT entrances exams. In addition, I had been invited to write two long articles on Vietnam, based on travels there, for an Indian magazine—and so I asked them to send my payment for the articles as a donation to the school for the same purpose. In all, the money will be enough for grants for two girls each year for this year and next. (Soon after I returned from India, I received a letter from the school warmly thanking me for the donation and informing me who had been selected as the first two girls to take the preparatory courses.)

If readers of the AWM *Newsletter* would like to contribute to continuing these grants beyond the next school year, please send your check, payable to "Kovalevskaia Fund" and earmarked "Valliammal School," to me at: Dept. of Math. GN-50, Univ. of Washington, Seattle, WA 98195.

If you plan a visit to India, will receive a salary or stipend, and anticipate having left-over rupees which you would like to give to the Madras schoolgirls, please contact me for details on how to do that.

EWM: EUROPEAN WOMEN IN MATHEMATICS

The first meeting of European Women in Mathematics (EWM) was held on December 13-14, 1986 in Paris. Our program included mathematical talks, personal reports and general discussions. It was decided that we meet once a year, that each European country appoint a national coordinator, and that national organizations, which should discuss their own activities and structure, can be formed. For the coming year Gudrun Kalmbach is responsible for the correspondence and for general information. The next meeting organizer is Bodil Branner. We hope to arrange a weekend meeting in Copenhagen toward the end of 1987. On the program will be invited mathematical talks, discussions on women in mathematics, and the formation of a European organization EWM. Contact addresses are Dr. B. Branner, Mathem. Inst., Techn. Univ. of Denmark, Bldg. 303, DK-2800 LYNGBY, Denmark and Prof. G. Kalmbach, Abt. Math. III, O.E., Univ. Ulm, D-7900 ULM, W-Germany.

FEMINIST VIEWS ON MATHEMATICS[1]

by Roberta Mura, Université Laval, Quebec, Canada

During the past fifteen years the existence of possible sex-related differences or sexist biases in mathematics has been studied extensively: differences in participation, attitudes or achievement; differences in interactions in the classroom or in the mathematical community; sexism in schoolbooks; discrimination and sexual harassment; etc. Almost all of these studies touched only on the practice of mathematics without questioning the theory.

Recently Isabelle Lasvergnas hypothesized that "the absence of women in science is not only their physical absence in the academic ranks, but it is perhaps above all the epistemological eviction of a different reality, that of the feminine sphere."[2] The question I wish to examine in this paper is the following: are there any consequences in the *theory* of mathematics of the fact that it was constructed mainly by men working in patriarchal societies? Does mathematical discourse itself carry traces of the monosexual tradition in which it was developed?

In recent years, there has been a rich production of critiques of knowledge from a feminist perspective. These works have exposed the androcentric point of view adopted in the social sciences, in the humanities, in biology and in the health sciences.[3] Does it make sense to ask the same question also about disciplines such as mathematics which do not seem to be concerned with sex differences? Some researchers suggest that the question is relevant and propose lines of inquiry. In the following I will present in outline some of their ideas.

In her opening lecture at the conference on Women and Math held in Montreal in June 1986, *Leone Burton* contrasted two views of mathematics.[4] The first one emphasizes the product, that is, the knowledge discovered or to be discovered; it is characterized by objectivity, logic, rigor, abstraction, rationality, impersonality, axiomatics, formalism, lack of applications, exactitude, certainty, completeness, absolute truth, power and control. The second one describes mathematics more as a personal process of exploration and construction tied to the cultural environment and characterized by intuition, creativity, incompleteness, conjecture and relativism.

According to Burton, the first view has been abandoned by the mathematical community, but it continues to dominate pedagogy and popular fancy. The old view, she says, is more consistent with masculine values of power, control, hierarchy and authority, the appearance of rightness being essential for upholding power and authority.

Evelyn Fox Keller, to whom Burton referred, has studied masculine attributes of the experimental sciences for several years.[5] In particular, she has dwelt on sexual metaphors of knowledge and on the notion of objectivity. She recalls that Francis Bacon (1561-1626) describes the "New Science" as "a Chaste and lawful marriage between Mind and Nature, the purpose of which was to lead Nature to you with all her children and bind her to your service and make her your slave." Another striking metaphor is about "putting Nature on the rack and torturing the answers out of her." These values of domination and exploitation, indeed of violence, were therefore explicitly present from the beginnings of modern science.

As for objectivity, Keller remarks that, according to leading scientific ideology, it is contingent upon the division of the world into two parts: the knower/mind/subject (masculine) and the knowable/nature/object (feminine). "The relation specified between knower and known is one of distance and separation." Only under these conditions may the knower acquire scientific and objective knowledge.

Keller explains this association, which she rejects, between objectivity and separation by a psychoanalytic analysis of the process by which the child's sense of self is formed. The capacity for objectivity, for delineating subject from object, is a function of the child's capacity for distinguishing self from not-self. This development of self-identity, which includes gender identity, requires more separation, distance and independence from the mother for little boys than for little girls. Men would thus have projected their psychological experiences onto epistemology.

Keller also suggests that if there is a convergence of masculine and scientific attributes, it is perhaps not only because men built science, but also because after the event, scientific attributes were used to redefine masculinity, which, we must not forget, is a concept constructed quite as artificially as femininity or "scientificity."

It remains to be seen up to what point Keller's methods and ideas can be applied to mathematics.

Recently, several mathematics educators have paid attention to the work of *Carol Gilligan* on the psychology of moral judgment.[6] Gilligan identified two styles of reasoning, one characterized by separation, the other by connection; the second one, which is found more often in women, gives more importance to context and to the network of relationships among all persons involved.

Dorothy Buerk, among others, asserts that these two styles of reasoning are present also in mathematics.[7] Going back to the words of Gilligan, she describes the two types of reasoning as follows: "separate" reasoning reaches the solution in a structured and algorithmic way, by stripping away any context; it uses abstract and formal thought; it searches for an objectively just solution upon which all rational persons can agree; it is legalistic; it works out rules and fair procedures; it has confidence in its judgment. "Connected" reasoning on the other hand, tries to experience the problem by relating it to the personal world; it clarifies language, it creates context and removes ambiguity, it uses contextual and narrative thought, it looks for the limitations of any particular solution and describes the conflicts that remain, it has a flexible attitude towards rules and is more willing to make exceptions, it is reluctant to make judgments.

According to Buerk, the first style of reasoning predominates in the teaching of mathematics, whereas the second one corresponds to the process involved in the creation of mathematics. As in Burton's analysis, the most "masculine" traits would therefore belong to school mathematics rather than "true" mathematics.

Note that the much greater importance accorded to context by women has already been catalogued by psychologists under the term "field dependence." Dale Spender observed that one could reverse the negative connotation of this term by replacing it with "context awareness."[8]

Nancy Shelley, one of the founders of and the first coordinator of the International Organisation for Women and Mathematics Education, has also reflected on the relationships among women, culture and mathematics. For Shelley, the culture of the present day is characterized by militarism, violence and destruction of the environment; its values are those of the warrior.[9] These same values, she says, are an integral part of the sciences and of mathematics. In fact, "mathematics enjoys a very high status," and "by far the greatest number of mathematicians are engaged in military research and development." Mathematical thinking supports the hierarchical structures of equality-claiming societies. It is a source of pride that mathematics is "ordered, consistent, logical, objective; culture-free, neutral, value-free." One "relish[es the] speed, sequencing, routine and predictability." A movement exists, it is true, which seeks to abandon the image of immutable mathematics, but it remains a small minority.

Shelley suggests that, in particular, the primacy accorded to logic in mathematics has "affected our concept of truth, the methods of learning we employ, our notions of intelligence, our defenses of objectivity, many of our attitudes within society, particularly those relating to power, and our obsession with prediction." Logical arguments, again according to Shelley, who quotes the philosopher Hannah Arendt, are "rigid and coercive;" they aim to "silence opinion and impose uniformity."

In contrast, women, because of the limits imposed on their life experiences, developed a feminine culture, based on cooperation and on community, quite isolated from the culture which has

grown around mathematics. All over the world today, women are victims of violence, oppression and exploitation, their values pushed to the side and scorned. The picture painted by Shelley shows a fundamental contradiction between feminine values and the militaristic values underlying mathematics and science, as well as the dominant culture.[10]

Isabelle Lasvergnas and *Minh Nguyen Thanh* suggest the possibility of a psychoanalytic approach where science is interpreted as a metaphor for the body.[11] Nguyen Thanh sees, for example, in certain mathematical concepts (e.g., the algebraically closed field [the French word for "field" also means "body"]) the rejection of castration, in others (e.g., the concept of infinity) the negation of death. According to her, mathematics constitutes a perfectly successful defense against instinctual impulses. Proceeding in this way, the question arises whether mathematics functions as a defense against instinctual impulses as perfectly for women as for men, or if a woman would not be more vulnerable to anxiety and to an uncanny feeling created by finding herself in a body, as metaphorical as it is, of the wrong sex.

Brigitte Sénéchal alludes to the same sort of ideas when after having evoked the image of mathematics as pleasure, she asks: "How can the girl, for whom pleasure is taboo, have a forbidden thought, she who has from infancy been diverted from herself for the sake of others?".[12]

In France, an interdisciplinary seminar, *Séminaire Limites–frontières*, has been organized around an interest in the manifestation of sexist ideology and of subjectivity in scientific theories.[13]

In attempting to identify the marks of social relations, or subjectivity, within a text, one soon finds out that the formalism of mathematical texts poses an additional difficulty. The Seminar has consequently paid special attention to the question of formalism and has already devoted two publications to it.[14]

If formalism constitutes a serious obstacle to feminist criticism, it is however only one stage of mathematical practice. *Christiane Frougny* and *Jeanne Peiffer*, members of the Seminar, have also studied other mathematical subjects: the Pythagorean table of opposites, the concept of limit and the deductive proof.[15]

Deductive proof, for example—as Peiffer points out—had its origin in the eloquence contests in which Greek citizens confronted each other, challenged each other, tried to break down the adversary's defenses, to drive him into extreme positions, to have a hold over him. The deductive form of mathematics has been forged in the context of competition, of challenge and the verbal combat of the agora, that is, in a place to which women did not have access.

The Pythagorean opposites illustrate the influence that ideological elements can exert on the development of mathematics. Frougny and Peiffer recall the table of these opposites, according to Aristotle: definite–indefinite, bounded–unbounded, odd–even, one–many, right–left, male–female, rest–motion, straight–curved, light–darkness, good–evil, square–oblong. They note that this table "associates with the female all that which is excluded from Greek mathematics: motion, the infinite, the curve that is continually brought back to the straight." In fact the influence of this table could well extend beyond the classical era. The history of the concept of limit, according to the same authors, suggests that "official mathematics has continually shunned the vague, the indefinite, motion, multiplicity, all of which are situated on the same side, which is also the female side, to the benefit of the definite, the stable, the unique, which accompany the male."

Finally, I will quote some of the ideas of *Ursula Martius Franklin*,[16] professor of metallurgy and materials science, on the subject of technology, which she defines as "the totality of operational knowledge, the practices, procedures and devices used to accomplish certain tasks in society."

In comparing the values and attributes of the world of women with those of the technological order—which she sees as the heir of the traditional power structure which is hierarchical and masculine—she observes that in the latter the "tasks are fragmented, specified and prescribed, [...] predictable, non-random, fully scheduled and carried out without reference to context." On the other hand, "tasks in the women's world arise in contexts and out of specific needs [...] More often than not, [they are] flexible, unpredictable, non-specific and integrated. They are unschedulable, and there is a high degree of randomness both in the reality and in the expectations.

"The technological order, narrowly specialized, offers little scope for improvision. The strict categorization of tasks and procedures, as well as the interchangeability of people and devices, leaves no room for spontaneity. The functioning of the technological order depends on the integration of

hierarchical structures of increasing complexity. Planning and scheduling are absolutely essential. Authority is derived from access to and control of the various levels and interfaces of the structure.

"The women's world, on the other hand, is to a large measure unplannable. It is horizontally structured and full of the unexpected, the 'who would have thought.' Diversity of skills is valued, as are personal loyalty and a sense of continuity. The world of women puts great stock in experience; experience is seen to be transferable to new, unforeseen or unforeseeable tasks. Inventiveness, spontaneity and improvisation are highly valued too.

"On the other hand, the technological system stresses efficiency [regardless of what is being done efficiently]; it demands innovation and constant change. It has little use for experience and particularly for unrelated experience. The technological order is an environment that emphasizes personal achievement and quantifies it like machine output. Loyalty and continuity are usually incompatible with the constant push for innovation."

Franklin contrasts "this notion of productivity—churning something out at the lowest cost whether anyone needs that something or not—with the idea of 'copeability', the ability to deal and cope adequately with a variety of circumstances, [a quality much] valued and respected in the women's world."

Finally, concludes Franklin, "the technological order is geared to maximizing gain, [while] the strategies of the women's world are more often than not aimed at minimizing disaster." The contradictions which she displays between the two systems are striking.

It seems to me that the majority of the preceding ideas are easily applicable to mathematics, especially to operations research.

I want to close with some warnings. The enterprise of searching for and exposing the androcentrism of mathematics, however fascinating an intellectual adventure it may be, risks bringing women back to the area of "ascientificity" right at the time when we are intensifying our efforts to leave it. Raising the hypothesis of a possible contradiction between feminine culture and logic, abstraction, power, objectivity or effectiveness, leaves us vulnerable to attacks by those who would like to enclose us anew—if we ever left—in the the stereotype of woman as irrational, powerless, ineffective, subjective, incapable of a thought which rises above practical and daily contingencies. Of course it is not *all* logic or objectivity which we want to dispute, but rather a certain kind of logic and objectivity, as well as the use made of it (though this is not always so clear among certain more "radical" thinkers); however, the distinction is sometimes subtle, and I feel we advance onto dangerous terrain.

This worry, which is not new, was recently expressed by Mary Beth Ruskai in a long letter to the Association for Women in Mathematics *Newsletter*.[17] Ruskai regrets that the movement for a feminist critique of science does not include women actively engaged in science and does not represent their point of view. She questions the feminism of certain statements and cites several cases where, according to her, false and stereotypical conceptions on the subject of science as well as on the subject of women have been spread. She objects, for example, to the assertions that women have more intuition than men and that intuition and logic are opposites. She sees in this type of assertion a return to prejudiced views on the irrationality of women and a disregard for the fundamental creative nature of science, where there is no conflict between logic and intuition.

I agree with her that it is very desirable for women mathematicians and women active in science to involve themselves in the task of critiquing their discipline. It is also essential to be extremely vigilant so that this work does not harm the progress of women in science.

We must keep constantly in mind and recall explicitly in our talks as in our writings that the concepts of masculinity, femininity and "scientificity" are social constructs which are constantly evolving. The attributes called feminine are only the product of women's experience, or even the artifact of ideology, and in no case do they apply to the entirety of people of the female sex. Ruskai is not the only one to reject a supposed female connotation of intuition. The French mathematician Brigitte Sénéchal, having identified power, logic–rigor, and creation–imagination as three images permeating mathematics, observes that *all* of these areas have masculine images, which makes it difficult for women to take their place in the three areas at the same time.[18] She notes that among women mathematicians, frequently the students—rejecting the opposition woman–math —assimilate the logic–rigor aspect and make a success of it, but then develop a denial of the creative side.

Like Ruskai, the historian of science *Ann Hibner Koblitz* has also severely criticized certain works on gender and science, such as those of Evelyn Fox Keller, that she believes to be weak from a

scientific point of view and dangerous from a political point of view, since "the whole thrust of these writings is to warn women away from science."[19]

The uneasiness among women mathematicians is witnessed by the remarks of Carol Wood, candidate for office in the American Mathematical Society, who, asked to make a statement by the Association for Women in Mathematics, said that one of her special concerns is "the virtually universal misunderstanding of the nature of mathematical activity, perhaps most alarmingly when it comes from some of our feminist colleagues in the social sciences."[20]

Beyond some possible misunderstandings on either side, I believe that we can see here the reflection of the debate on "otherness" that has always been at the heart of the feminist movement.

The project of considering mathematics from a feminist perspective leads us to reconsider feminism (from a mathematical perspective?) and forces us to clarify and make explicit our theoretical presuppositions, for the concepts at issue, at the crossroads of the imaginary and of social reality, are loaded with all the ambiguity which has made them into the historical traps we know so well.

Notes

1. This is a revised version of an article published simultaneously in *Resources for Feminist Research, 15:3*, 1986, pp. 59-61, and in L. Lafortune (Ed.), *Femmes et mathématique*, pp. 201-215, Les éditions du remue-ménage, Montréal, 1986. Support by the Canadian Research Institute for the Advancement of Women is gratefully acknowledged. I wish to thank Amy Leggett and Professor Anne Leggett for translating this paper into English.

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10. In a letter she wrote me in response to this article, Shelley made several points that I would summarize as follows.
    - The casting of intuition and logic as opposites is destructive and historically recent.
    - The creative/intuitive nature of mathematics is very clear in its history, but in practice, with few exceptions, it is found only among some very privileged researchers.
    - Women may want to reclaim attributes such as abstraction, objectivity, logic, efficiency and power, but we must keep in mind (a) that their development parallels and underpins patriarchy's development towards annihilation and (b) that they are not fixed (and neither are creativity or mathematics).
    - The most crucial issue is the examination of power and of mathematics' link with it. Power today means destruction; we must invent and bring about a different kind of power.
    - Women have the potential to operate in an alternative "power" culture, not because of biology, but because we are less compromised by the present power structure.

- Any mathematics arising from such a culture would be truly creative.

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Ed. note: thanks to Mary Beth Ruskai for bringing this article to our attention.

SCIENCE CAREERS IN SEARCH OF WOMEN: ARGONNE NATIONAL LABORATORY

by Louise A. Raphael, National Science Foundation, Washington, DC 20550

On April 9th and 10th, 1987, the University of Chicago and Argonne National Laboratory sponsored a conference called "Science Careers in Search of Women." The objective was to encourage women to pursue graduate studies and careers in science. Approximately 200 junior and senior undergraduate women who are majoring in mathematics, science or engineering attended. They represented ninety colleges ranging from the Ivy League schools to the small liberal arts colleges. The students' mean grade point average was 3.85.

The organizers of the conference, assisted by the Affirmative Action Program, were women research chemists, physicists, computer scientists, biologists, and engineers. The speakers and panelists (of which I was one) were research scientists, engineers, and mathematicians from industrial or government labs, universities, and government agencies. Also, a postdoc and a graduate student participated on the panel. The speakers included Judy Bostock, an MIT physicist, who is on loan to OMB (Office of Management and Budget) and two research chemists—a mother and daughter—Isabella Karle of NRL (Naval Research Laboratory) and Louise Karle Hanson of BNL (Brookhaven National Laboratory).

I spoke about NSF programs (graduate fellowships, REU [Research Experiences for Undergraduates], ROW [Research Opportunities for Women], SEE [Science and Engineering Education]), admission processes to graduate schools, how to interact with research mathematicians, and how to reenter research after an interruption.

From the reactions of the women science undergraduate participants this was an upbeat, motivating and helpful conference. I hope this is the first of many such conferences.

ACTIVITY REPORTS FROM NSF

The National Science Foundation's Division of Materials Development, Research and Informal Science Education has published four reports describing awards made between 1984 and 1986 and totaling approximately $88 million for the support of more than 220 science education projects.

The booklets summarize activities in both formal and informal science and mathematics education covering all scientific disciplines and carried out by a variety of academic institutions, museums, and other organizations. Each report covers the major initiatives of the Division in the following areas: development of instructional materials for kindergarten through grade 12 classrooms; research in how students learn and on effective teaching strategies; exploration of the potential of new technologies for classroom use; and creation of programs that reach a broad audience outside of the classroom through museums, radio and television media, and community-based learning activities.

All programs are designed to stimulate the excitement and joy of discovery and the active involvement of participants—whether inside or outside the classroom. Another important thrust of the programs is to extend opportunities in science and mathematics to all the nation's youth, with special emphasis on programs aimed at girls, minorities, and the handicapped.

Copies of the reports may be obtained by sending a gummed, self-addressed label to: NSF, Division of Materials Development, Research and Informal Science Education, Room 420, Washington, DC 20550. For additional information, contact the Division office at (202) 357-7076.

STAR WARS: PENTAGON INVADES ACADEMIA

by William Hartung and Rosy Nimroody

Two years and $1.7 billion after President Reagan's "Star Wars" speech, enthusiasm for the Strategic Defense Initiative (SDI) research effort is at an all time high among the nation's defense contractors. Over 300 major firms have bid on SDI research contracts. And every one of the Pentagon's top 10 contractors now has one or more major SDI projects under way. As one DoD official put it, "They've adopted the attitude that this is their future. That it's life or death." Now the Pentagon is turning its attention to university researchers. Its objective is to convince them that their future also depends on participating in "Star Wars" research.

Universities are Targeted

The rush to involve prominent universities in SDI raises serious questions about the future conduct of scientific research in the United States. Will university involvement in SDI be used to legitimize the program independently of future research findings? Will Pentagon research funding, led by SDI, "crowd out" federal support for civilian basic research programs? How will SDI security restrictions affect the free flow of information that has long been a major strength of US research universities?

In the fall of 1984 the Strategic Defense Initiative Organization set up an office of Innovative Science and Technology (IST). Its mission, according to James A. Ionson, the program's director, is to "pursue...highly innovative, high-risk concepts that could have a revolutionary impact on the Strategic

Defense Initiative." Although the office will not limit its awards to university-based scientists and engineers, Ionson hopes to "tap the reservoir of brilliant minds in the academic community and promote university involvement in the SDI program."

DoD Presence Growing on Campus

The push to involve university research personnel in SDI is only the latest and most dramatic example of a growing Pentagon presence at the nation's universities. Since 1980, Department of Defense funding for university research has jumped from $495 million to $930 million, an *89 percent* increase. The next fastest growing source of federal support for university research was the National Science Foundation—funding for campus-based research from NSF grew by 51 percent over the same period. If DoD funding to off-campus affiliates like MIT's Lincoln Laboratories is taken into account, the Pentagon is now outspending NSF on university research. Campus funding from other major federal agencies—including the Departments of Agriculture, Energy, and Health and Human Services—has grown less than half as fast as DoD support since 1980. Today, DoD research accounts for 16 percent of all federal spending for university research, up from 10 percent in 1980. United States' universities are now as strongly dependent on the DoD for research funding as they were in 1968, at the height of the Vietnam War.

This growing dependence on Pentagon support is particularly extreme in certain key fields. In fiscal year 1985, more than 30 percent of all federal funding for university oceanography research is from DoD, as is more than *one half* of federally funded university work in mathematics and computer sciences. All forms of engineering research at universities now receive more than 37 percent of their federal support from the Pentagon. And the specialties of astronautical engineering (82%), electrical engineering (56%), aeronautical engineering (54%) and metallurgy and materials engineering (48%) lean most heavily on the DoD (See Table I).

The SDI Organization's (SDIO) new innovative science and technology program will accelerate this trend of university dependence on military contracts. While the FY 1985 allocation for SDI innovative programs is only $28 million, this budget is scheduled for a fourfold increase to $100 million in FY 1986. Much of this new money will go to university researchers.

Since the innovative science and technology program is slated to receive five percent of all SDI funding in each of the next five years, it could be a $300 million program by 1988. Robert L. Park, executive director of the Washington Office of the American Physical Society, told the *Chronicle of Higher Education* that researchers in some fields, like plasma physics, may see SDI funding as the only alternative for keeping their research projects alive. "Obviously there are some scientists who are going to apply," says Park. "This is a tight time for a lot of fields." James Duderstadt, Dean of the College of Engineering at the University of Michigan, expressed a similar view after attending a Pentagon briefing on SDI: "I was very impressed. This will be one of the few sources of new money for basic research in the physical sciences in coming years."

Topics the SDIO would like university researchers to investigate are wide ranging. Major areas of interest include ultra-high-speed computing, new space-based power sources, novel laser concepts, new types of optical sensors, microelectronic devices that can operate "in the hostile space environment for extended periods of time", and various studies of "how the natural atmospheric environment might affect the performance of strategic defense surveillance sensors and directed energy weapons." Researchers whose projects don't fit into any of these "research thrust" areas are encouraged by SDI to apply to the individual research grant division of its innovative science office. This division is "mandated to provide fast reaction funding for...research programs that represent totally new or revolutionary ideas that don't easily conform to existing consortia or concepts programs."

The combination of a rapidly growing budget and technical challenges spanning a number of disciplines has already sparked heavy interest in the innovative science program. David Parnas, a computer software expert from the University of Victoria, British Columbia who resigned from SDI's expert panel on "Computing in Support of Battle Management" in June of 1985, argues that many scientists who do not believe an effective strategic defense system is technically feasible are applying for funding anyway. "During the first sittings of our panel, I could see the dollar figures dazzling everyone involved. Almost everyone that I know within the military industrial complex sees SDI as a new 'pot of gold' just waiting to be tapped," argues Parnas. "For others, the project offers an unending set of technological puzzles that are fun to work on. Several of the speakers at the first meeting of our panel could not hide their delight at the unbounded set of technical challenges implicit in the unattainable goals of the project."

TABLE I: THE PENTAGON'S SHARE OF FEDERAL FUNDING FOR UNIVERSITY RESEARCH BY MAJOR FIELD OF SCIENCE, FY 1985 (dollars in thousands)

Field of Science	Total Federal Funding	DoD Funding	DoD Share of Total Federal Funding to the Field
Mathematics/ Computer Sciences	232,065	117,427	50.6 %
Mathematics	96,059	33,605	35.0
Computer Sciences	93,453	43,136	46.2
Math & computer sciences not elsewhere classified	42,553	40,686	95.6
Engineering	510,435	193,930	38.0 %
Aeronautical	47,372	25,424	53.7
Astronautical	17,458	14,384	81.0
Chemical	32,693	1,667	5.1
Civil	43,870	4,457	10.2
Electrical	113,810	64,731	56.9
Mechanical	60,101	26,465	44.0
Metallurgy & Materials	115,207	55,237	47.9
Other Engineering	79,624	1,565	2.0
Environmental Sciences	361,092	80,620	22.3 %
Atmospheric	98,427	16,054	16.3
Geological	94,408	14,572	15.4
Oceanography	158,540	49,427	31.2
Psychology	125,509	24,951	19.9 %
Physical Sciences	747,999	88,412	11.8 %
Astronomy	68,338	4,830	7.1
Chemistry	250,532	37,090	14.8
Physics	414,652	43,084	10.4
Other Physical Sciences	14,477	3,408	23.5
Life Sciences	2,873,779	64,423	2.2 %
Social Sciences	128,408	79	.06%

Source: National Science Foundation, Federal Obligations for Research to Universities and Colleges by Agency and Detailed Field of Science: Fiscal Years 1973-1985

Contracting Techniques are "Innovative"

The SDIO's aggressive effort to involve universities in "Star Wars" work officially began with the first annual "SDIO/IST Technical Review for Universities" held on March 29, 1985 on the outskirts of Washington, D.C. The meeting, attracting more than 240 scientists and engineers from 124 colleges and universities, was designed to familiarize university research personnel with the major "Star Wars" "research thrusts." University participants were duly impressed upon hearing the

innovative science program's research shopping list. "SDI seems to want just about everything under the sun," said Richard G. Griskey, Dean of Engineering at the University of Alabama at Huntsville.

While SDIO's determined pursuit of academic researchers has yielded results, it has also sparked criticism. A remark by IST director Ionson has led some university officials to wonder whether all the rush is tied to a political timeline. Asked why IST was soliciting proposals for FY 1986 funding so far in advance of congressional budgetary decisions, Ionson told *Science* magazine, "It's probably something that's never been done, but this office is trying to sell something to Congress. If we can say that this fellow at MIT will get money to do such and such research, it's something real to sell. That in itself is innovative."

Ionson has streamlined the contracting process to encourage as many researchers as possible to apply for SDI funding. Each participant at the March briefing was encouraged to submit a "white paper"—an informal pre-proposal "not to exceed ten pages of technical content." SDIO justifies this procedure as a labor-saving device: "Researchers are initially spared the laborious task of preparing a formal proposal requiring corporate or university approval since no budgetary details, lengthy résumés, or grandiose program definition need to be included."

Whatever its rationale, this new method has been successful in attracting proposals. Less than six months after the March meeting, SDI spokesperson Lt. Col. Lee DeLorme told the *New York Times*, "We are presently considering over 2600 applications from individuals and universities."

SDI's plan for letting university contracts calls for the whole application cycle—from white paper to contract award—to be completed in just nine months. University researchers were informed by the innovative science program office that "most of the research contracts" for FY 1986 "are anticipated to be let by January 1, 1986." By soliciting proposals before Congress has appropriated FY 1986 funds, and by aiming to spend all of its allocations within the first three months of that fiscal year, Mr. Ionson's office has sent out a strong signal to university researchers: the SDI innovative science program can produce research funds quickly, but only if they apply *now*.

In fact, the IST office has already committed $62 million in long-term contracts to support six research consortia including 29 universities in 16 states. These academic-industrial teams have been set up under the IST's Research Thrust Division to "address specific science and technology areas that are known to be of critical importance to the success of SDI." The consortia named to date will investigate the following areas:

- *Non-nuclear space power:* a $19 million four-year program involving Auburn, the State University of New York at Buffalo, Polytechnic Institute of New York, Texas Tech, and the University of Texas at Arlington.

- *Optical computing:* a $9 million three-year consortium consisting of Carnegie-Mellon, Caltech, Georgia Tech, Stanford University, MIT's Lincoln Labs, the University of Alabama at Huntsville, and the US Naval Ocean Systems Center.

- *Electronic circuits for computing, sensing, power generation, and directed-energy beams:* a $4 million three-year program involving the University of California at Berkeley, Stanford, Purdue, the University of Florida at Gainesville, and the University of Southern California.

- *High-speed electronic systems, new dielectric materials for storing power for directed-energy and kinetic-energy systems, and advance power sources for lasers and particle beams:* a $2.5 million three-year program undertaken by SUNY at Buffalo, the Naval Research Laboratory, and General Electric.

- *Composite materials development:* a $15 million three-year program involving researchers at MIT, Pennsylvania State, Colorado School of Mines, Johns Hopkins, Texas A&M, Brown, Rensselaer Polytechnic Institute, and the Naval Research Lab. They are to team up with such firms as United Technologies, Martin Marietta, Fiber Materials, Aeronautical Research Corp. of Princeton, and Ultrasystems Inc.

- *Chemical-laser exhaust problems, spacecraft radiation, electromagnetic waves, and particle beams:* a $12.5 million three-year program involving investigators at Johns Hopkins's Applied Research Lab, the Universities of Arizona, Maryland, Michigan, Iowa, Kansas, and California at

Berkeley, Utah State, UCLA, MIT, Stanford, NYU, the Naval Research Lab, and Air Force Geophysics Lab.

Other long-term research consortia to investigate nuclear space-power, propellants, and ultra-shortwave lasers are expected to be announced shortly. For some universities that have warmed up to SDI as a source of badly needed research funds, the partnership has already proved enriching. As Table II demonstrates, 31 universities received over $84 million in SDI research funds for FY 1985 alone from the IST office and other divisions.

Although SDI funds are rapidly pouring into university research departments, the methods used by the SDIO and the goals of the "Star Wars" program have stirred a level of controversy at the nation's campuses not seen since the anti-Vietnam war protests.

A Threat to Academic Freedom?

Fear that the secrecy surrounding the program will clamp down on academic freedom to publish and disseminate research findings has dampened the interest of some university scientists and administrators. Most major research universities nationwide have maintained policies from the Vietnam war era prohibiting classified research on campuses. And many wonder whether a politically sensitive program such as SDI will ultimately classify research on campus.

TABLE II: TOP UNIVERSITY SDI CONTRACTORS, FY 1985

University	$ Value FY '85
MIT*	$ 59,696,000
University of Texas	5,672,036
Georgia Tech Research Company*	4,586,000
Johns Hopkins University	2,894,000
Stanford Research Institute	2,655,000
Utah State University	2,420,000
Auburn University	973,000
California State University	866,000
Penn State University	540,000
Texas Tech University	500,000
New York Polytechnic	400,000
Small Business High Tech Institute	400,000
California Institute of Technology	300,000
Princeton University	280,000
University of Alabama	273,000
University of Washington	270,000
University of California	227,000
University of Arizona	206,000
University of S. Florida	200,000
State University of New York	150,000
Carnegie-Mellon University	130,000
Kent State University	100,000
Polytechnic Institute of New York	85,000
University of New Mexico	80,000
University of Dayton	67,000
University of Kansas	50,000
University of Illinois	40,000
New York Institute of Technology	35,000
Boston College	27,000
University of Denver	23,000
SE Ctr. Electrical Engineering Education	15,000
TOTAL	$84,150,036

** Figures for MIT and Georgia Tech include awards let to affiliated off-campus research institutes.*

Sources: Preliminary FY 1985 estimates from the Federation of American Scientists and data from the Strategic Defense Initiative Organization.

Publicly, IS&T director Ionson has stated "any work for SDI performed on a university campus will not be classified and therefore not subject to any control or restrictive clauses or security classifications... You do not stimulate innovation behind closed doors." But in an official memo he issued last August to set the record straight on "Star Wars" publications, Ionson qualified his earlier remarks. Although SDI research on university campuses is funded out of the budget for advanced development (with disclosure restrictions), it will be treated as "fundamental basic research" (with no disclosure restrictions). "However," the memo goes on to stipulate, "when there is a likelihood of disclosing operational capabilities and performance characteristics of planned or developing military systems, or technologies unique and critical to defense programs, the responsibility for the release of information resulting from IST research belongs to the sponsoring office."

On the surface, this clause appears to leave open the option for universities to get involved in classified research. It also gives the Office of IS&T the right to classify research once findings are deemed applicable to developing strategic defense systems. Since the innovative science program is essentially a "mission-oriented basic research" program, it is only a matter of time before unclassified research at universities becomes "critical" for the SDI program. As one congressional aide told *Defense Week*, "Many Pentagon (research and development) programs begin this way with unclassified efforts. It's an effort to get their nose under the tent."

Controversy over the long-term status of SDI research on campus is prompting some universities to reconsider their long-standing policy banning classified research. While some universities facing higher political costs will ban SDI research before it becomes classified, others may revise policy guidelines so that badly needed research money from SDI will be allowed on campus. University administrators are already confronting serious public relations problems over accepting SDI research contracts.

Universities as "Political Instruments"

Those universities receiving the largest SDI awards so far have also been the most vocal in criticizing the Pentagon's promotion of the program. At MIT's graduation exercises last summer, President Paul E. Gray criticized Ionson's claim that academic participation in SDI would add "prestige and credibility" and "influence the Congress to be more generous in funding the program." Gray argued, "What I find particularly troublesome about the SDI funding is the effort to short circuit debate and use MIT and other universities as political instruments in an attempt to obtain implicit institutional endorsement. This university will not be so used."

At the California Institute of Technology, President Marvin Goldberger accused SDIO officials of making "manifestly false" statements about the university's participation in SDI's university consortia in an effort to build public support for the program. Although one Caltech electrical engineering professor received a $50,000 subcontract for research on optical computing from Dayton Research Institute, Goldberger insisted the university institution had not signed an agreement with any SDI consortium.

Yet, in justifying the SDI contracts already let to some MIT professors, Provost Francis E. Low stated "The same tradition of academic freedom that permits professors to take public positions on public issues permits them to work on research projects of their choice, provided that the projects...are appropriate projects for the university....Our acceptance of research under the SDI program in no way constitutes an institutional position on the SDI program."

Whether SDI research is officially conducted by individual investigators or academic institutions, universities will not find it easy to divorce themselves from their professors and students. Any SDI on-campus research will spark new confrontations between students and faculty members working on Pentagon contracts and those members opposed to such work.

Boycotting SDI Funds

The campaign to boycott "Star Wars" on campus promises to stand as a watershed in the history of weapons development because there has never been such a level of dissent aimed at specific weapons programs. Unlike other recent university-based campaigns led by undergraduates, this movement is spearheaded by faculty members and graduate researchers who are the target of SDI.

Physicist David Wright of the University of Pennsylvania, who helped organize the early anti-SDI petition at Cornell, stresses that the pledge targets individuals rather than institutional policies against accepting SDI funds to avoid violating the academic freedom of those researchers choosing to

do "Star Wars" work. Wright asserts that many signatories at Cornell were convinced that "the political reality is that by sending in a proposal you will be giving legitimacy to this program."

At the University of Illinois, organizers drew up the anti-SDI petition on May 16, and had more than half of the science and engineering faculty signed on by May 20th. Michael Weissman of the physics department asserts that the effects of SDI funding on the university research process were a secondary consideration for him in his decision to help organize the petition drive: "I really see Star Wars as a life and death issue. Star Wars is a big step towards nuclear war, and everything else pales in comparison with that."

These issues are of special concern at MIT. With $248 million, or 26 percent of a total $942 million in DoD research funds let to universities in FY 1983, MIT is the university most sought after by Administration promoters of SDI. Its off-campus Lincoln Laboratories alone has been awarded $12.9 million in SDI funds as of last September. In all, MIT and its off-campus affiliate received over $59.6 million in SDI awards in FY 1985. To review potentially adverse consequences of SDI research on MIT's academic autonomy and freedom, the school has appointed a nine-person committee. Other universities are in the process of reviewing these issues as well.

Distorting the Research Process

US universities have a strong record in extending the boundaries of scientific knowledge through the conduct of applied and basic research. In recent history, universities have benefited from a diversified base of federal support—civilian and military—and an open environment in which research results may be disseminated freely among scientific colleagues. The phenomenal growth of DoD university funding in general, and the SDI innovative science program in particular, threatens the diversity of funding sources and the open research process—essential strengths of scientific research at US universities.

The DoD's increased share of federal funding to universities has already siphoned off funds that might otherwise have gone to civilian research projects. While the Pentagon's 16 percent share of total federal funding for university research may seem too small a figure to provide DoD a dominant role in shaping the conduct of university research, several factors magnify its influence. Pentagon funding is far and away the fastest growing source of money for university research. Between 1980 and 1985 DoD support for university work grew nearly twice as fast as any other source of federal money for university research. It is, therefore, an obvious target for academic scientists looking for new sources of support.

In addition, the Pentagon is not the only sponsor of military research conducted at universities. Both the Department of Energy (DoE) and NASA sponsor military projects, including DoE's new $3 to $5 million per year SDI innovative concepts program. Finally, the Pentagon has a particularly large share of the available federal funding for research in fields like computer science, electrical engineering, and metallurgy. All these fields are key to the future development of US high technology industries.

Universities have been a major source of unbiased basic scientific research, driven neither by military requirements nor the imperatives of commercial product development. Growth of military funding under the Reagan Administration has shifted the balance away from basic research and towards weapons projects. This trend appears to be worsening: in the proposed FY 1986 budget, DoD research and development is scheduled to increase by 21 percent, while basic research will grow by only 1 percent. Within the basic research budget, Pentagon-sponsored projects are proposed for a 16 percent increase, more than twice the 7 percent growth rate of National Science Foundation-sponsored basic research projects. Outside the physical sciences, basic research funding will be *decreased* by five percent by the next fiscal year.

In addition to accelerating this drain on basic research funds, SDI may distort the entire direction of US high technology research. Robert Reich, an industrial policy theorist and author of *The Next American Frontier*, asserts that SDI's innovative science office will control roughly 20 percent of US high technology venture capital over the next four years. "The problem is that never before on this scale have we entrusted so much technological development to the Pentagon in so short a time," argues Reich. "A handful of Pentagon officials are pre-empting scientific resources and picking winners and losers of the technology race, with large defense contractors advising them."

Japan's edge over the US in the development of affordable, high quality commercial electronics and computer products stems in part from its ability to sponsor applied civilian research directly through its Ministry of International Trade and Industry (MITI). Since the Japanese government

spends over six times less on military R&D than the US, relative to its GNP, it can spend proportionately more on MITI without straining its budget. Some analysts, such as Wolfgang Demisch of the First Boston investment firm, argue that, "Star Wars is the American answer to MITI." This ignores the fact that SDI, even more so than other US military projects, will be shrouded in secrecy and focus on extreme performance goals with little attention to cost. While SDI will achieve technical breakthroughs, very few of them are likely to find their way into cost-effective commercial applications.

Universities and academic research personnel will have to decide soon where they stand on the goals and the methods of the SDI innovative science program. Given the strong promotional atmosphere in which SDI contracts are being awarded, participation of academic researchers in the program is likely to be billed by the Pentagon as an endorsement of the technical feasibility of a strategic defense system.

With constraints on other funding sources, many campus-based scientists will be tempted to apply for SDI funding regardless of their views of its goals. Others will participate on the grounds that SDI is strictly a research program that can advance scientific knowledge even if its overall goals are never achieved. This would be tantamount to conceding control of our nation's advanced scientific research effort to the Department of Defense.

FAIRTEST AND S.A.T. SCORES

thanks to Claudia Zaslavsky for bringing this information to our attention

"Low S.A.T. Scores Perplex Women" by Jonathan Friendly, *The New York Times*, Aug. 3, 1986, p. 16

> It is well documented that women as a group get higher grades than men in both high school and college. But when it comes to the Scholastic Aptitude Test, it is men who turn in the higher scores.
> ...
> The difference between men's and women's scores has been known for at least 20 years, but only recently has it become a focus of research and discussion. FairTest, an organization in Boston that advocates changes in academic and professional testing, has charged that the contrast between women's lower test scores and their superior performance as freshmen casts doubt on how well the S.A.T. measures academic ability. This can be critical, FairTest says, because S.A.T. scores can mean the difference between acceptance and rejection at selective colleges.
> Robert G. Cameron, executive director for research and development at the College Board, acknowledged that the S.A.T.'s "slightly underpredict" how well women do as freshmen. Thus, he said, the board urges college admissions committees in its literature to "take into appropriate consideration predictions of performance for applicant subgroups," including women.
> ...

"Critics Charge Sexual Bias in NY State Scholarships" by John Hildebrand, *Newsday*, March 10, 1987

> Testing critics charged yesterday that many female students across the state were unfairly denied $2,000-a-year college scholarships under a government-sponsored program that relied on test scores.
> ...
> Awards are based solely on scores from college-entrance examinations, either the Scholastic Aptitude Test or the American College Testing program. Critics contend that the use of such tests discriminates against girls, whose scores are lower on the average, though the test sponsors insist their questions are bias-free.
> ...
> The groups endorsed a bill, now before the Legislature, that would require test publishers to release data showing how women, blacks and other groups perform on specific test questions. Critics also urged that additional factors, such as students' grades, be considered in awarding scholarships. But state authorities said any such system would be cumbersome and probably unfair to students attending the most demanding schools.
> ...

FairTest press release

> "Strategies to Eliminate Sex-Bias from Standardized Tests" was the theme of an invitational seminar held April 16, 1987, at Hunter College, New York City. The seminar featured presentations by Eleanor Smeal, President, National Organization for Women; Leslie Wolfe, Executive Director, Project on Equal Education

Rights (NOW Legal Defense and Education Fund); and Phyllis Rosser, FairTest Consultant on Sex-Bias in Testing, Contributing Editor to *Ms.* magazine. This working seminar focused on the impact of unfairly low college admissions test scores on young women's ability to receive financial aid.

"S.A.T.'s Are Biased Against Girls, Report by Advocacy Group Says" by Deirdre Carmody, *The New York Times*, April 17, 1987

High school girls get lower scores than boys on the Scholastic Aptitude Test because the tests are biased against girls, according to a report released yesterday by an advocacy group that monitors standardized testing.

...The findings are based on the conclusion that because girls earn better grades than boys in high school and college, they should do as well or better on the test. The test therefore fails in its purpose of predicting performance in the freshman year of college, the report says.

...

"All these factors contribute to a real dollar loss for females in later life, as they get less prestigious jobs, earn less money and have fewer leadership opportunities," says the report, which is entitled "Sex Bias in College Admissions Tests: Why Women Lose Out." It was prepared by the National Center for Fair and Open Testing, a nonprofit advocacy group for fair standardized tests....

Last month the New York State Board of Regents, expressing concern about possible bias against women in the S.A.T.'s, asked Governor Cuomo and the Legislature for $100,000 to devise a new test to replace the S.A.T. as a basis for awarding state scholarships.

"Equality in testing," editorial, *Boston Sunday Globe*, April 26, 1987

...

SAT officials have attempted to explain the disparity away by arguing that women tend to take easier courses in college—fine arts and literature instead of mathematics and science—and thus get better grades even though their SAT scores were lower. That argument has been rebutted by admission officers at Massachusetts Institute of Technology, who have found that women hold their own across all subject areas, even math and science, despite their lower SAT scores.

...

What is troubling, however, is that the prestigious National Merit Scholarships—worth a total of $23 million a year—are awarded solely on the basis of scores obtained on the SATs (usually taken during during the senior year) and the PSATs (taken during the junior year). Many other scholarships are awarded to college-bound students largely because they have received a National Merit Scholarship.

...

The weight of the evidence appears to have finally tilted strongly against the SATs. An increasing number of colleges are realizing that, and are finding other ways to judge whether to admit an applicant. The SATs also should not be allowed to remain as a major determinant for scholarships.

FairTest info

The National Center for Fair & Open Testing (FairTest) is a research and advocacy organization dedicated to ensuring that the 40 million standardized tests annually administered to America's students and job applicants are fair, open and educationally sound. Our publications will keep you up-to-date about legislative hearings, lawsuits, research and other important developments concerning America's growing movement for evaluation reform. For more information, write FairTest, P.O. Box 1272, Harvard Square Station, Cambridge, MA 02238.

OF POSSIBLE INTEREST

Women's Studies. Rutgers University Press, 109 Church St., New Brunswick, NJ 08901.

Women's Studies. Temple University Press, Broad & Oxford Streets, Philadelphia, PA 19122.

Hypatia, A Journal of Feminist Philosophy. Dept. of Philosophical Studies, Southern Illinois University at Edwardsville, Edwardsville, IL 62026.

DEADLINES: July 24 for Sept.-Oct., Sept. 24 for Nov.-Dec., Nov. 24 for Jan.-Feb.
AD DEADLINES: Aug. 5 for Sept.-Oct., Oct. 5 for Nov.-Dec., Dec. 5 for Jan.-Feb.
ADDRESSES: Send all Newsletter material **except ads** to Anne Leggett, Dept. of Math. Sci., Loyola University, 6525 N. Sheridan Rd., Chicago, IL 60626. Send everything else, **including ads**, to AWM, Box 178, Wellesley College, Wellesley, MA 02181.

JOB ADS

Institutional members of AWM receive two free ads per year. All other ads are $10.00 apiece and must be prepaid. The vacancies listed below appear in alphabetical order by state. All institutions advertising below are Affirmative Action/Equal Opportunity employers.

Wheaton College. Mathematics Dept., Norton, MA 02766. Rochelle Leibowitz, Chair. Two-year tenure track asst professorship 9/1987. Required: PhD in math sciences, & commitment to quality teaching and active scholarly activity. Preferred areas: analysis, probability & statistics, computer science. Send application, vita, transcripts & 3 letters of recommendation to Chair.

Western Michigan University. Dept of Math & Stat, Kalamazoo, MI 49008. Tel (616) 383-6165. Dr. Joseph T. Buckley, Chairperson. Fall vacancies. (1) Instructor of Math (1 year renewable). Required: M.S. or M.A. in math, teaching experience. Preference given to applicants beyond Masters level. Duties: Teach 11-12 credit hours per semester of undergraduate math courses & perform other duties expected of full time faculty. (2) Asst Professor of Math Education. Required: PhD in Math Educ or in Teaching of Math. Some school teaching (K-12) highly desirable. Person who has completed all doctorate requirements except thesis may be considered. Duties: teach math educ in both elementary & secondary educ programs, research & perform other duties expected of full time faculty. (3) Instructor of Math Education (1 year renewable). Required: Masters Degree in Math Educ or in Teaching of Math. Duties: Teach 11-12 credit hours per semester of undergraduate math educ courses & perform other duties expected of full time faculty. Salary for all positions competitive; good fringe benefits. Dept also teaches service courses in math & stat for other units such as business, computer science & engineering. Send credentials to Chairperson.

Office of Naval Research. Arlington, Virginia. Civil Service position in mathematical sciences. Salary range $38,727 to $69,976, depending on qualifications. Responsibilities: plan & manage research & development programs in fields of calculus of variations, the variational theory of ordinary & partial differential equations, optimal design, multivariate & robust control theory. Required: PhD in math & one year of appropriate professional experience or equivalent combination of education & experience. Send list of publications & a resume or Standard Form 171 to be received by Aug. 14, 1987 to Office of the Chief of Naval Research, Civilian Personnel Division, Code 01242P, Attn: Announcement #87-45 (AWM), 800 N Quincy St, Arlington, VA 22217-5000. For further information call (202) 696-4705.

Office of Naval Research. Arlington, Virginia. Civil Service position in mathematical sciences is available. Salary range is $38,727 to $69,976, depending on qualifications. Responsibilities are to plan and manage research and development programs in the fields of boundary value and inverse problems for ordinary and partial differential equations. Required: PhD in math & one year of appropriate professional experience or equivalent combination of education & experience. Send list of publications & a resume or Standard Form 171 to be received by Aug. 14, 1987 to Office of the Chief of Naval Researach, Civilian Personnel Division, Code 01242P, Attn: Announcement #87-44 (AWM), 800 North Quincy Street, Arlington, VA 22217-5000. For further information call (202) 696-4705.

University of Wisconsin-Eau Claire. Dept of Math, Eau Claire, WI 54702. Marshall E. Wick, Chmn. At least one tenure track position anticipated. All specialties considered but prefer those in algebra or geometry who are interested in teaching upper-level undergraduate courses as well as other entry-level courses. PhD preferred. Twelve-hour teaching load. Required: evidence of potential for excellence in teaching. One- or two- year initial appointment. Applications considered as received, until positions are filled. Send letter of application, resume, graduate & undergraduate transcripts, and 3 letters of recommendation to Chmn.

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Box 178, Wellesley College, Wellesley, MA 02181
617-235-0320 Ext 2643

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