Association for Women in Mathematics

Volume 19, Number 4 NEWSLETTER July-August 1989

PRESIDENT'S REPORT

I was disappointed to read in the May issue of the AAAS *Observer* that 1987 marked a reversal in the trend of increasing numbers of science doctorates earned by American women. One of the causes may be that women are "less likely than men ... to have either institutional or federal support during their graduate study and more likely to be self-supporting." Furthermore, a recent National Research Council study found that "women scientists continue to be paid considerably less than men in the same field and at the same experience level." This situation will have to improve if we are to do anything about the problem of the lack of women in the pipeline.

A call for the full funding of women and minority graduate students in mathematics, and the sciences in general, was one of the recommendations of the working group on women and minorities at the CBMS Workshop on Mathematics Education that I attended in March. Tricia Cross was also there to represent AWM, and her report on the workshop will appear elsewhere in this newsletter. While I was at the workshop I had the opportunity to speak with Ivar Stakgold, President of the Society for Industrial and Applied Mathematics. We agreed to hold a joint session on women mathematicians in industry at the SIAM national meeting in 1990.

I am delighted to announce that the American Mathematical Society has contributed $2000 to the endowment for the Alice T. Schafer prize. We have also received a number of very generous individual contributions.

Congratulations to Marcia Sward on her appointment as Executive Director of the Mathematical Association of America. The MAA could not have made a better choice. Those of us who have worked with Marcia in the past are well aware of her dedication and effectiveness as Associate Executive Director of the MAA, Administrative Officer of the CBMS, and most recently as Executive Director of the Math Sciences Education Boards. We wish her all the best.

We have been able to make two additional grants to AWM members joining the People to People delegation to China. They were given to Annie Alexander Selden and Adrienne Dare. It would seem that the delegation will arrive in China at an exciting and pivotal time. [Ed. note: due to the political situation, the delegation has been postponed.]

I am looking forward to seeing everyone, and the mountains, in Boulder this August. We hope to have a session with some of the women graduate students in the area to give them an opportunity to meet some more established women mathematicians. The final arrangements have not yet been made, so please stop by the AWM table in the registration area to find out the details. Also, elsewhere in this newsletter is some background information on the panelists for our program at the meeting. It promises to be quite an interesting one.

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AWM ELECTION

We are happy to announce the candidates for the AWM Executive Committee:

President-Elect: Carol Wood, Wesleyan University

Members-at-Large: Ruth Charney, Ohio State University
Eleanor Jones, Norfolk State University
Maria Klawe, University of British Columbia.

The Nominating Committee consisted of Bhama Srinivasan (Chair), Linda Keen, and Vivienne Mayes.

Nominations by petition are invited. A petition must be signed by twenty members and submitted to Jill Mesirov by September 1, 1989.

Statements from and short bios of the candidates will appear in the November-December issue along with the ballot.

NSF-AWM TRAVEL GRANTS FOR WOMEN

The objective of the NSF-AWM Travel Grants is to enable women to attend research conferences in their field, thereby providing a valuable opportunity to advance women's research activities, as well as to increase the awareness that women are actively involved in research. If more women attend meetings, we increase the size of the pool from which speakers at subsequent meetings are drawn and thus address the problem of the absence of women speakers at many research conferences.

The Travel Grants. The grants will support travel and subsistence to a meeting or conference in the applicant's field of specialization. A maximum of $1000 for domestic travel and of $2000 for foreign travel will be applied.

Eligibility. Applicants must be women holding a doctorate in a field of research supported by the Division of Mathematical Sciences of the NSF (or have equivalent experience). A woman may not be awarded more than one grant in any two-year period and should not have available other sources of funding (except possibly partial institutional support).

Target Dates. There will be four award periods per year, with applications due November 1, February 1, May 1, and August 1.

Applicants should send a description of their current research and of how the proposed travel would benefit their program, a curriculum vita and a budget to Association for Women in Mathematics, Box 178, Wellesley College, Wellesley, MA 02181.

NSF-AWM TRAVEL GRANTS AWARDED

The largest number of NSF-AWM Travel Grant proposals thus far resulted in the following awards. Congratulations to the grantees.

Karen Brucks, Michigan State University
Joint Summer Research Conference, Arcata, California

Susan Jane Colley, Oberlin College
1989 International Zeuthen Symposium

Chris Gennings, Virginia Commonwealth University
Glim 89 & the 4th International Workshop on Statistical Modeling, Trento, Italy

Wanda M. Henry, University of Arizona
International School of Material Science & Technology Course on
Non-linear Waves in Solid State Physics, Sicily, Italy

Jeanne Wald Kerr, Michigan State University
Microprogram on Noncommutative Rings, Berkeley, California

Esther R. Lamkin, University of Vermont
British Combinatorial Conference, Norwich, England

Rita Saerens, Michigan State University
1989 Summer Research Institute in Several Complex Variables and Complex Geometry, Santa Cruz, California

Claudia Spiro-Silverman, Massachusetts Institute of Technology
Journée Arithmétiques, Marseilles, France

Many thanks to our distinguished panel. Please continue to send in your proposals — the next deadline is August 1, 1989.

AWM PANEL MEMBERS

brief bios of the panelists for "Women in Operations Research: Their Work and Experiences," a panel to be held at the Boulder meetings in August

Janice H. Hammond is an Assistant Professor of Business Administration at Harvard University. At Harvard, she has taught courses in Managerial Economics (quantitative methods), Business Logistics, and Decision Support Systems in the MBA program. In the fall, she will teach a course in Production and Operations Management.

Professor Hammond's theoretical research interests lie in the general area of mathematical programming. In this area, her research focuses on the convergence of computational procedures for computing network equilibria. Specifically, this work analyzes the convergence of nonlinear programming algorithms adapted to solve asymmetric variational inequality problems and systems of equations such as those that define traffic equilibria and spatially separated economic market equilibria.

Her applied research interests lie in the areas of logistics and operations management. This research project studies how companies use decision support systems to make decisions about their logistics structure and policies.

Professor Hammond holds an Sc.B. in applied mathematics (*magna cum laude*) from Brown University and a Ph.D. in operations research from the Department of Mathematics of the Massachusetts Institute of Technology. While at M.I.T., she assisted in teaching courses offered by the Mathematics Department, the Electrical Engineering and Computer Science Department, and the Sloan School of Management. She is a member of the Operations Research Society, the Mathematical Programming Society, the Association for Women in Science, and Sigma Xi. She was a participant in the 1980-82 National Science Foundation Chataqua course, "Increasing the Participation of Women in Mathematics." Her outside interests include music and sports.

Margaret H. Wright received her B.S. in Mathematics and her M.S. and Ph.D. in Computer Science from Stanford University. She was in the Department of Operations Research at Stanford from 1976 until 1988 and is now a Member of Technical Staff in the Computing Mathematics Research Department at AT&T Bell Laboratories, Murray Hill, New Jersey. Her primary research interests are in numerical optimization and linear algebra.

She is a member of the SIAM Council and an editor of the SIAM *Journal on Scientific and Statistical Computing* and of *Mathematical Programming*.

Margaret L. Brandeau earned a B.S. in Mathematics from M.I.T. in 1977, an M.S. in Operations Research from M.I.T. in 1978, and a Ph.D. in Engineering-Economic Systems from Stanford in 1985. She has been an Assistant Professor in the Department of Industrial Engineering and Engineering Management at Stanford University since 1985. She is a recipient of a 1988 Presidential Young Investigator Award from the National Science Foundation.

Her primary research interest is applied operations research. Some of her current research projects include: mathematical analysis of design and control problems in automated guided vehicle networks; analysis of large-scale binary integer programs arising from certain project sequencing problems; development of facility location models that incorporate economic externalities of customer choice equilibria; and development of a mathematical model of AIDS screening and intervention. In her free time she enjoys swimming, traveling, gardening, and renovating her house.

WANTED: WOMEN APPLICANTS FOR THE AMS RESEARCH FELLOWSHIPS

by Susan Montgomery, Chair, AMS Committee on Fellowship Policy

At the AMS Centennial Meeting in Providence last summer, the AWM made a generous donation to the AMS fellowship fund, with the remark that we hoped someday a woman would receive one. (A minor comment: in fact, one woman was awarded one about 10 years ago. But she declined it to go to medical school.) A major difficulty in ever awarding the Fellowship to a woman is that almost no women apply. In the last three years, about 70 men have applied but only two women. Thus I urge AWM members to encourage good candidates to apply (including themselves!).

The requirements for the 90-91 fellowship are slightly different than for 89-90: now applicants should be 7-12 years past the Ph.D., and the Selection Committee will give preference to applicants who have not had extensive postdoctoral support. Having held one fellowship, such as an NSF postdoc, is not considered "extensive," and I would certainly encourage former NSF postdocs (of whom about 25 are women) to apply.

Application forms are available from the AMS in Providence, though the completed forms should be sent to the address on the forms. The deadline for application is December 1, 1989. Check the July/August and September issue of the *Notices* for details.

MAA/AMS ELECTIONS

Partly at the instigation of AWM, the Executive and Finance Committees of the Mathematical Association of America have asked candidates for MAA office to submit for the ballot a statement on the main challenges facing the MAA. MAA members: please read these statements before you make your choices. If the calendar allows, in the future we will ask MAA candidates for statements on issues of interest to AWM as we already do for the AMS election.

AMS members: remember to hang on to your ballots until you have had a chance to read the candidates' statements in the September-October issue.

AWARDS AND HONORS

At the Smith College commencement exercises held on May 21, 1989, mathematician Evelyn Boyd Granville received an honorary doctor of science degree. A 1945 Smith graduate, she received a Ph.D. in mathematics from Yale University in 1949, becoming one of the first two American black women to receive that advanced degree. She taught mathematics on the college level for more than three decades before retiring from California State University, Los Angeles in 1984. Since then, she has continued to teach mathematics and computer science at a small private college in Texas.

Granville also has extensive experience in government and private industry in the areas of applied mathematics, numerical analysis, celestial mechanics, trajectory and orbit analysis and computation, and digital computer programming. She was a mathematician and researcher with the Department of the Army, International Business Machines and Space Technology Laboratories, among other posts. She co-wrote the college textbook *Theory and Applications of Mathematics for Teachers*, now used by colleges and universities around the country.

Jennifer Tour Chayes of the University of California, Los Angeles, Jill C. Pipher of the University of Chicago, and Leslie D. Saper of Duke University have all received Sloan Research Fellowships.

Of the ninety-one 1989 Fellows in the sciences and economics, twelve are women. In announcing the awards, Albert Rees, President of the Sloan Foundation, said, "We are most pleased that there are twelve women among the new fellows, the largest number in more than a decade. We hope that this indicates a longer-run increase in the number of outstanding women attracted to academic careers in science."

Iris L. Anshel and Elise E. Cawley have earned National Science Foundation Postdoctoral Research Fellowships in the mathematical sciences. Anshel received her Ph.D. this year from Columbia University and will continue there for her fellowship. Cawley, a 1989 Ph.D. at the University of California, Berkeley, will work at CUNY Graduate Center.

The stipend of $66,000 provides support for two nine-month academic years and three two-month summers. The academic year support may be used in either a full-time or a combination full-time and half-time option.

Vivian Kraines of Meredith College has received a $38,236 grant in the NSF Faculty Enhancement program. Her project is "Computers in the classroom for mathematics education." Mary G. O'Donnell of the University of Pittsburgh-Greensburg has received a grant of $82,321 for a 4-week program for 36 students in the NSF Young Scholar program.

Several Canadian women mathematicians have received administrative appointments. Professor Lynn Margaret Batten of the University of Winnipeg has been appointed to be Head of the Department of Mathematics and Astronomy at the University of Manitoba. Professor Joan W. Pelletier is just completing a term as Chair of the Mathematics Department at York University (Toronto). Professor Harriet Botha has recently assumed the post of Chair of Mathematics and Computer Science at Atkinson College, the evening component of York University.

Congratulations to all!

LETTER COLUMN

It has always been our policy to print letters to the editor or to the general membership. Because letters have appeared on a sporadic basis, members are not always aware that we publish such letters (I receive regular suggestions that we should print letters!). I hope that by calling this a "column" that more members will be encouraged to share their views with the organization. If you wish your letter to be considered for appearance in the *Newsletter*, please mark it "for publication."

The letter appearing below was forwarded to us by Yaffa Draznin, a historian who is Dr. Bernstein's sister. She is "anxious that the many women in mathematics who know of Dorothy Bernstein be apprised of the efforts we are taking to memorialize her name and her work."

Dear Colleagues,

Many members of the mathematical community still recall with fondness the memory of Professor Dorothy L. Bernstein, one of the first woman research mathematicians to receive her Ph.D. in the United States, who passed away last year after a long illness. Professor Bernstein devoted her life not only to research in partial differential equations and numerical analysis but also to public service on behalf of the mathematical community. She served as First Vice President and then President of the MAA — the first woman elected to this position — and on many committees of the MAA and the AMS. She was a member of the National Research Council and a representative to its Mathematics Advisory Panel, as well as a member of and consultant to various governmental bodies and forums dealing with mathematics.

Following Professor Bernstein's death, her family and friends decided to memorialize her name by establishing the Dorothy L. Bernstein Scholarship Fund for women studying mathematics at the University of Haifa in Israel, an institution in which Professor Bernstein took especial interest during the last years of her life. Contributions to this fund, which are tax deductible, are welcomed from all members of the mathematical community who hold Professor Bernstein's memory dear. They can be made through the American Friends of Haifa University, 41 East 42nd Street, New York, NY 10017. (Please designate explicitly that they are intended for the Dorothy Bernstein Scholarship Fund.)

I thank you very much for your aid and support for this worthy project.

Sincerely, Professor Jonathan S. Golan, University of Haifa

GENDER DIFFERENCES IN MATHEMATICAL ABILITY — PERCEPTIONS VS. PERFORMANCE

AWM panel, Wednesday, January 11, 1989, Joint Mathematics Meetings, Phoenix

Pat Rogers, York University, Toronto, Canada

This talk is a version of a paper which was given at ICME-6 in Budapest, July 1988. The paper will appear as a chapter in the UNESCO publication *Gender and Mathematics: An International Perspective*, edited by Leone Burton, forthcoming Spring 1990. Reprinted by permission.

Among the teachers with whom I work in my role as a teacher trainer and educator and also among my colleagues in the mathematics department, the most commonly expressed view is: "My best students are female." The perception is that intellectually able women perform at least as well in mathematics as their male peers. Yet despite the superior high school achievement of many women entering post-secondary education, research shows that their attrition rate is higher than that for men: "In 1986, while females accounted for about half of all bachelor's degrees in math, they received only about one-third of master's degrees and less than one-fifth of all doctorates."[1]

Gila Hanna's research shows that in grade eight, differences in achievement are culturally based and not related to gender. So given the attrition that is experienced beyond the compulsory years of high school mathematics, the question we must ask is what is going wrong? I believe the answer lies in our pedagogical practices and the nature of the power-relations within the classroom.

Some support for this view is provided by the research of Belenky *ét al.* [1986] reported in *Women's Ways of Knowing* (the November-December 1988 issue of this newsletter features an excellent review by Judy Roitman of this book [p. 14-15]). Three points are worth highlighting:

1. Students do better when we believe in them — thus *students need a positive learning environment in which to develop.*
2. Cognitive strategies and intellectual growth are psychologically grounded, and there is often considerable emotional trauma associated with progressing from one stage of intellectual maturity to another. Thus *the learning environment must be supportive of students.*
3. *Techniques which work with white middle-class males may fail with other populations.*

At this point I would like to read to you from a letter I received from a teacher — I will call him Dr. Alan[2] — who is trying to come to terms with and account for a paradoxical situation in which he finds himself.

> The fact that [the students] find me intimidating has been with me since day one of my teaching. The only explanation that I have about the disparity of this perception and the reality (= I am quite accessible) is that I do not wish to be the students' "pal" when I teach. On the one hand I wish to create the environment in which the students ask any questions and think any thoughts, unfettered, so they can learn. On the other hand they must be trained to think precisely and "speak the truth" — they must learn that some of the things that they will think or say will be labeled as nonsense by someone. They cannot forever remain "children"— some things will not be forgiven (after a certain time). Well, you see the dilemma. I am just a "stern and loving father" to them — a model of a father that is probably totally lost to the current American generation.

Students flock to Dr. Alan's courses, taking courses with him year after year, and yet they describe him as intimidating, as "striking fear in the hearts of undergraduates." The reason they give for continuing to take his courses is that they learn so much from him. As one female student explained to me: "Sure you hate him while you're going through it, but in retrospect, you look back and 'Wow! What a great teacher. I learned so much. I want to get him again!' " And so when the class schedule comes out for the next semester, many students will "look to see what he's teaching, then take it!"

In the remainder of my talk, I will explore the way power typically is used and how it can be used in the mathematics classroom to help students find their own voices and become independent of the need for a teacher. This discussion is based on my study of a particular mathematics program in which I am seeking to understand the reasons for their success in influencing large numbers of students, a majority of them female, to choose a mathematical career and in supporting and retaining them in their studies.

Background to the study[3]

Currently fewer than 1% of all bachelor's degrees granted in North America are in mathematics; at the State University of New York (SUNY) College at Potsdam the corresponding figure has been at least 20% in each of the last four years. According to a recent MAA survey [Albers *et al.*, 1987] for the period 1980-85, while overall undergraduate enrollments in the United States remained relatively stable, there was an increase in the number of undergraduate mathematics degrees of 45%; the corresponding increase at Potsdam was 152%.

The success of the Potsdam Mathematics Department was first documented by the Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America (MAA) in a report where they were described as an example of a department which is successful in "attracting a large number of students into a program that develops rigorous mathematical thinking and also offers a spectrum of (well taught) courses in pure and applied mathematics" [CUPM, 1981].

A small undergraduate institution serving about 4000 students, Potsdam College is situated close to the Canadian border in the northeast corner of New York State, a rural area known as the North Country. From its early beginnings in 1816 the college had been involved primarily in teacher education until it became the State University College of Arts and Science at Potsdam in 1962.

According to admissions personnel, the college draws from a wide area of New York State, attracting students primarily from lower middle class backgrounds, often from farming communities and small villages. Students are invariably the first in their family to attend college. With no tradition of post-secondary education to support them, poor self-concept and low self-esteem are often problems. The college population is 54% female, and admissions statistics for 1987 indicate that female and male students specifying mathematics as their major apply and are admitted in roughly equal numbers.

In 1983, more than 60% of all of Potsdam's mathematics degrees were awarded to women compared with less than 43% nationally. Furthermore, in five of the last seven years the top graduating student in the college as a whole has been a female mathematics major.

A recent report of the Project on the Status and Education of Women [Ehrhart and Sandler, 1987] concludes that the retention of women in traditionally male programs at the post-secondary level is strongly linked with the quality of their college experiences. While women may have made considerable gains in equal access to post-secondary education, female students still have significantly fewer opportunities than their male peers to develop academic self-confidence and to have their academic goals and career aspirations validated by faculty and administrators. "Behaviors and attitudes that express different expectations for women or single them out or ignore them because of their sex ... can have a profound negative impact on women's academic and career development" [Ehrhart and Sandler, 1987, p. 5].

In "A Modern Fairy Tale?," Poland [1987, p. 294], discusses his impressions of the Potsdam College mathematics program. He attributes its success to the way they are able to "instill self-confidence and a sense of achievement." Students he talked to said they felt the faculty cared for each one of them. Poland observed that the caring the students experienced resulted in their expressing a high degree of confidence in their own mathematical abilities. He speculated that this could be why "they graduate more women in mathematics than men, that they address and redress a lack of confidence many women may feel about their ability to be mathematicians or to do mathematics competently" [Poland, 1987, p. 293].

Description of the Study

My investigation into the reasons for Potsdam's success with female students began in April, 1987. Since then I have visited the department on eight occasions, during which time I have used ethnographic techniques to gather and analyze a variety of data. The bulk of my data consists of transcripts of taped interviews with students and detailed notes of other interviews with counselling, admissions and administrative personnel, and all mathematics department faculty members. As well, I have observed office consultations between faculty and students and many classroom situations.

In a study of this kind it is difficult not to bring certain expectations to the field; the essential task for the researcher is to avoid having these biases inform the findings. Poland had rejected the view that "teaching techniques" might explain Potsdam's success [Poland, 1987, p. 295], but I remained unconvinced. Indeed, my view now is that it is Potsdam's approach to teaching that is at the heart of their success, especially with their female students. I will elaborate on this later in this talk, but first I will discuss one factor about Potsdam that I did not expect to find.

Heroes, Idols and Patriarchy

Given the importance that has been placed on providing female students in male-dominated fields such as the mathematical sciences with female role models [Ehrhart and Sandler, 1987, p. 6], it surprised me to find that in a department of 15 faculty, only one is female (this despite repeated recruitment efforts). Further, it surprised me to learn that the female students themselves were profoundly ignorant of the fact that females are often discouraged from taking mathematics. Only a few students admitted to being aware of the stereotyping of mathematics as a male domain. Certainly when they look around at Potsdam, mathematics would appear to be a female domain. For many of them this was also their experience in high school. I had anticipated finding a department which was aware that women were under-represented in the field of mathematics and which had taken deliberate steps to recruit female students and to meet their perceived special needs. What I did find was a department which, in its desire to encourage *all* students to reach their potential, had developed ways to cultivate and nurture its best students and use them as role models to inspire others. Coincidentally many of these early role models were women.

A recurring theme in the interviews with female students was the "teacher as father-figure." I asked one student why she liked Dr. Alan when her description of him made him sound so intimidating. She laughed and replied, "Yah, he's friendly about his intimidation ... That's why [he] comes off more like a father ... kind of nurturing you ... like 'Yes, you've made a mistake, but you haven't done anything that any of my other students haven't done.' So I don't feel bad." Other terms which are frequently used interchangeably with "father-figure" are "hero," "idol," "role-model," and "mentor." The faculty too refer to themselves as "father-figures," as is typified by the passage I quoted earlier. However, as stern, demanding and challenging as these fathers can be, they can also be "loving."

At this point I should emphasize that I am not arguing against the need for affirmative action. Indeed I see it as an essential step towards achieving an equitable society. However, I am suggesting that it is possible to study within a patriarchal environment without experiencing the negative consequences so often associated with it [Ehrhart and Sandler, 1987, p. 5-7]. At Potsdam, the mitigating factors would appear to be the balance the faculty are able to maintain between challenge and love and the fact that their motive in wielding their authority in the classroom is that they might later relinquish it.

Mathematics Pedagogy and Subjectivity

The authority of teachers generally resides in the fact that they control the transmission of skills and knowledge both in form and content. They also control the means and methods of evaluation. In the case of mathematics teaching this power is further enhanced by students' mistaken beliefs and myths about mathematics. Most important among these is the notion that teachers possess a great deal of knowledge which can be obtained only from them and which they will impart only if the student obeys the rules.

Many social and psychological factors are recognized as contributing to mathematics avoidance by women. However I would suggest that a more decisive factor is the way that mathematics is traditionally presented and experienced in the classroom. Students at the secondary and post-secondary levels are rarely given the opportunity to play with ideas in mathematics and to construct their own meanings and understanding. They are presented with mathematics through textbooks and the polished lectures, where mathematics is made to appear finished, absolute and predigested product. A pedagogy that emphasizes product deprives students of experiencing the process by which ideas in mathematics come to be and perpetuates a dualistic view of mathematics in which right answers are known by authorities and are the property of experts [Perry, 1970, 1981]. Such a pedagogy strips mathematics of the context in which it was created and is probably largely responsible for creating students' misconceptions.

Gilligan's research [1982] in the field of women's moral development provides a link between mathematics avoidance and mathematics pedagogy. She identified two styles of reasoning which, although not gender-specific, are thought by some to be gender-related: one, the traditional style, is characterized by objectivity, reason, logic, and appeal to justice; and the other, "connected thought," often identified with women and consequently devalued, is characterized by subjectivity, intuition, and a desire to maintain relationships.

This audience does not need to be persuaded that creative work in mathematics requires facility with both styles of reasoning. But the problem with the way mathematics is so often taught, particularly at the tertiary level where the lecture mode of instruction is so predominant, is that students are not given the opportunity to be involved in the journey: the process of constructing mathematical ideas where "connected" thought is so important. Thus there is an enormous cognitive gulf between the style in which mathematics is presented and the way in which students are best able to construct their own understanding of it. Some students are able to bridge this gap for themselves, but many are not. Bridging this gap requires initiative, independence of thought and risk-taking, the very skills possessed by effective problem solvers, and the very skills that are discouraged in the young female.

Another reason why the expository mode of presentation may adversely affect women more than men is because it uses and appeals to authority as a means of imparting knowledge. Power in the lecture situation resides with the speaker, and few students are able to cultivate their own voice. However, there are marked gender differences in relationship with authorities [Belenky, *et al*., 1986, p. 43-45]. Males are encouraged from an early age to challenge authority and receive support for holding the floor and presenting their own views. Women, on the other hand, are encouraged to subordinate their own voice to that of authorities and are far less likely than men to maintain a sense of their own autonomy. Ehrhart and Sandler [1987, p. 6] argue that not only are the physical sciences often "dominated by men in terms of numbers, but their operating procedures, values, and power structures could be termed 'masculine' in the sense that they emphasize hierarchy, individual prowess, and highly assertive behavior instead of cooperation." Thus the mathematical experience of most female undergraduates is dominated by males employing authoritarian modes of communication to which they often respond in customary silence.

Portrait of an empowering teacher

Dr. Alan does not believe that only the gifted and talented few are capable of becoming mathematicians. Instead he tells his students that they are all capable of learning mathematics, provided they are prepared to work hard. He sees his job as identifying "the needs and level of understanding of his students and [finding] a way to help them learn what they need to know." For what purpose? He says, "So that they might learn to think precisely and speak the truth." Note that he did not say "*learn* the truth" but "*speak* the truth." The focus here is on developing your own voice through which to express what you know in a way that is true, rather than developing skills at passively absorbing material thought to be important for you to learn.

How does Alan teach his students to speak the truth? Not by subscribing to the "banking" concept of education in which the teacher's role "is to 'fill' the students by making deposits of information which the teachers consider to constitute true knowledge" [Friere, 1979, p. 63]. Instead his goal "is to make [the students] independent of [him] and any other teacher." In his opening remarks at the start of a new course he warns his students that "we should tell you as little as possible and help you to read your text[book]." He sees his role as "providing opportunities for the students to think up and write down correct proofs and appropriate counterexamples... to do little for you, and give opportunities [for you] to do a lot for yourself."

In Alan's class there is almost no lecturing. Most of the time, students are working together informally in small groups, discussing problems, arguing, negotiating meaning. Dr. Alan walks around, looking over shoulders, asking questions. From time to time he sends a student to the board to write up her solution. Then there is some discussion with the student-teacher taking a leading role. The class may end with a brief lecture on some new material or an assignment of new problems to be taken up at the next meeting.

This teacher shares the journey of recreating mathematics with his students. He believes that students need to know that they are capable of intelligent thought, not as a reward for finishing the course successfully, but as a prerequisite for engaging in it productively. The role of expert in his classes shifts between teacher and student. The stage is shared, and as the drama unfolds the students learn that theories are not the sole property of experts, rather they develop the ability to reconstruct them for themselves. In this way, Alan supports the growth and evolution of the students' thinking and helps them discover their own voices. In his class, knowledge is not the private and exclusive property of the teacher, but is negotiated in a community of trust where confidence and self-esteem are protected.

Power in mathematics resides with those who have knowledge of process. With such knowledge students are able to become independent of their teachers, not needing them for approval or for confirmation. The Potsdam faculty actively encourage this independence in their students in a variety of ways: by true acceptance of the students they have rather than the students they might wish they had (I heard no complaints of the "If only we had better students!") variety); by having their students model as "expert" and trusting them to learn from experience; by teaching students how to read mathematical literature; by encouraging collaborative learning and peer tutoring; and by respecting the students' ultimate right to personal responsibility for their own learning.

Conclusion

The teacher I have described above has made no particular effort to attract female students and no specific adaptations to meet their perceived special needs. In this, his is typical of the approach of all mathematics teachers at Potsdam College. Indeed, gender does not appear to be a factor in their teaching, either directly or indirectly. The evidence provided by the Potsdam mathematics program suggests that, in an environment which is genuinely open to and supportive of *all* students and in which the style of teaching is true to the nature of mathematical inquiry, women are attracted to mathematics and are just as successful as men.

As a final note it should be underlined that while the success of the Potsdam mathematics department is the result of a cooperative effort between *all* faculty and students, one person, a black mathematician named Clarence Stephens, deserves special recognition for providing the leadership and philosophical direction which shaped and enriched this program as it developed during the seventeen years he was Chairperson.

Notes

1. See the report on Herbert Northrup's research (*The Changing Role of Women in Research and Development*) in the November-December, 1988 issue of this newsletter, p. 16.
2. Dr. Alan is a pseudonym for a composite teacher from SUNY College at Potsdam.
3. I wish to acknowledge and thank the Social Sciences and Humanities Research Council of Canada for financial support of this study.

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Gila Hanna, The Ontario Institute for Studies in Education

Professor Hanna began by presenting some slides, the content of which she then discussed. The slides follow.

#1: Focus on facts… Who studies what at university: Full-time undergraduate enrollment for 1985-86
Source: Statistics Canada; compiled by Donna Lam; Patrick Corrigan, Toronto *Star*

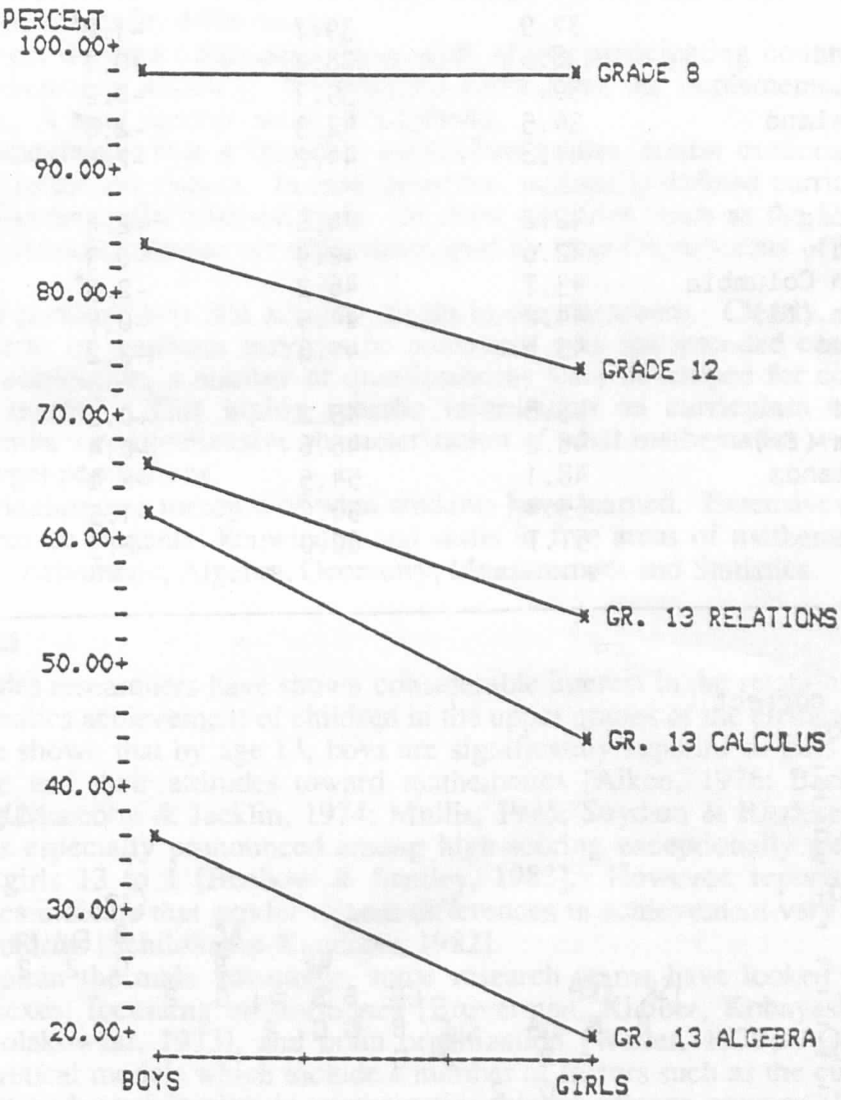
Subject	Men	Women	Subject	Men	Women
Agriculture/sciences	12,039	15,202	Humanities	13,403	19,972
Education	13,865	26,895	Maths/sciences	21,267	7,997
Engineering sciences	36,276	5,084	Social sciences	61,804	61,661
Fine and applied arts	5,724	8,512	General arts/science	31,004	33,088
Health professions	8,267	16,490			

Maths/science: Men 73%, Women 27%; •Engineering: Men 88%, Women 12%

#2: 1987 Degrees, Canadian Universities (% female followed by total degrees awarded)

	BA	MA	Ph.D.
Math	36 (2295)	27 (191)	13 (80)
Medicine	42 (2181)	50 (423)	30 (204)
Law	47 (3175)	39 (109)	33 (12)
Physics	12 (655)	12 (196)	5 (101)
Biology	51 (3383)	43 (312)	32 (129)

#3: Plot to Compare Enrollment of Boys and Girls, Ontario 1982



#4: The absence of women in math/science:

1. one-half of the population finds its options limited (gender equity)
2. efficient use of human resources:
   – expansion of scientific activity
   – untapped human resources of one-half of the population

#5 & #6: Tables used in the presentation of information on geometry (data from the Second International Mathematics Study)

Table 2-3: Means for Girls and Boys, and Mean Differences between the Sexes, by Country

	Girls	Boys	Differences
Luxembourg	23.9	29.6	-5.7*
Nigeria	24.1	27.6	-3.5*
Swaziland	30.8	33.0	-2.2
Israel	36.2	41.3	-5.1*
France	36.6	42.4	-5.8*
USA	37.9	39.7	-1.8*
Thailand	38.5	38.4	+0.1
Sweden	39.1	39.3	-0.2
New Zealand	39.5	42.3	-2.8*
Ontario	41.8	44.2	-2.4*
Hong Kong	42.2	44.8	-2.6*
Finland	42.6	42.9	-0.3
British Columbia	43.7	46.2	-2.5*
Belgium (fl)	44.2	44.9	-0.7
Scotland	45.6	47.8	-2.2
England	45.8	45.2	+0.6
Belgium (fr)	46.2	46.6	-0.4
Netherlands	48.1	54.5	-6.4*
Hungary	55.4	56.9	-1.5
Japan	57.7	60.0	-2.3

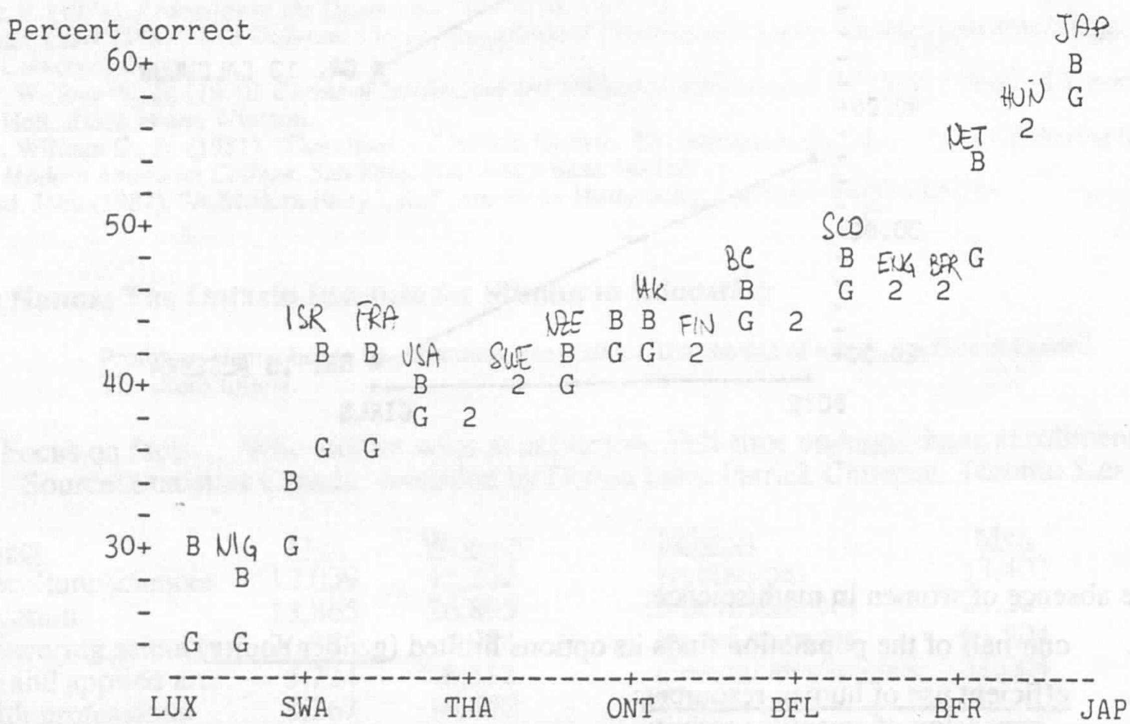


Figure 2-1: Average percent of correct answers for boys and girls in each country. (G = Girls, B = Boys, 2 = Boys and Girls)

Professor Hanna then presented data from her paper "Gender Differences in Mathematics Achievement Among Eighth Graders: Results from Twenty Countries." That paper is reprinted below. A shorter version of this paper, "Mathematics Achievement of Girls and Boys in Grade Eight: Results from Twenty Countries" appeared in the May 1989 issue of *Education Studies in Mathematics*. Reprinted by permission.

The purpose of this paper is to investigate gender differences in mathematics achievement among eighth graders, making use of data of the Second International Mathematics Study (SIMS) conducted by the International Association for the Evaluation of Educational Achievement (IEA). In IEA terms, the eighth grade in the United States and Canada is called Population A, the grade in which the modal student age lies between 13.0 and 13.11 years by the middle of the school year.

The study used a very large random sample stratified by region and school type in each of the 20 participating countries. Due to the very large scale of this study, precise and generalizable conclusions can be drawn about all the aspects of the teaching and the learning of mathematics that were measured, and certainly about the scope of gender differences.

The IEA survey sought detailed information from each of the participating countries on three interrelated aspects of mathematics teaching: the intended curriculum, the implemented curriculum and the attained curriculum. A brief description of each follows.

1. The *intended* curriculum is that reflected in curriculum guides, course outlines, syllabi and textbooks adopted by the educational system. In most countries, nationally defined curricula emanate from a ministry of education or similar national body. In other countries, such as the U.S., intended goals or specifications of curricular content are often developed by state Departments of Education or by local school districts.

2. The *implemented* curriculum is that actually taught in the classroom. Clearly, the teachers' selection of topics or patterns of emphasis may not be consistent with the intended curriculum. To identify the implemented curriculum, a number of questionnaires were developed for completion by the individual classroom teacher. This highly specific information on curriculum coverage and instructional strategies permits a comprehensive characterization of what mathematics was taught and how it was taught to the target populations.

3. The *attained* curriculum is a measure of what students have learned. Extensive achievement tests were designed to measure students' knowledge and skills in five areas of mathematics deemed important and appropriate: Arithmetic, Algebra, Geometry, Measurement and Statistics.

Previous Research Findings

In the past two decades researchers have shown considerable interest in the relationship between the gender and the mathematics achievement of children in the upper grades of the elementary schools. Many studies to date have shown that by age 13, boys are significantly superior to girls in both their mathematical performance and their attitudes toward mathematics [Aiken, 1976; Backman, 1972; Benbow & Stanley, 1980; Maccoby & Jacklin, 1974; Mullis, 1975; Suydam & Riedesel, 1969], and that the male advantage is especially pronounced among high-scoring exceptionally gifted students, with boys outnumbering girls 13 to 1 [Benbow & Stanley, 1983]. However, reports on research carried out in nine countries indicate that gender-related differences in achievement vary considerably both within and among countries [Schildkamp-Kündiger, 1982].

In attempting to explain the male advantage, some research teams have looked at biological differences between the sexes, focussing on hormones [Broverman, Klaiber, Kobayashi, & Vogel, 1968], genes [Bock & Kolakowski, 1973], and brain organization [Waber, 1979]. Other research teams have proposed theoretical models which include a number of factors such as the curriculum, the situation, the environment and participation in mathematics-related science courses [Eccles, 1985; Fennema, 1985; Leder, 1982, 1986]. The literature on sex differences has also considered the possibility that male mathematical superiority is due to psychosocial processes, such as stereotyped sex-role identifications [Aiken, 1976; Becker, 1981; Burton, 1986; Walden & Walkerdine, 1986] and social reinforcement contingencies [Fox, Tobin, & Brody, 1979].

The Data

The 20 countries participating in the study formed two groups. The first group consisted of the seven countries that took part in the longitudinal version (a pretest at the beginning of grade 8 and a posttest at the end of that year), while the second consisted of the 13 countries that took part in the cross-sectional version (tested once only).

The present analyses are based on both the cross-sectional and the longitudinal data. In the cross-sectional part of the study, there were 175 items, 40 items in the Core test and 33 or 34 items in each of four Rotated forms, while in the longitudinal part, there were 180 items, 40 in the Core test and 35 in each of the four Rotated forms. There were 156 items common to the two parts, so the total number of items in the present analysis is 199 (180 + 175 - 156). The results for the 156 common items are based upon 20 countries. Of the remaining 43 items, the results for 23 are based on the seven countries in the longitudinal part of the study, while those for the remaining 20 items are based on the 13 countries in the cross-sectional part. These items were distributed over five major content areas, or subtests, as follows:

Table 1: Number of items in each subtest

Subtest	Longitudinal	Cross-Sectional	Common
Arithmetic	62	46	46
Algebra	32	40	30
Geometry	42	47	38
Measurement	26	24	24
Statistics	18	18	18
Total	180	175	156

Procedure

Every response to an item was coded into one of three categories: correct, wrong, or item omitted. Within each country the achievement results were obtained as follows: for each item the percentage of correct responses (p-values) was calculated separately for boys and for girls, with the student as the unit of analysis. Mean p-values were then obtained for each sex separately and for each country by averaging the p-values for the individual items in that country. Finally, the mean p-values for subtest, country and sex were averaged to yield an overall (for all the countries) average mean p-value for each sex for each of the subtests, with the item as the unit of analysis.

The analyses focussed on:

1. Overall differences between boys and girls by subtest for all countries taken together.
2. Overall differences by subtest and item difficulty.
3. Sex differences within and between countries. (Multivariate analyses of variance and paired t-tests were used.)

RESULTS

Table 2 shows the number of girls and boys in each participating country as well as the mean p-values and standard deviations for the Algebra subtest.

Overall Differences Between Boys and Girls by Subtest

The boxplots in Figure 1 display the distribution of the differences in percentage of correct answers for all the countries taken together (for a total of 37,043 girls and 37,410 boys).

The major results are the following:

- Arithmetic: The median of mean differences between girls and boys (defined as girls' percent correct responses minus boys' percent correct responses) in the Arithmetic subtest (62 items) was zero. The distribution of the differences is shown in the boxplot: the median difference is zero, the range is -9 to +8, and the distribution is more or less uniform across that range. Thus, half the questions favored boys while another half favored girls.

Algebra: The boxplot displaying the differences for the 42 items reveals that for 41 items the differences ranged from -3 to +4 with a median of +1, while one item was an outlier with a difference of -7. Girls had a higher success rate than boys on 50% of the items of this subtest.

Table 2: Descriptive Data on the Algebra Subtest

	Girls		Boys	
	N	Mean (sd)	N	Mean (sd)
Belgium Flemish	718	61 (14)	652	56 (13)
Belgium French	874	57 (16)	1001	53 (16)
British Columbia	1080	52 (18)	1066	51 (18)
Ontario	2401	44 (16)	2421	44 (16)
England	1338	43 (13)	1247	42 (13)
Finland	2091	46 (17)	2303	41 (15)
France	4629	51 (15)	3586	53 (15)
Hong Kong	2726	44 (15)	2822	44 (14)
Hungary	908	51 (19)	844	47 (16)
Israel	1651	48 (16)	1711	50 (16)
Japan	3924	61 (17)	4167	60 (15)
Luxembourg	1016	36 (18)	989	38 (15)
The Netherlands	2667	49 (17)	2769	50 (17)
New Zealand	2574	39 (13)	2629	38 (12)
Nigeria	389	30 (17)	1040	34 (17)
Scotland	627	45 (16)	729	44 (14)
Swaziland	485	26 (12)	414	26 (12)
Sweden	1660	33 (16)	1830	32 (14)
Thailand	1833	39 (16)	1988	37 (14)
USA	3452	43 (14)	3202	42 (13)
Total	37043		37410	
Percent	49.75%		50.25%	

Mean p-values and standard deviations (in brackets) by gender for the twenty countries taken together are as follows:

1. Arithmetic:	Girls 50 (15)	Boys 50 (13)
2. Algebra:	Girls 45 (13)	Boys 45 (12)
3. Geometry:	Girls 42 (15)	Boys 44 (15)
4. Statistics:	Girls 55 (17)	Boys 55 (16)
5. Measurement:	Girls 49 (20)	Boys 51 (18)

- Geometry: In Geometry the picture is slightly different: the boys' success rates were higher than the girls' for 75% of the items. As the boxplot shows, there was a difference of 21 percentage points on one of the items in that subtest. The girls' performance was higher on one quarter of the items.
- Statistics: On the 18-item Statistics subtest girls did slightly better than boys on 50% of the items. The boxplot shows that the differences between the sexes ranged from -4 to +3 percentage points.
- Measurement: Boys did better than girls on the Measurement subtest. The differences ranged from -9% to +5%. The boys' performance was higher on about 70 percent of the items.

```
Subtest

                                                       -------
Arithmetic                                     --------I    + I---------
                                                       -------

                                                          -----
Algebra                                        *        ----I  +I---
                                                          -----

                                                     -------
Geometry          O                            ------I  + I------
                                                     -------

                                                        --------
Statistics                                           --I    +  I--
                                                        --------

                                                     --------
Measurement                                    ---------I+    I-----
                                                     --------         diff.
        -+---------+---------+---------+---------+---------+in
       -24.0     -18.0     -12.0      -6.0       0.0     p-values
```

Figure 1: Boxplots of differences in p-values between girls and boys by subtest. (The location of the median is indicated by a '+'. Outliers are marked with '*', and far outliers with '0'.)

Overall Differences by Subtest and Item Difficulty

To display the differences between boys and girls as a function of item difficulty, the data were also plotted in "flat" plots, in which the Y-axis represents the difference in p-values (girls - boys) for all the countries taken together, and the X-axis the average in p-values for the two sexes taken together. Thus the differences in p-values were plotted against the total proportion of correct answers — which is, in effect, the index of item difficulty. Each "*" in the plot represents one item.

A number of points illustrated by these plots may be of interest:

(a) In Arithmetic, differences between boys and girls tended to be in the boys' favor for the more difficult items (index of difficulty up to 35 percent), and in the girls' favor for the less difficult ones (index above 65 percent).

(b) In Algebra, the only item that showed a difference exceeding 5% is in the 45% level of difficulty. The differences in the girls' favor are spread over the entire range of item difficulty, as are those in the boys' favor.

(c) In Geometry, boys did better than girls on the majority of the items over the entire range of difficulty; when results were better for girls, they were also spread out over the entire range. The item on which boys were considerably more successful than girls (the difference being 21%) was not the most difficult; its average rate of success was 59% (see Figure 2).

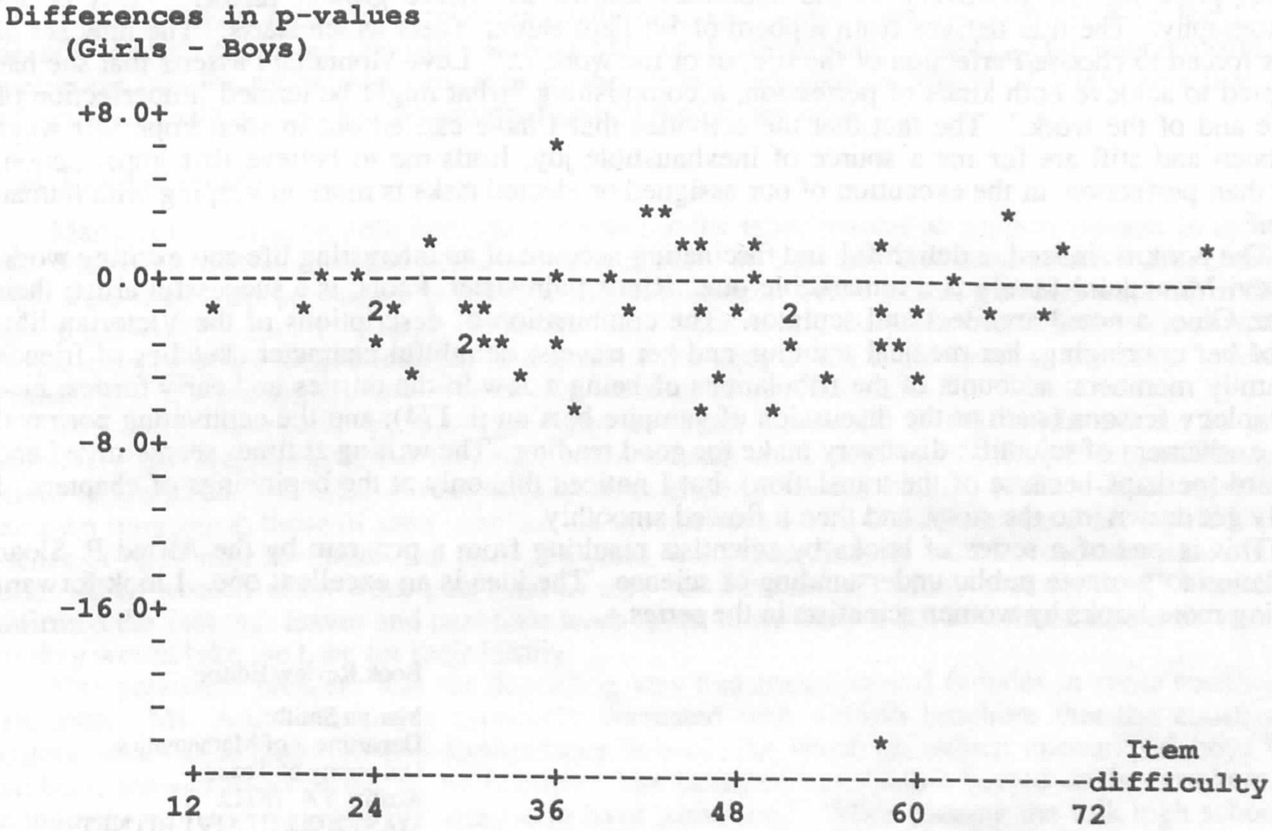


Figure 2: Differences in Geometry between girls and boys as a function of item difficulty. (The differences in p-values are positive for items on which girls did better and negative for items on which boys did better. Each '*' represents one item; each '2' represents two items.)

(d) Girls tended to do better than boys on the easier items in the Statistics subtest. The range of difficulty for the items on which the boys were more successful was from 22 to 60, while girls were more successful on items in the difficulty range from 45 to 85.

(3) In measurement there is a clear pattern of greater success rate for boys on the more difficult items. Boys did better than girls on all the items in the difficulty range from 18 to 45. For the items in the difficulty rate of 46 or more, there is no clear pattern in the distribution of p-values.

— to be continued —

BOOK REVIEW COLUMN

In Praise of Imperfection: My Life and Work by Rita Levi-Montalcini. tr. Luigi Attardi, Basic Books, New York, 1988, ISBN 0-465-03217-6, 220 + xii pages, $18.95.
Reviewed by Martha Smith

Rita Levi-Montalcini is a biologist who, jointly with biochemist Stanley Cohen, received in 1986 a Nobel prize for the discovery of the substance known as "nerve growth factor." This is her autobiography. The title derives from a poem of William Butler Yeats which starts, "The intellect of man is forced to choose/Perfection of the life, or of the work ..." Levi-Montalcini asserts that she has attempted to achieve both kinds of perfection, accomplishing "what might be termed 'imperfection of the life and of the work.' The fact that the activities that I have carried out in such imperfect ways have been and still are for me a source of inexhaustible joy, leads me to believe that imperfection, rather than perfection, in the execution of our assigned or elected tasks is more in keeping with human nature."

The book is, indeed, a delightful and fascinating account of an interesting life and exciting work. The Levi-Montalcini family is a remarkable one. Rita's twin sister, Paola, is a successful artist; their brother, Gino, a noted architect and sculptor. The combination of descriptions of the Victorian life-style of her upbringing, her medical training, and her travels; delightful character sketches of friends and family members; accounts of the tribulations of being a Jew in the thirties and early forties; nice little biology lessons (such as the discussion of vampire bats on p. 174); and the captivating portrayal of the excitement of scientific discovery make for good reading. The writing at times seems stilted and awkward (perhaps because of the translation), but I noticed this only at the beginnings of chapters. I quickly got drawn into the story, and then it flowed smoothly.

This is one of a series of books by scientists resulting from a program by the Alfred P. Sloan Foundation to promote public understanding of science. The idea is an excellent one. I look forward to seeing more books by women scientists in the series.

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AWM EDUCATION COMMITTEE COLUMN

Ann Moskol, Associate Professor of Mathematics/Computer Science, Rhode Island College and a member of the AWM Education Committee, received a grant from the Swedish Institute for a study visit to Sweden in June, 1988, focusing on Swedish projects to encourage women to enter technical careers. What follows is the second of a two-part adaptation by Professor Moskol of her report to the Swedish Institute. In the previous issue (May-June, 1989), the column covered education projects. In this issue, the column covers working life projects and recommendations. [See the AWM *Newsletter*, November-December 1984, for an earlier committee report on Sweden.]

WORKING LIFE PROJECTS

Although the percentage of women who work is nearly equal to that of men (86% versus 89%), women are often segregated in low-paying jobs. Eighty-two percent of women work in offices, services, health-care, children's care, shops, and education, while most men work in technical jobs, manufacturing, transportation, communication, agriculture, forestry, fishing, and commerce. In education, pre-school and junior-school teachers are predominantly women (95% and 99% in NBE, I 86:74, p. 21) while educational administrators are predominantly male (89% in NBE, I 87:40, p. 3).

Most women work for the state, and when there are cuts, women lose their jobs. In addition, 45% of women work part-time compared to 10% of men, most of whom are elderly pensioners. When women retire, they usually obtain less money for retirement because a pension is based on the highest 15 years of a worker's salary.

Several recent bills and documents affirm the state's commitment to equal rights for women in employment. Enacted on July 1, 1980, the Equal Opportunities Act prohibits sexual discrimination in jobs. According to the equal opportunities program of the National Labour Market Board (adopted on February 10, 1984), labor must promote equal opportunities through placement, vocational guidance material, and labor market training. Special programs to encourage women to pursue technical jobs, such as job creation projects, recruitment subsidies, and wage subsidies, are cited in the Labour Market's official document [Swedish Labour Market Administration, 1984]. One concern of a new government bill for establishing equality in the 1990's (adopted in March of 1988) was that most teachers are female, while most educational administrators are male.

Work Environment

Many commented on how important it was for the labor market to support women in technical jobs. Many felt that women did not advance as rapidly as men and that labor union leaders, most of whom were male, had not been concerned with this problem. One woman, who had worked for fifteen years to get more women into technical work, said, "I am now at the point that I don't want to work on this question anymore unless industry will employ the girls at the same level as the boys." Another commented, "Women get the lowest level jobs because of discrimination."

One theory advocated by Gerd Lindgren at Umea University is that while women in groups cooperate, men form hierarchical rankings; when women work with men, men put the women at the bottom of the hierarchy. Men feel especially threatened by strong women, while women subordinate their own interests to those of their families. Although both women and men can share a paid leave of absence of up to nine months at the birth of a child, it is predominantly women who take time off from work. Also, women often work part-time to care for the family. Many women that I interviewed confirmed the fact that leaves and part-time work result in slower job advancement; however, most felt that they would take the time for their family.

One persistent problem was the degrading way that males treated females in some traditionally male jobs. Ms. Anita Ferm was especially disgusted with a 1986 brochure that the construction industry sent out to boys leaving Compulsory School; the brochure, which encouraged boys to be plumbers, showed a naked girl in the bathtub. The board of education objected to the brochure, and the industry replied "that they just wanted to have some fun." When visiting the folk high school for women in Gothenburg, I met a young female technical teacher who had recently left her job as a civil engineer because of problems with her male boss.

The poor treatment of women which exists in traditional male fields like construction does not seem to be present in newer technical industries. The women computer scientists at Erital AB, who were all young (under 40, and most under 30), felt that they were treated equally to the males. Of the 14 women (out of a total workforce of 65) employed at Erital, 12 worked in the development department; one was an assistant group leader, and four were group leaders.

Courses for Male Supervisors

Some companies have given short courses to train male supervisors how to treat women. The local board of education in Stockholm, which has recently started up a cooperative venture with a housing management company to provide practical work for school children, invites supervisors to a training program. Mr. Gote Edvinsson of Boras related how Volvo and Saab have special courses for their supervisors. These programs can be an effective and important first step; participating industries typically need to recruit more skilled workers.

Job Training for Women

Several projects financed by the National Swedish Labour Market Board have helped unemployed women prepare for technical jobs. In Norrkoping, 15 unemployed women were given the opportunity to study technical subjects; two decided to continue further, while 11 became engineers. In Kronobergs, 38 unemployed women were invited to a three-day seminar, "Women in Technics and Industry," where they met women working in technical fields. They attended seminars on subjects such as how to work with men. The project also arranged seminars with male labor representatives to discuss problems that women face while working in male-dominated jobs.

One recurring problem in training women for a male-dominated job is that women often have difficulty obtaining a job because males do not want to accept them. According to Agneta Setz, women in one job training program worked free for a while to convince industry that they were competent. To overcome this problem, a training program at Trollhattan was begun in 1984 in cooperation with Saab; those women who completed the three year technology program were guaranteed a job.

Another problem is that women trained for technical jobs do not remain in them for a long time. Marit Roger is researching this problem in Kristianstad, where women who were trained for male-dominated work ten years ago are now in female-dominated jobs. A similar study done by Liljestrom and Furst-Mellstrom from the University of Gothenburg found that women trained for men's work ultimately ended up in female jobs [Kalvemark 1983, p. 47]. A related problem for women is that they are often the first to be fired, because women are often the last to be hired.

RECOMMENDATIONS FOR POSSIBLE FUTURE WORK

1) A crosscultural study of females studying technical fields and employed in education in Sweden and the United States.

Although the United States and Sweden are both technologically advanced countries, there are some remarkable differences in technical subjects that females pursue. For example, unlike the United States, many Swedish females major in chemical engineering. In 1982, 22.5% of those who earned degrees in chemical engineering in the United States were female [American Council on Education, 1987, p. 174]. In comparison, 45% of the chemical engineering students at the Royal Institute in 1982 were female. (Since the dropout rates for males and females are reportedly similar, the earned degree percentages should be similar; also, I was told that the percentage of females is approximately the same at other universities in Sweden.)

The United States, on the other hand, has more females majoring in computer science. In 1984 and 1986, the percentage of women in computer science at the Royal Institute of Science was 14% and 19%. In the United States, 37.1% of those awarded degrees in computer science during 1983-84 were female [U.S. Office of Education, 1987, p. 176].

In education, the percentage of elementary teachers in Sweden who are females is higher — 99% in Sweden [NBE, I 87:40, p. 7] compared to 86.2% in the United States [U.S. Bureau of the Census, 1987]. Moreover, fewer Swedish administrators are women. Recent percentages are 11% for Sweden [NBE, I 87:40, p. 3] compared to 26% in the United States [Pander, 1988, p. 7]. A new Swedish bill specifically addresses the need to increase the number of female administrators in education.

A study of the reasons why more females pursue a particular study area of job in one country would be helpful in understanding subtle cultural biases. It might also help provide strategies that a country with comparatively low representation could pursue to increase the number of females.

2) Longitudinal projects to increase women in technology

Several expressed frustration that project money was often allocated on a short-term basis, making long-term planning difficult. For example, money given to the institutes of technology during the 1983 campaign had to expended within a year. Some expressed concerns that money for their project had run out, and they had to spend much time trying to find funding sources.

Continuous efforts are needed to increase females in technological fields. When information activities about technology lines for ninth grade girls were curtailed, fewer girls applied for these lines.

Money for long-term projects would allow follow-up activities to determine why girls chose a particular career path. This would permit an examination of the effectiveness of various projects so that necessary changes could be made.

SUMMARY

Although the achievement of equal opportunities for women in technological fields is a complex problem, the Swedish government is committed to achieving this goal. Projects in education are being done at all levels. Preschool students are learning technology through hands-on experiments; hopefully real change in attitudes will be achieved by starting with very young children. At the compulsory school level, projects include special courses for girls in technology and computer science, inservice programs for teachers and counselors, informational programs for ninth grade girls, and vocational placements in technology for girls. For girls in technical programs at the upper secondary school, projects include support groups and programs to inform girls of the advantages of continuing their education in an institute of technology.

Cooperative efforts by labor are also critical to achieving sexual equality for women. A few technical companies are providing courses to train supervisors how to treat women. Swedish researchers are currently investigating why so few women stay in technical careers. Job training for technical fields works most effectively in cooperation with a guaranteed job placement. In new technological fields such as computer science no tradition of sexual bias exists; however, comparatively few women have chosen to enter this field.

Although most agree that Sweden still has a long way to go, most also are optimistic that Sweden can achieve sexual equality in technical fields. The 1984 labor accord and the 1988 government bill describe programs to increase the number of women in technology. These measures offer hope of long-term planning and continuity that will be necessary to attain the goal of sexual equality in technology.

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AWM PARTICIPATES IN CBMS WORKSHOP

by Tricia Cross, AWM Executive Director

The Conference Board of the Mathematical Sciences (CBMS) held a session entitled "Workshop for Strategic Planning in Mathematics Education" in Washington, DC, March 30-April 1, 1989. The workshop brought together representatives of all the CBMS organizations, including two members of the AWM Executive Committee, President Jill P. Mesirov and Past-President (and CBMS Executive Committee member) Rhonda J. Hughes, and AWM Executive Director Tricia Cross. The purpose of the workshop was to focus on the role of CBMS and of the individual professional societies which comprise CBMS in improving education in the mathematical sciences at all levels, elementary school through graduate school. The workshop organizers stated two main objectives: (1) to develop a comprehensive picture of the major issues and activities in the national effort to reform mathematics education and thereby to inform the leaders of the professional societies of the entire landscape of these reform efforts, and (2) to create an agenda for coordinated action by the CBMS societies directed toward the common goal of improving education in the mathematical sciences.

CBMS reaffirmed that "there is universal agreement among leaders in the mathematical community that the mathematics education system needs to be greatly improved, and that changes required to bring about this improvement will not come easily or quickly. Far reaching and enduring reform will require a continuing commitment of time and effort from all constituencies in the mathematical sciences community, as well as development and constant nurturing of attitudes, both in this community and in the public at large, which fosters this reform."

The issues considered at the workshop were grouped into three broad categories: People, Curriculum, and Teaching. The people issues concerned attitudes and resources; the curriculum issues, what is to be taught at all education levels; and the teaching issues, how teachers are trained, how they teach, how students learn, and how to use technology to enhance teaching and learning. The framework for the discussion was provided by the problems and questions raised by the society presidents and representatives.

Mesirov stated in her letter to CBMS Administrator Ron Rosier, "Mathematics education has always been a major concern of the AWM. Our members are involved in teaching at the high school, undergraduate and graduate levels. One of the basic goals of the AWM is to encourage young girls and women to continue their mathematics education and to give them the requisite support to succeed."

With forty-five participants involved in various sessions and activity groups, recommendations and proposed activities too numerous to mention here were produced. Hopefully, action will be taken on some of the best. Some notes follow.

The People category was divided into three subgroups: Attitudes, Pipeline, and Women and Minorities. These subgroups were represented on the "Planning Group" (*i.e.*, the three-person group that set the agenda and directed the discussion of the particular subgroup session) by Cross, Hughes, and Mesirov respectively.

The Attitudes subgroup agreed that the first attitude that must be changed involves expectations. When you expect more, more is achieved. Another set of critical attitudes is the negative ones against the study of mathematics and the need to study mathematics. Many organizations are combatting these attitudes. ORSA's continual efforts to develop new teaching materials to address the negative attitudes toward mathematics and mathematics education and our own Sonia Kovalevsky High School Mathematics Days were cited as good examples of positive efforts getting good results. A number of societies support math competitions, teacher recognition programs, mentoring programs and the like.

The Pipeline subgroup concluded that in order to increase the numbers at all points along the line, the total numbers entering the pipeline at the beginning must first increase. The mathematics community needs a substantial national publicity program (like the national illiteracy programs) which addresses the need for mathematics. Business and industry and government agencies all agree that students need more mathematics background. Many programs exist (DOE, NSF, Young Scholars, etc.) that bring students to business and industry to see how mathematics and science is used, but more of this needs to be done. Similar programs should be initiated for teachers. Uri Treisman's summer program for women and minority students was cited as a much needed and very popular program. The group felt there was a clear need for serious summer work for math students that is not being met by existing programs.

The Women and Minorities subgroup brought forth a number of suggestions and challenges to the societies. They commended the MSEB for taking the lead in moving toward establishing a Corporate Council for Mathematics Education. CBMS societies should encourage this and use this effort as leverage to acquire funding for women and minorities programs. Suggested programs were corporate adopt-a-school programs; aggressive visiting scientist programs; "Big Brother/Sister" programs for MAA, SIAM student chapters and Pi Mu Epsilon Chapters; and luncheon programs for teachers, parents, and students sponsored by corporations. Societies should identify and publicize positive pilot programs and develop materials to help local groups duplicate them. The session encouraged CBMS societies to continue with their individual efforts and to avoid duplication by joining forces whenever possible. However, the group felt that as single entities or even in collaboration, societies alone cannot do it. A positive impact on the current status of women and minorities in mathematics education will not be effected without the help and financial support of business and the federal government.

Three subgroups discussed the varied issues concerning mathematics curriculum. In addition to activities and action items brought before the various groups, time was spent on reaction to and support of the recently released NCTM Standards. AWM went on record in support of the standards last December, as have fourteen other mathematical sciences organizations and twenty-five other professional organizations. But the critical issue is what CBMS member societies could do to promote greater acceptance of the new vision of mathematics education.

A sampling of the recommendations follow: An informed dialogue on the new vision of school mathematics should be conducted within member societies through meetings, publications, and policy making. Members of all societies should promote the new vision of school mathematics among teachers, education policy makers, and the public at large. CBMS societies should attempt to influence test developers to develop tests more compatible with the new vision of school mathematics. At the college level, CBMS societies should work to develop an undergraduate curriculum based on the needs of teachers who will implement the new vision of school mathematics. Imaginative teaching and course development should be recognized at the undergraduate level. At the graduate level, the AMS and MAA should collect and disseminate materials on the training of teaching assistants with particular attention to model programs.

CBMS asserts that the success of reform efforts will depend ultimately upon teachers.

> How they are educated and the conditions under which they work are thus of primary concern to the entire mathematics community. At all levels, the emphasis in teaching mathematics is shifting from transmitting information to actively engaging the students in doing mathematics. Imitation of procedures is to be replaced by real understanding. The emphasis on problem solving, exploration, and communication of mathematical ideas demands different teaching methods. There are many problems related to introducing advances in technology into the math curriculum. Those cited include: resistance to change, how to use them, obtaining the right equipment, the high cost, and how to cope with the rapid growth of technology today and in the future.

All subgroups recommended better communication between educators at all levels. There is a great need for better materials for teachers, more in-service training, better working conditions with emphasis on professionalism, and more.

These issues related to mathematics education are, of course, at the heart of many AWM programs. Our efforts to establish a Resource Center at the AWM office to spearhead new activities and revitalize already successful ones will be the focal point for the mathematical community for information relating to women and mathematics. Current activities including the Sonia Kovalevsky High School Days, the Speakers' Bureau, and the dissemination of career materials are all aimed at these goals. Through articles and book reviews, the AWM *Newsletter* intends to inform and encourage educators at all levels. The new Resource Center will coordinate these efforts and allow the Association to reach a much wider audience than in the past. AWM is currently writing proposals to support these programs and will vigorously pursue funding possibilities in the coming months.

The dialogue at the CBMS workshop prompted Mesirov to write to CBMS presidents urging a mutual sharing of resources and information. In the spirit of the conference, she informed her colleagues that AWM is ready to form partnerships with their organizations to assist them in identifying areas where we could effect positive results. AWM in turn will benefit by reaching a wider audience within the community concerned with women and mathematics.

Special thanks go to Professor Ron Rosier (CBMS Administrator), Ms. Lisa Kolbe (CBMS Administrative Assistant), and the Workshop Planning Committee chaired by Professor Joe Crosswhite for organizing the workshop.

AAUW FELLOWSHIPS

The American Association of University Women Educational Foundation has awarded more than 5000 fellowships since 1888. For 1988-89, $1.4 million was awarded, funding 171 fellowships. Graduate fellowships are awarded in the following areas to women who have demonstrated scholarly excellence: American Fellowships (postdoctoral stipends of $20,000 and $16,500 in 1989-90; $10,000 stipend for final year of doctoral work), International Fellowships ($10,000 stipend for graduate study for foreigners), Project RENEW (grants from $500-$5000 for coursework for reentry into the workforce, career change, or career advancement), and Selected Professions Fellowships ($5000-$7500 stipends for final year of graduate study in selected fields, including the mathematical sciences).

Applications will be available July 15 for the International Fellowships and August 1 for the others; they are due 11/15 for AF, 12/1 for IF, 1/1 for PR, and 12/15 for SPF. To request an application for one (only one) of the fellowships, write to: AAUW Educational Foundation, 2401 Virginia Ave., NW, Wash., DC 20037; (202) 728-7603. Include your name, address, field of study, signature, and date. Please verify your eligibility for the fellowship and specify fellowship category on envelope. Beverly Diamond, a recipient of a postdoctoral American Fellowship for 1988-89, suggests that you obtain the application package as early as possible. "Besides the time required for the receipt of the actual application, some extra time is required for receiving back from references the completed letters of reference, sealed, (and possibly transcripts) which are to be included in the single application package sent from the applicant." She also comments that there is a $15 filing fee.

TEACHER-LINK

The University of Virginia has an electronic network system called Teacher-Link which allows faculty and students in the Curry School of Education to communicate with each other, with faculty and students at other universities, and with public schools locally and around the world. This network has been expanded to Kid-Link where students are communicating locally and internationally.

Teachers, on the electronic conferencing system, are communicating about teaching a variety of topics and collaborating with each other. The conferencing system has many applications as a communications link during teaching internships.

Several teachers have described this electronic conference system as invaluable to their teaching. "What we talk about is everybody's business, and business is booming."

AWM members are encouraged to join in this communication process.

For more info, write Jo Ann Perkins at Western Albemarle High School, Crozet, VA 22932; JAP6T@JABEZ.EDUC.VIRGINIA.EDU.

USSR FULBRIGHTS, 1990-91

The Council for International Exchange of Scholars (CIES) invites applications from American scholars in any field of mathematics or computer science for Fulbright lectureship awards in the USSR during the 1990-91 academic year. Support for this program has been substantially increased. The application deadline is September 15, 1989.

Candidates may apply for either semester or for the academic year. The minimum stay is four months. Eligibility requirements include US citizenship at time of application; in most instances, a doctorate; and postdoctoral college or university teaching experience at the level and in the field of the lectureship sought.

Benefits include $1,700 to $1,800 per month (in US dollars), plus an initial allowance of $4,980 to $7,320 to cover such items as international travel, excess baggage, settling in, books, and services, based on number of dependents (figures quoted are for AY 1988-89). In addition, the USSR host institution provides housing for the grantee and, usually, for dependents, plus a maintenance allowance of 705 rubles per month and an allowance of 830 rubles for the purchase of scholarly materials. Tuition reimbursement for accompanying K-12 children is provided, to $12,000 for grants of 9 months and over, or $8,000 for grants of 4-8 months.

Placement is at institutions of higher learning in the USSR, according to the program to which application is made (Basic Program: lectures at state universities; Academy Program: lectures and seminars exclusively at institutes of the Academy of Sciences of the USSR and of republic academies; Travel-Only Program: international travel grants for US scholars with confirmed private affiliation at a Soviet institution of higher learning for a minimum of two months of research and/or lecturing; no other benefits). For guidance, contact CIES program staff. For further information contact: USSR Program Officer, CIES, 3400 International Drive, NW, Suite M-500, Washington, DC 20008; (202) 686-6247.

Lecturing and research awards are also available in over 100 other countries; for further information, call (202) 686-7866.

CONFERENCE ON WOMEN IN MATHEMATICS AND THE SCIENCES

On November 10-11, 1989, St. Cloud State University in St. Cloud, MN will host a two-day conference for 80-100 selected participants. This conference will seek to tap into some present efforts to reverse the tendency among capable women students not to pursue undergraduate study in mathematics and the sciences. While a substantial amount of research on this issue has been undertaken at the K-12 level, this subject is frequently neglected at the undergraduate level.

The conference will aim to provide not just information on different definitions and approaches to the problems of underrepresentation of women in mathematics and science, but also a workshop opportunity for participants to troubleshoot some of their own institutions' problems and efforts in this area. Our aim is to make the conference a functional initiation of a networking system through which the participants can report and get long-range support and consultation from other institutions for their efforts.

Marsha Matyas of AAAS will be the keynote speaker, and directing the three different tracks of the conference will be Margaret Cavenaugh (St. Mary's College, IN) — Physical Sciences and Engineering, Clare Woodward (U. Minn.) — Life Sciences, and Sabra Anderson (U. Minn., Duluth) — Mathematical Sciences.

We are now soliciting presentations concerning the problem of participation of women (including minority women) in mathematics and science programs. We are interested in descriptions of projects in action or at the research stage which make programs in science and mathematics more hospitable to women, and methods for encouraging and supporting women as students and professionals. We are also interested in factual, data presentations or suggestions how to obtain better data. We would like to see suggestions and methods for forming bridges with high schools (students and teachers), community colleges, and industries. We want the conference to offer material that can be reacted to and applied in workshop groups so that participants can take materials home to their institutions and put these materials to use. A central aspect of the conference will be this application-workshop function, so presentations should reflect that goal. Proceedings will be published.

If you are interested in being a presenter, please send an abstract of proposed presentation and brief vita to: Dr. Sandra Z. Keith, Director, Conference on Women in Mathematics and the Sciences, Mathematics and Statistics Department. 720 4th Ave. S., St. Cloud, MN 56301. Phone: office (612) 255-2282 or home (612) 253-9419.

This conference is funded by the Ford Foundation, Honeywell Foundation, and Cray Research.

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 and book review material** to Anne Leggett, Dept. of Math. Sci., Loyola Univ., 6525 N. Sheridan Rd., Chicago, IL 60626;
email: cantor!borel!alm@gargoyle.uchicago.edu (or .bitnet) (preferred); LMA24@LUCCPUA (bitnet)
Send all material regarding **book reviews** to Martha Smith, Dept. of Math., University of Texas, Austin, TX 78712. email: MAST202@UTAIV1.BITNET
Send everything else, **including ads**, to Tricia Cross, AWM, Box 178, Wellesley College, Wellesley, MA 02181. email: PCROSS@LUCY.WELLESLEY.EDU

ADVERTISEMENTS

Institutional members of AWM receive two free ads per year. All other ads are $20 and must be prepaid. Institutions listed in alphabetical order. All institutions advertising in the AWM NEWSLETTER are Affirmative Action/Equal Opportunity Employers.

FLORIDA STATE UNIVERSITY. Mathematics Dept., Tallahassee, Florida 32306. Apps are invited for two tenure-track asst. professorships, one in the area of Euclidean harmonic analysis and one in the area of transcendental number theory, with appointment beginning August 1990. The candidates should have potential for excellence in research and teaching. Please send resume, and arrange for three letters of recommendation to be sent to Ralph D. McWilliams, Chair. App deadline in Sept 15, 1989

MARSHALL UNIVERSITY - Mathematics; tenure track and/or temporary positions. Rank and salary dependent on qualifications and experience. Minimum qualifications are Master's degree in mathematics. Ph./d. degree or its equiv is required for tenure track positions. Duties will consist of 12 to 15 hours of math instruction and taking an active part in the affairs of the dept. Apps will be accepted until positions filled; first screening is June 12, 1989. Send resume, graduate transcripts and three letters of reference to Professor Steven Hatfield, Search Committee Chair, Mathematics Dept., Marshall University, Huntington, WV 25755-2560.

Mathematical Sciences Research Institute, Berkeley, California. The Institute invites apps for the year 1990-1991. These programs will be featured: Partial Differential Equations and Continuum Mechanics (full year), Representations of Finite Groups (first half), Strings in Mathematics and Physics (second half). There are three categories of awards: postdoctoral fellowships, senior memberships, and research professorships. For complete announcement of the Institute's 1990-1991 programs and information sheet for applicants write to Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, CA 94720.

Association for Women in Mathematics

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Note: AWM membership year is October 1 to October 1.

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July - August 1989

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