AWM
ASSOCIATION FOR WOMEN IN MATHEMATICS

Volume 22, Number 3 NEWSLETTER May-June 1992

PRESIDENT'S REPORT

New (Temporary) Quarters

Since I last wrote, Jodi Beldotti has made massive strides towards efficiency in the AWM office at its new location at Wellesley, in the Simpson wing of the Infirmary, second floor, rooms 206-208. We may stay there for a few months while a more permanent location is decided. Thanks are due Wellesley, as always, for its hospitality! Arrangements are under consideration, lest we truly overstay our welcome at Wellesley, but nothing is settled yet.

By the time you receive this you may also have received less welcome mail, namely dues reminders and updates; if not, please look at your checkbook register and make sure you're paid up.

Sleeping With the Enemy?

The March 13th issue of *Science* has several articles about women in science, including one about mathematics written by Paul Selvin. I am dismayed by the negative tone and discouraging message of this article and understand that there will be some retraction of the bit about graduate programs which appears to be attributed to Rhonda Hughes but does not reflect her views. Several of us, including women interviewed by Selvin, are writing a letter expressing our dismay, and there may be more written in these pages as well. The article concludes that the situation for women in mathematics is worse than in other sciences. Not!

On the Brighter Side

The NSF has funded distribution of our *Careers That Count* booklet, and already several boxes of our supply of 30,000 have been shipped to programs encouraging the study of mathematics. We even sent copies over the Canadian border to Katherine Heinrich and Malgorzata Dubiel at Simon Fraser, in time for their March outreach program, "Discover the Possibilities." The MAA and JPBM have also publicized the booklet, and the orders keep the student assistants busy.

IN THIS ISSUE

AWM
ASSOCIATION
FOR WOMEN IN
MATHEMATICS

The Association was founded in 1971 in Boston, MA. The purpose of the association is to encourage women to study and to have active careers in the mathematical sciences. Equal opportunity and the equal treatment of women in the mathematical sciences are promoted.
The *Newsletter* is published bi-monthly.
The Editor welcomes articles, letters, and announcements.
Circulation: 4,000.

Siam In July

Joyce McLaughlin has organized an outstanding panel of mathematicians working in government labs to take place at SIAM in July 1992. Panelists include Laif Swenson, Pamela Coxson, Alex Tolstoy, Suzanne Lenhart, Fern Hunt, and Helen Yee. Don't miss it! The Schafer Prizes will be awarded on July 21; we also plan a dinner for the winners.

Changing a Culture or Two

The National Academy's report of the Committee on Doctoral and Postdoctoral Education in the U.S. was printed this month. This committee, chaired by Ronald Douglas, visited several programs to see what works/what doesn't work, and their report contains substantial observations about the nature of current programs. Appendix B contains sound advice for prospective graduate students in mathematics, advice which acknowledges the importance of a good learning environment.

The AAUW report "How Schools Shortchange Girls" speaks bluntly about how girls are doing in math and science, and several AWM members are involved in roundtable discussions of this call for equitable treatment of girls in the classroom.

Thanks

❧ to Mary Gray for drafting the dispute resolution statement (see below)

❧ to Linda Langdon for donating hours in the AWM office

❧ to Jill Mesirov and Alice Schafer for seeing that AWM has a home

and

❧ to Beth Ruskai for learning more about non-profit finance than she wanted to.

Best wishes for a productive, restful summer,

Carol

Carol Wood
Middletown, Connecticut,
29 March 1992

P.S. I am saddened to report the sudden death of AWM member Larry Corwin. His efforts on behalf of women will be sorely missed, as will his kindness and his wit.

Carol

AWM STATEMENT ON DISPUTE RESOLUTION

To judge the relative merits of mathematicians is not an easy task. Whereas people of good will may differ on the substance of decisions concerning hiring, tenure and promotion, most would agree that such judgements are best made within the mathematics profession, rather than in courts of law. Unfortunately, situations arise where faculty feel that they have not been fairly treated and that inappropriate considerations have entered into the deliberations of their colleagues or of administrators. If an impasse has been reached, some institutions have found that a useful technique is to form an outside review committee consisting of those with expertise in the field of the faculty member who is challenging an adverse personnel decision. For example, two persons might be chosen by each side to the dispute, and those four might chose a fifth person. Although an outside committee can only make recommendations, with the institution retaining the authority to grant promotion and/or tenure, the advice of knowledgeable parties not directly involved may lead to a solution satisfactory to all.

AWM recommends that referral of a dispute to an outside review committee be considered as an alternative to resolution by the courts.

The above statement was approved by the Executive Committee of the Association for Women in Mathematics in February 1992.

CORWIN MEMORIAL FUND

A fund is being set up in memory of Larry Corwin, probably for a named lecture series or possibly for a student fellowship. Checks made payable to the Rutgers University Foundation/Larry Corwin Fund may be sent to Lynn Braun, Department of Mathematics, Rutgers University, New Brunswick, NJ 08903.

AWARDS AND HONORS

CONGRATULATIONS to the women listed below for their meritorious achievements.

Six National Science Foundation Graduate Fellowships were awarded to women in the mathematical sciences.

This list has been arranged alphabetically with the following information: name, current field, baccalaureate institution, level of study (1 indicates an awardee with current or previous graduate study), and tentative fellowship institution. Fellowships provide three years of support. Names of persons offered continuation awards are not included below.

The fellows are: Elaine Chew, Operations Research, Stanford University, Stanford University; Karen Elizabeth Edwards, Topology, Berkeley, Berkeley; Lisa Karen Fleischer, Operations Research, 1, Harvard University, Cornell University; Lucy Lifschitz, Algebra, 1, UCLA, Yale University; Kathy Elizabeth Russell, Statistics, Rice University, Texas A&M University; and Catherine Ann Sugar, Algebra, Pomona College, Princeton University.

Five NSF Minority Graduate Fellowships were awarded to women in the mathematical sciences. The list is given in the same format as above.

The fellows are: Karen Marie Apodaca, Mathematics, New Mexico State, New Mexico State; Maria F. Basterra, Algebra, University of Texas at Austin, Berkeley; Kathryn Marie Lewis, Topology, University of Kentucky, Purdue University; Cassandra Moore, Applied Math, Southwestern University (TX), Rice University; and Dorn Vernessa Vernon, Algebra, Howard University, Howard University.

Three NSF-NATO Postdoctoral Fellowships were awarded to women in the mathematical sciences.

This list has been arranged alphabetically with the following information: name, current field, current institution, and fellowship institution.

The fellows are: Lea R. Birmiwal, Probability and Statistics, University of Connecticut, University of Toronto; Catherine R. Carroll, Dynamics, Northwestern University, Institut des Hautes Études Scientifiques (IHES); and Rachel A. Kuske, Applied Math, Northwestern University, University of Utrecht.

MEMBERSHIP AND NEWSLETTER INFORMATION

Membership dues

Regular: $25
Family: $40
Student, unemployed, retired: $8
Prize Fund add-on: $5
General funds add-on: $10
Contributing: $100
Institutional:
Level 1 (two free ads and up to three student memberships): $80
Level 2 (two free ads and up to ten student memberships): $120

Subscriptions and back orders

Individual and institutional members receive a subscription to the newsletter as a privilege of membership. Libraries, women's studies centers, etc., may purchase a subscription for $30/year. Back orders are $6/issue plus shipping/handling ($5 minimum per order).

Ad information

AWM will accept advertisements for the *Newsletter* for positions available, programs in any of the mathematical sciences, professional activities and opportunities of interest to the AWM membership and other appropriate subjects. The Executive Director, in consultation with the President and the Newsletter Editor when necessary, will determine whether a proposed ad is acceptable under these guidelines. *All institutions and programs advertising in the newsletter must be Affirmative Action/Equal Opportunity designated.*
Institutional members receive two free ads as a privilege of membership. For non-members, the rate is $60 for the first eight lines of type plus $6 for each additional line.

Deadlines

Editorial: 24th of January, March, May, July, September, November
Ad: 5th of February, April, June, August, October, December

Addresses

Send all **Newsletter** material **except ads and book review material** to Anne Leggett, Dept. of Math. Sci., Loyola University, 6525 N. Sheridan Road, Chicago, IL 60626. FAX: (312) 508-3514; phone: (312) 508-3554; email: aleggett@lucpul.it.luc.edu; LMA24@LUCCPUA.BITNET
Send all material regarding **book reviews** to Cathy Kessel, 2803 Parker, Apt. 2, Berkeley, CA 94704. email: kessel@soe.berkeley.edu
Send everything else, **including ads**, to Jodi L. Beldotti, AWM, Box 178, Wellesley College, Wellesley, MA 02181. Phone: (617) 237-7517; email: jbeldotti@lucy.wellesley.edu

Martha Sloan, an electrical engineering professor at Michigan Technical University, has been elected the President-Elect of IEEE. She will be IEEE's first woman president.

Christine M. Anderson received the 1991 Gertrude M. Cox Scholarship at the Joint Statistical Meetings in Atlanta, August, 1991.

Joan Raup Rosenblatt received a Founders Award from the American Statistical Association, August, 1991.

Helga Tecklenburg was awarded the Thales-Preis für Geometrie for 1991 by the Diercks-von-Zweck-Stiftung.

AMS AWARDS

Congratulations to AWM members Marcia P. Sward and Harvey B. Keynes on the awards they received recently from the American Mathematical Society.

Keynes received the 1992 Award for Distinguished Public Service for his work with the University of Minnesota Talented Youth Mathematics Program, an intense and accelerated mathematics program for highly talented mathematics students in grades 5-12. He has served on the faculty of the University of Minnesota for most of his career, as well as holding numerous visiting positions. He earned his B.S. and M.A. from the University of Pennsylvania and his Ph.D. from Wesleyan University.

His citation reads:

> For his multifaceted efforts to revitalize mathematics education, especially for young people. Keynes' career encapsulates, in a single individual, the tripartite mission of the university: education, research, and service.

Sward received the 1992 Citation for Public Service. Currently the Executive Director of the Mathematical Association of America, she has served on the faculty of Trinity College and in a number of administrative positions, including the Executive Directorship of the Mathematical Sciences Education Board for which she received the award. She earned her B.A. from Vassar College and her masters and doctoral degrees from the University of Illinois.

Her citation reads:

> For her contributions toward establishing and directing the Mathematical Sciences Education Board (MSEB) from its inception in the fall of 1985 until August 1989. She blended a deep understanding of educational issues with vision, judgement, creative management, and unswerving optimism to transform the MSEB from an untested dream into what is widely recognized as one of the premier national leadership organizations in the country.

CAMBRIDGE MEETING

European Women in Mathematics (EWM) and the Association for Women in Mathematics (AWM) are arranging some informal joint activities for the combined meeting of the American Mathematical Society (AMS) and the London Mathematical Society (LMS) in Cambridge, England, June 29 through July 1, 1992.

AWM/EWM will display materials in the exhibit area. Although the meeting format precluded arranging a formal session, we hope that an informal lunch can be arranged. Details will be posted at the display table and will be available from Bettye Anne Case, Cora Sadosky, and Caroline Series. It would be helpful if interested participants identified themselves to us in advance; the AWM office (jbeldotti@lucy.wellesley.edu) will coordinate, or you may email case@math.fsu.edu.

BOOK REVIEW

Surveying Sisters: The Position and Perception of Women in an Erstwhile Male Profession, by Clara Greed, Routledge, New York, 1990, ISBN 0415048451.

"As research and human experience have shown, women suffer considerable disadvantage within a built environment that is developed by men primarily for men," said Clara Greed in her study of women surveyors in Great Britain. She noted that this fact alone is enough to argue that women should be recruited and encouraged in Great Britain's surveying community, a group of professionals who deal not only with land surveying, but also with land's valuation, investment, transfer, development, and management.

The Royal Institution of Chartered Surveyors (RICS) consists of mapping scientists and geodesists as well as field practitioners and housing managers. Ninety-seven percent of RICS is male. Yet, twenty percent of the surveying student population is now female.

Professor Greed utilized a feminist perspective together with qualitative sociological methods to study RICS members and their world views; their assumptions about land use; their assumptions about other people and about women; and finally, their assumptions about who is the "right type" to be a surveyor.

Although her audience is women surveyors, Greed's secondary targets are those concerned with women in science and mathematics, and those concerned with urban theory and professional practice.

The author purposely left herself in the narrative, and as a result, her insights, conclusions, and recommendations are of interest not only to all women surveyors, but also to men surveyors on the forefront of worldwide progress in the mapping professions.

"It is a major hypothesis of this study," said Greed, "that one should not see all the 'little' occurrences of everyday life as being trivial, irrelevant, or not serious enough to be counted as real data for the research; but rather as the very building blocks of the whole subcultural structure." Consequently, Greed's findings on the status of women Chartered Surveyors are comparable to findings on women surveyors and cartographers in the United States.

For example, "far from encouraging girls, many schools positively discouraged them from entering surveying," Greed noted. "One woman said she was made to feel naughty and disobedient for wanting to be a surveyor."

Once into and out of the university, "several women commented that 'when we were all in school together, we got on as a team,' but the very same women say their treatment in the team in retrospect was less than equal. 'It's only when you get out in practice and talk to others that you realize how different it might have been.' "

Other findings included those of women searching for jobs, who encountered a men's network for the first time; stories of women on the job, who discovered that they were judged differently from their male colleagues; and reports on "inverted colonialism" in professional associations themselves.

On the bright side, Greed pointed out that women have come a long way in the last twenty years, the second wave of feminism. Backlash in the thirties, forties, and fifties had negated or seriously retrenched the gains that women had made during the first wave of feminism that had also won them the right to vote. It is no small miracle that the backlash was finally challenged in the late sixties and early seventies, eventually opening a few doors. Greed noted that the continuing wrongs should be

studied, so that they can be corrected, and she offered solutions.

With regard to "patriarchal women," i.e. those who become ultraconservative and instrumental in the male network, Greed was understanding and forgiving. This is how they have had to "get by," Greed said. Deep down, they all have a feminist conscience, which should give us hope. Moreover, countering those few women who have attempted to hold other women back, there have been some men who have supported women in the surveying and mapping professions, and Greed commended those men who have, with the help of their mothers, sisters, friends, wives, and daughters, developed a feminist conscience.

On the other hand, chivalry (gentlemanly graciousness coupled with a subtly superior attitude) was not considered by Greed to be beneficial to women surveyors. Damaging in the long run, chivalry is evidence of a patriarchal network in which women remain daughters, figuratively speaking, and never become equal partners at the top.

Another common observation of women surveyors was their sense that inequalities and other problems are made to seem like their own fault. Therefore, women have often hesitated to make recommendations. In an extreme example of the ignoring of a woman surveyor's suggestion, her advice for better lighting in a shopping mall's parking lot was not taken, and the lot became the scene of a rape-murder. Of course, yielding to a woman's counsel does not necessarily prevent death, and Greed made it clear that she did not wish to sensationalize the worst-case scenario. However, she noted that women's perspectives must be considered, in order to better both the surveying profession and the world it serves.

Often, the scientific and technical professions have tried to change women; for example, with assertiveness-training and seminars on power-dressing, women have been instructed on how to "fit in." Greed found this absurd, instead recommending that the science and technical professions learn *from* women. For the surveying and mapping professions, she suggested a neo-Marxian approach, linking society to space (or land, or territory). "Humankind should be studied in the context of land, the built environment, and landed property interests."

Up until now, "surveyors have exempted themselves from social issues, and are instead concerned with developers' profit. Human need is marginalized as a purely social issue," said Greed. "Therefore, the profession, by ignoring human need, can have a *negative* impact on society," Greed cautioned. "It would seem that the concept of market demand fuses together in the surveyor's mind a mixture of 'what the people need' with 'what the investors want.' "

With the post-1992 European Community in a position to rediscover itself, and with the mapping professionals needing to find their place in that new order, the time is now for those professions to redefine themselves to include social issues and modern management. Instead of telling women to be more assertive, she argued, we must teach the professions to be more receptive and responsible toward society.

Reviewer: Wendy J. Woodbury Straight, Professional Land Surveyor; Editor, Progress and Perspectives: Affirmative Action in Surveying and Mapping

Book Review Editor:

Cathy Kessel
2803 Parker, Apt. 2
Berkeley, CA 94704

QUERIES

A middle school teacher is looking for photos of some women mathematicians. If you know a source, please contact the Wellesley office. The women are: Irmgard Flugge-Lotz, 1903-1974, engineering mechanics, aeronautics, and automatic control; Ellen Amand Hayes, Wellesley College, 1851-1930, applied mathematics; Pelageya Yakolevna Polubarinova Kochina, 1899-?, hydrodynamics, differential equations; Helen Abbott Merrill, Wellesley College, 1846-1949, analysis; and Hanna Neumann, 1914-1971, combinatorial group theory.

Kathy Heinrich at Simon Fraser University (heinrich@cs.sfu.ca) would like to know if anyone has been doing research into the ways in which mathematics has been used in North American native societies. Please send her any references you may have.

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. International travel must be on U.S. flag carriers.

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. The three award periods have deadlines of February 1, May 1 and October 1.

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

EDUCATION COMMITTEE

The following report, contributed by Tang Rui Fen (East China Normal University, Shanghai, China), presents information about initial explorations with computer-assisted mathematics instruction in selected Chinese schools.

In China, computer-assisted instruction (CAI) for mathematics in schools has been in the process of development for several years. This article describes the current situation and the results obtained and also proposes some problems which need further investigation.

The Current Situation

In recent years, many key schools in China have been equipped with microcomputers; meanwhile various CAI experiments are being tried out by mathematics teachers (many of whom are women). They produce software, practice in classrooms, and analyze the achievement and ability of students in experimental and control classes.

Next we describe the main patterns of CAI for mathematics used in China.

1. Teacher's exposition (which plays an important role) incorporates demonstration by computer.

Mostly this pattern is used to show some geometric figures and graphs of functions, for example, in order to understand the features and variability of elementary functions. It is especially the computer which can simulate a dynamic process, generating geometric loci and changing parameters so as to observe the variations of shape. Geometric transformations such as translation and rotation can be visually described on the "electronic board."

In fact, this pattern belongs to the traditional teaching pattern; the whole procedure is controlled by the teacher, and the computer is only an assistant, an advanced tool provided for the teacher.

2. Students study independently with the computer.

This pattern often occurs as a unit review of teaching content. The specific software, including a summary and system of knowledge as well as a series of exercises or problems, is designed so that students, by themselves, can assess their comprehension and their ability to do applications and skill operations. Now it is more concerned with number drill and expression.

The characteristic of this pattern is the interaction between student and computer. When the student is responsible for operating the machine and makes decisions and choices with his or her own mind, it seems to

better embody the spirit of "students are the main source of learning." Thus the pattern is different from traditional learning.

3. Tutoring pattern, student and teaching joining together

In accordance with the programmed instruction principle, software instruction for a whole chapter or section is designed to explore whether CAI can replace regular class instruction. Each software presentation always divides into steps: a review, the introduction of new concepts, the consolidation of knowledge, and exercises. Before or after the student operates the computer, the teacher makes some outline and checks the homework.

In these experiments, the general teaching objectives, even the concrete requirements, are prescribed by the teacher, whereas the representation, transition, and acceptance of knowledge are performed independently by the student. Teachers only observe and help individuals when needed. Thus it is not "teacher-centered, textbook-centered" any more.

Results

The traditional teaching method — teacher speaking and students listening — was changed, and it is advantageous to realize that mathematics should be a process of mathematics activity.

By motivating the student's learning interest and cultivating the student's creative ability, in particular, CAI enhanced the student's ability to acquire more and better knowledge themselves.

By strengthening both the communication and the connection between teacher and student and by speeding up the alternation of learning and feedback in time, CAI helps in implementing the principle of "teaching students in accordance with their aptitudes" and to carry out the individualization of instruction.

By providing a powerful visual means, representing an active concrete image, CAI helps to cultivate the ability of abstract thinking.

Some Thoughts

The experience which comes from practice should be investigated and explored intensively. Research should be undertaken based on mathematical education theory.

Technological aspects should be improved in order for CAI to develop successfully.

Constructing a powerful team to make experiments and study CAI for mathematics is an urgent need.

It is suggested that the following activities be done first: strengthen the research on mathematics education theory in the computer age, particularly concerning mathematics education methodology and modes; starting from the aim of mathematics education, analyze and select the content of mathematics, and determine whether it is appropriate for CAI; and devote more attention to teacher training, to prepare a new generation of teachers for an information society.

Any comments? Write to:

AWM Education Committee
c/o Sally I. Lipsey, Chair
70 E. 10th Street, #3A
New York, NY 10002-5102

WISENET

Women in science, mathematics or engineering and students interested in those disciplines are encouraged to join a newly established network to help them progress in their careers. WISENET/Midwest (Women In Science and Engineering NETwork) is a Midwest network that promotes the interests of women and girls in science, mathematics and engineering.

Its objectives include: to improve access to careers and advancement in science and engineering for girls and women of diverse backgrounds; to support research and analysis of recruitment and retention strategies; to maintain a database of resources and information about women scientists and engineers in the midwest; and to serve as a communication link among midwest groups and individuals interested in women in science and engineering.

This mail list has been established as one means of communication. It is available to anyone with access to electronic mail; the owner is Dr. Alice Dan, U16715@UICVM.BITNET. To activate your membership, send the following command in the *body* of email to listserv@uicvm.uic.edu on Internet or LISTSERV@UICVM on BITNET:

SUBSCRIBE WISENET your full name

SUMMER MEETINGS AND CONFERENCES

The 44th International Meeting of the ICSIMT (International Commission for the Study and Improvement of Mathematics Teaching) will be held at the University of Illinois at Chicago, August 3-8, 1992.

The theme of the meeting is "The Student Confronted by Mathematics." The meeting will focus on the following questions: What is the nature of the knowledge and understanding of mathematics that students have? What mathematics do we want students to develop? What out-of-school mathematics do students bring to the classroom? How can we exploit this? What are the obstacles to developing concepts and learning mathematics (language, symbolism, abstraction, formalism, students' and teachers' conceptions of mathematics)? How do students develop mathematical concepts, and how can this be stimulated? How can students be involved in doing mathematics? How can this involvement lead to the development of mathematical knowledge?

Plenary sessions will set the theme of the conference. The main activity of the conference will take place in small working groups where the above questions will be discussed. Working groups will include presentations directly related to the topics under discussion.

For more information, write ICSIMT 44, c/o Dr. A.I. Weinzweig, University of Illinois at Chicago, Department of Mathematics, Statistics, and Computer Science m/c 249, Box 4348, Chicago, IL 60680; phone (312) 996-8612; FAX (312) 996-1491; email U14818@UICVM.BITNET.

The Center for Research on Parallel Computation (CRPC), a consortium of Argonne National Laboratory, Caltech, Los Alamos National Laboratory, Syracuse University, Rice University, and the University of Tennessee, is committed to a program of research that will make parallel computer systems truly usable — at least as usable as sequential computer systems are today. Several programs exist within the center, along with several research thrusts, to attain this goal. Programs involving students include fellowships, minority outreach, course work, employment, and academic degrees.

The CRPC is pleased to offer annual summer research opportunities for undergraduates, all of which are 10-12 weeks in duration, May through August, and include: a stipend to cover housing and expenses; assignment of a CRPC researcher/ mentor to assist with project design and implementation; and training on the use of parallel machines.

The programs at each CRPC site are: Argonne National Laboratory, research projects in optimization and scientific application areas; Caltech, research projects in compositional programming systems, differential equations, and scientific application areas; Los Alamos National Laboratory, research projects in differential equations and scientific application areas; Rice University, research projects in FORTRAN programming systems and optimization; the University of Tennessee, research projects in implementations of distributed memory versions of LAPACK linear equation software, virtual shared memory implementation of linear algebra algorithms, and performance comparison between workstation network, virtual memory, and MIMD distributed memory systems; and Syracuse University, research projects in FORTRAN programming systems and scientific application areas; focus on industrial applications, virtual reality, and geographic information systems; weekly seminars on computational science, graduate school, and other topics; and a final project, which includes a written research report, presented to faculty and students at Syracuse University.

The application deadline has already passed. However, late applications may be considered. For further information contact Ann Redelfs at (713) 285-5181.

H.R. 3746

H.R. 3746 would establish a Commission on the Advancement of Women in the Science and Engineering Work Forces. Introduced by Congresswoman Morella (R-MD) with 23 co-sponsors as of March 6, the aforementioned Commission would study issues related to the recruitment, employment, retention, and advancement of women scientists in academia, industry, and government, including a synthesis of available research on successful programs and practices.

STEVENS INSTITUTE TELECONFERENCES

The New Jersey Network, a group of four public television stations funded by the state, and Stevens Institute of Technology have jointly produced a series of nationally broadcast live, interactive television programs showing high school teachers how to enliven their math classes with computers. Teachers from five New Jersey school districts have participated for the last three years in the Center for Improved Engineering and Science Education, a Stevens educational initiative; about 60 teachers are currently enrolled.

Each of the 90-minute programs includes two 10-minute modules, or videotaped segments, first showing a teacher using mathematics software in class and then explaining its use. The same teacher featured in the taped segment was then available to answer questions phoned in to an 800 number. Topics of the programs included how to introduce new ideas, collaborative learning, exploratory learning, the teacher as coach, real world contexts, and other thematic approaches to high school mathematics instruction. Workbooks with further suggestions for teachers, exercises for students, and associated materials were also mailed to registered teachers.

Many students respond positively to computers because they can interact privately with the machines, which don't embarrass the student by telling the whole class when his or her answer is wrong. Much of the available mathematics software also communicates with images and sound in ways that appeal to teenagers who have played video games. But most schools limit computers' use to teaching elective courses such as computer programming.

Says Dr. Edward A. Friedman, professor of management at Stevens and director of CIESE:

> Computer technology is rarely adapted to teaching core academic subjects, such as science and mathematics, where the technology could have its broadest effect. The full potential of computers — providing individualized instruction and giving teachers feedback on students' progress — has yet to be realized.

Now is the time to get teachers involved with computers, Friedman believes. There are about 3.3 million computers in K-12 level schools for the nation's 40 million students, and schools in the United States are acquiring new computers at a rate of close to 500,000 a year, according to Link Resources Inc., a market research company in New York. "Computers are becoming increasingly pervasive in our schools," says Friedman. "They are going to be used. We'd like to see them used effectively."

BU'S PROMYS

A Program in Mathematics for Young Scientists (PROMYS) will be held at Boston University, June 28 to August 8, 1992. PROMYS offers a lively mathematical environment in which ambitious high school students explore the creative world of mathematics. Through their intensive efforts to solve a large assortment of unusually challenging problems in number theory, the participants practice the art of mathematical discovery — numerical exploration, formulation and critique of conjectures, and techniques of proof and generalization. More experienced participants may also study abstract algebra and dynamical systems. Problem sets are accompanied by daily lectures given by research mathematicians with extensive experience in Professor Arnold Ross's longstanding Summer Mathematics Program at Ohio State University. In addition, a highly competent staff of 18 college-aged counselors lives in the dormitories and is always available to discuss mathematics with students. Each participant belongs to a problem-solving group which meets with a professional mathematician three times per week. Special lectures by outside speakers offer a broad view of mathematics and its role in the sciences.

PROMYS is a residential program designed for 60 ambitious high school students entering grades 10 through 12. Admission decisions will be based on the following criteria: applicants' solutions to a set of challenging problems included with the application packet; teacher recommendations; high school transcripts; and student essays explaining their interest in the program.

The cost to participants is about $1,250 for room and board. Books may cost an additional $100. Financial aid is available. PROMYS is dedicated to the principle that no student will be unable to attend because of financial need.

PROMYS is directed by Professor Glenn Stevens. Application materials may be obtained by calling (617) 353-2560. Applications are due by June 1, 1992. Women and minority students are encouraged to apply.

Here is a quote from a former young woman participant:

> I have had quite an educational, enlightening, and fun-filled summer. Educational, because I learned more about math and myself that I could ever have imagined. Enlightening, since my experiences have caused me to understand and appreciate many things in new ways. It was fun-filled for many reasons: the fun students, many of whom I grew very close to and formed lasting friendships with; the stimulating classes; the city and the openness to explore it; and most of all the math — everywhere, all day, wherever, whenever, there was math, beautiful, complex, intriguing math. I have never had as productive (and still such a fun) summer!

Obviously a satisfied customer!

WOMEN IN SCIENCE TABLOID

Try this inexpensive vehicle for introducing girls to the many interesting careers available today. In sixteen heavily illustrated pages, this tabloid profiles a variety of contemporary women with exciting careers in fields from computer programming to biophysics, from engineering to medicine. It's packed with historical notes on women scientists, inventors, and Nobel Prize winners, as well as games, quizzes, puzzles and a resource bibliography.

Bulk orders are discounted for classroom and program distribution: $52.50 per 30 copies, plus 10% shipping/handling; $150 per 100 copies, plus 10% shipping/handling. Purchase orders and credit cards are accepted. For more information, contact the National Women's History Project, 7738 Bell Road, Windsor, CA 95492; (707) 838-6000.

ENRICHMENT PROGRAM SEEKS VOLUNTEERS

For a few hours each month, a dedicated group of adults have explored tropical rain forests, probed the mysteries of the deep and found fascination under a microscope with their ten-, eleven- or twelve-year-old friends. The kids are Boston Public School students, and the adults are their volunteer mentors in an innovative program called Masterminding Math and Science.

Spearheaded by Boston Partners in Education, a nonprofit organization dedicated to enriching the total educational experience of Boston Public School children, Masterminding Math and Science is designed to increase the quality and quantity of math and science teaching in the schools and to stimulate student interest in pursuing careers in those fields.

At the heart of this initiative is the pairing of mentors with Masterminding students. Mentors are not tutors, but they do serve as role models for these youngsters, providing them with encouragement and assistance in their math and science work.

The program is supported by a partnership of The Dynatech Corporation and Millipore Corporation with the Museum of Science. It is a model business/community/school collaboration that offers students an enriched math and science curriculum along with field trips to the Museum of Science and other area institutions.

Since its inception in 1990, Masterminding has enjoyed great success among students, teachers and mentors alike. Plans are now in place to expand the program, and new Masterminding mentors are needed for fifth grade students in two Boston public schools.

So if you like kids and want to share your love of science and math with them, this is a wonderful opportunity to assist in addressing one of our nation's most critical challenges. It requires just a few hours a month. But the rewards can be tremendous.

For more information about becoming a Masterminding mentor or serving in another volunteer capacity, contact Kathy Baublis or Linda Macgregor at Boston Partners in Education, Inc., 145 South Street, Boston, MA 02116; (617) 451-6145.

WOMEN IN MATHEMATICS AND PHYSICS: INHIBITORS AND ENHANCERS

Executive Summary, December 1, 1991
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I. Introduction

In the Fall of 1989 the Sloan Foundation asked the Mathematics and Physics Departments of the University of Michigan to examine the literature to assess what is known and what strategies had worked in attracting women to these fields. These departments enlisted the help of their social science colleagues on campus and the Center for the Education of Women.

This executive summary has two major goals, to provide a literature review of published studies on women in science and mathematics, and to present synopses of three studies that we carried out at the University of Michigan.

The literature review in the full report gives extensive coverage of materials that have been published on women at the college and post-college levels. Far fewer studies have been conducted and published on gender issues at the college than at the pre-college level. We occasionally refer to studies of high school and elementary school children when they amplify a point that seems important for undergraduate or graduate students. The review covers statistical trends; studies of enrollment and attrition and of the background characteristics of women who choose science and mathematics; studies of the individual and environmental factors that influence these choices at the undergraduate and graduate levels; and descriptions of interventions and special programs, including research internships, that have been instituted to attempt to influence the career decisions of women.

The studies conducted at the University of Michigan attempt to fill out what is known about the experiences of women and men in mathematics and science programs at a major research university. We focus on three groups of students: 1) those who took Honors mathematics courses in their first semester at Michigan in the fall terms of 1987 or 1988; 2) those who graduated with degrees in mathematics and physics in 1990; and 3) women currently enrolled in doctoral programs in mathematics and physics. In all three studies we focus on what the students believe enhanced and inhibited their decisions to pursue or not to pursue academic work and careers in mathematics and physics.

These materials lead to recommendations for the design and direction of future research. We end the report with recommendations for institutional changes which our current analysis shows would have the greatest impact on improving the academic experience of women in the fields of mathematics and physics.

A copy of the full report (cost, $12.00) may be obtained by contacting the Center for the Education of Women at the University of Michigan, 330 E. Liberty Street, Ann Arbor, MI 48104-2289; (313) 998-7240.

II. Overview

A. Statistical Trends

Proportional Increases for Women

Statistics provided by the National Research Council Survey of Earned Doctorates, the National Science Foundation reports on the state of mathematics, science, and engineering, and the National Center for Educational Statistics make clear that the proportion of degrees conferred on women in these fields has increased over the past twenty years.

Dynamics of the Proportional Growth for Women

The dynamics through which this growth occurred varied over time. Sometimes the proportional increases for women occurred because the drop in enrollments was lower for women than for men. At other times, the number of women enrolled actually increased while the number of men went down. At yet other times, enrollments increased among both genders, but more among women than among men. Drawing conclusions about trends based on data from any two to three year period therefore can be quite misleading. To obtain a valid picture of trends, it is necessary to look at the relative enrollments of men and women across a long span of years.

Overall Enrollments

These proportional increases for women must be put in the context of what was happening to overall enrollments in the sciences and mathematics. Physics and mathematics provide illuminating examples. The absolute numbers of degrees awarded, at all levels, declined drastically after 1970. Compared with 1969-70, in 1980-81 there were only 41% as many mathematics bachelor's degrees awarded and in 1979-80 only 58% as many physics doctorates. In the eighties these percentages have slowly increased to where in 1989 physics awarded 78% as many bachelor's and 78% as many doctorates as in 1970. Mathematics has rebounded much more slowly. In 1989 there were only 67% as many bachelor's and 61% as many doctorates as in 1970.

These figures do not differentiate between citizens and non-citizens. For U.S. citizens, the percentages for doctorates for the latter half of the eighties need to be halved. The absolute numbers of citizens earning a mathematics doctorate (both men and women) have been flat for the latter half of the eighties. In mathematics, in contrast with physics, at the bachelor's level, women are approaching par in numbers with men. However, many of the women are specializing in actuarial science or teacher education, areas which do not require a doctorate.

The ratio of bachelor's degrees to doctorates is significantly different for physics and mathematics: the physics ratio is 8 to 12 times larger than the mathematics ratio in the two decades since 1970. Probably this reflects the greater job opportunities for bachelor's in mathematics and the use of undergraduate mathematics degrees as preparation for many graduate and professional programs. But this ratio, coupled with the small number of doctorates in mathematics compared with other fields of study and the slow rebound in the number of bachelor's degree recipients, gives definite cause for concern about whether the mathematical community will be able to meet the nation's needs in the 1990s and beyond.

Student Interest

Studies of students' interest in science, mathematics, and engineering do not provide an optimistic picture for the future. A smaller proportion of college students in 1988 than in 1983 intended to major in these fields. This decline in interest raises doubts as to whether or not the upturn in degrees awarded around 1983 will be sustained into the 1990s.

Types of Institutions Producing Male and Female Doctorates

Analyses of the undergraduate institutions that were attended by men and women earning Ph.D.'s during the 1980s show that the types of institutions that are effective in producing the nation's doctorates did not differ greatly for men and women. Research Universities I (see Appendix A) are the big producers in all fields for both men and women. These large, prestigious research universities are more effective, however, in sending on men than women to mathematics and physics/astronomy. The large comprehensive colleges and universities are the next most likely to produce Ph.D.'s, although again in certain fields (e.g., psychology, political science, and foreign languages), these types of institutions are disproportionately effective with men. It is the prestigious liberal arts colleges that stand out for being especially effective with women. In all fields except English, a larger proportion of women than men who earned Ph.D.'s in the 1980s had attended the prestigious liberal arts colleges.

B. Enrollment and Attrition: Making the Decision to Pursue Mathematics and Physical Sciences

Differential High School Preparation: Not the Whole Issue

The high school years are a critical filter that can block or foster advanced study in the sciences and mathematics. Although college women who end up majoring in these fields are better prepared by their high school courses than women who go into other fields, they are less prepared than men students who go into mathematics and science. One of the continuing and serious problems is that female students in high school still elect fewer mathematics and science courses than male students.

Lack of preparation is not the whole story, however. There are enough young women who are sufficiently prepared by high school background to achieve parity with men as science majors as has occurred in mathematics. At the University of Michigan in the fall of 1989, 76 percent of the females and 90 percent of the males entered with four years of high school mathematics. This yields a

sizeable group of female students who could potentially go into mathematics and the sciences. Moreover, in the studies of Michigan undergraduates included in this report academic ability and preparation did not differ substantially by gender.

The Decision Process

Women who enter college with a commitment to some type of science are more likely than their male counterparts to choose either biology or medicine. In our study of students taking first year Honors mathematics, women were more than twice as likely to go into medicine as into mathematics or pure sciences, while men were three times as likely to choose mathematics or sciences as medicine.

These intentions are not set in stone, however. Studies of men's and women's decision processes indicate that women tend to make the decision to pursue science careers later than men, so there is still an opportunity to attract women into science in the early college years. In our study of mathematics and physics majors, nearly half of the women had not entered college intending to go into these fields. Our studies show, moreover, that experiences in initial college courses often influence the choice of major.

C. Determinants of the Science/ Mathematics Choice

Personal Determinants

The research on individual factors assumes that barriers to women's achievement in mathematics and the sciences lie within the individual. Sometimes it is argued that women lack mathematics ability or spatial visualization, although other researchers put less emphasis on ability than on motivational factors such as self-confidence and attitude and interest problems among women.

Ability: Studies of the abilities of males and females to perform certain specific mathematical tasks (problem solving, spatial visualization, computation) do not show a conclusive picture of gender differences. There is growing agreement in the research literature that what differences do exist are already quite small. Furthermore, these apparent task-related gender differences can often be explained by differences in preparation.

Self-confidence: Differences in self-confidence may account for why more men than women go into the sciences and mathematics. Self-confidence may well be the most distinguishing characteristic in the approach of men and women to mathematics. It is important to note that women report lower confidence even when they perform as well as males, and that their confidence drops during the critical early years in college. The situations which erode confidence are those in which social comparisons are made publicly, those in which performance feedback is somewhat ambiguous, and those in which the task is societally defined as typically male. Women who succeed in mathematics and physics show a high degree of self-confidence, but the causal dynamics of this relationship are not yet understood.

Other Factors: Research shows little evidence of other motivational differences that conceivably might account for the gender patterns in mathematics and science. Studies of specific attitudes and preferences find only small and often no gender differences. New research on the role of emotion in problem solving and the learning of mathematics has not yet probed the impact of gender. Finally, while there do seem to be some reliable gender differences in relevant personality traits and in causal attributions, these differences are not large enough to account for the clear edge that males have in choice, retention, and achievement in mathematics and science.

Gender Stereotypes

Self-confidence and sex-role congruency are intertwined in their effects. Women students do not easily venture into a sex-role inappropriate realm and must have unusually strong confidence in their abilities to counter societal definitions of appropriate gender roles. The gender stereotypes which depict mathematics and science as male endeavors continue to affect women's choices of majors and careers.

Environmental Influences

We have already noted that initial college courses and overall college experiences influence women's choice of majors. In general, the research on environmental factors shows that women are especially sensitive to cues from the environment that tell how well or how poorly they are performing and how likely or unlikely it is that they will succeed.

Women's socialization trains them to be more sensitive than men to negative experiences of the environment, as well as more sensitive to supportive ones.

Many studies of environmental factors have focused on classroom dynamics and in particular on possible differences in the interactions between teachers and their male and female students; differences in the responses of male and female students to teaching style, differences in responses to competition between students and to classroom climate, and differences in the social support given to male and female students.

Encouragement: Direct encouragement, getting information about opportunities, being taken seriously by teachers and counselors, and having a comfortable relationship with an advisor are all important to both men and women. But according to the published literature and our own studies, women students report receiving fewer of these positive experiences. In our studies of majors in mathematics and physics and of students who took Honors mathematics, we found that the female students had received less encouragement and less information about accelerated course work than had the male students. Our focus groups with current graduate students in these fields confirm that encouragement from faculty members, parents, and peers during the undergraduate years was critical in bringing about their eventual commitment to pursue advanced degrees.

The effectiveness of the prestigious liberal arts colleges in sending women on to doctoral work may stem from the amount of encouragement and feedback which can occur more naturally in a small department.

Research Internships: Research internships help both men and women students. These experiences are especially useful for students who are uncertain of their career paths. Students are more likely to continue in mathematics and science fields if they have opportunities to work in science labs and other research settings. For women, the close interaction with a faculty member plays an important role in building self-confidence.

Gender-Biased Classroom Experiences: There is some evidence that women majoring in mathematics and science have more negative classroom experiences than women in other fields. The women report feeling put down, being called upon less frequently, patronized, and ignored. Both men and women mathematics and physics majors agreed that the gender of a student has an effect on how the student is treated, and the women students were nearly unanimous in the view that it is women who are treated less positively. But just as there can be negative experiences, some teachers are particularly successful in encouraging women to go on in science and mathematics. These teachers include information on women scientists in the curriculum, avoid sex-stereotyped views of science and scientists, and are sensitive to not using sexist language.

Mathematics as Problem Solving: The research literature provides some evidence that men and women students approach the study of mathematics somewhat differently. Women more than men tend to perceive mathematics as something done according to rules and may be less likely to seek alternative approaches to a problem. A less algorithmic approach to calculus would probably have a significant impact on attracting and retaining women students, as would a problem solving course requirement. Preliminary results from a University of Michigan freshman combinatorics class and a new innovative chemistry course indicate that women may flourish in discovery-based classes.

Competitive Environments: Women generally respond negatively to what is perceived as an overly competitive environment. The general literature we have reviewed and our own study of Honors mathematics students indicate that women find cooperative atmospheres somewhat more helpful and competitive atmospheres more harmful than do male students. The research on competition, however, has not distinguished between various types of competition or exactly why an environment is perceived as competitive. Usually the studies simply present the terms "competition" and "cooperation" and let students provide their own definitions. The studies look at practices such as grading on a curve, ability grouping, individual and team competitions for prizes, and excessive emphasis on grades. Since these practices inevitably involve individual social comparisons, they have a negative effect on the confidence of women students. More research needs to be done to find out exactly why competitive environments seem to deter women more in science and mathematics than in other fields, and to delineate which competitive practices have the most negative impact.

D. Description of Current Intervention Programs

Many colleges have designed programs to increase the numbers of women who complete degrees in mathematics and the physical sciences. Most of these programs can be grouped under the following headings:

1. Recruiting and attempts to stimulate women's interest in the career.
2. Support (e.g., mentoring, networking, peer groups).
3. Internships and apprenticeships.
4. Re-designing courses and degree programs to be more interesting and accessible to women.

Very few programs have been developed to change the institutions themselves by restructuring the academic environment or by changing the attitudes and behavior of faculty members.

III. University of Michigan Studies

A. Description of the Studies

If the pool of U.S. mathematicians and physicists is to be enlarged, research universities must play a central role. Yet few studies have examined the experience of mathematics and physics undergraduate and graduate students in major research universities. Moreover, little is known about factors which have a particular effect on the experience of women students in these fields.

In order to address this knowledge gap, during the past year three studies were conducted at the University of Michigan under the auspices of the Sloan Project. Each of these studies explored students' perceptions and the factors which contributed to student persistence or attrition.

The first of the three studies surveyed students who were enrolled in first semester Honors mathematics courses during the Fall Terms of 1987 or 1988. Students enrolled in these classes represent some of the best prepared incoming students and are a potential pool of mathematics science concentrators. The study documents a high "dropout" rate in terms of continuing mathematics enrollments. Only 15% of all the male and female students enrolled in the program completed the Honors mathematics sequence. There is a striking difference between the male and female students who "dropped out." The majority of the women (58%) dropped out of an Honors mathematics sequence and elected no further mathematics courses; whereas the majority of males (54%) dropped out of Honors mathematics and continued in non-Honors mathematics. Gender differences in experience and choice revealed by the study appear to be based on differences in perception, not in ability.

The second study used survey methods to examine the experiences of students who graduated with majors in mathematics and physics in 1990. While this study revealed few gender differences, the differences which did emerge were consistent with those identified in the study of Honors mathematics enrollees and in the larger body of research literature. Even among those who completed mathematics and physics majors, women were less likely to find encouragement in their departments, less likely to find professors to take a special interest in them, and had slightly lower self confidence than their male counterparts.

The third study involved two focus groups of women graduate students in mathematics and physics. Several themes emerged from the qualitative analysis of the focus group content that were again consistent with the literature and the data from the two Michigan surveys. Among them, encouragement from faculty and parents played a key role in the women's undergraduate experience and their decision to persist in their studies.

B. Conclusions of the Three Michigan Studies

The three University of Michigan research projects provide snapshots at varying points of time along the road to advanced educational training in mathematics and the physical sciences: initial entrance into the accelerated undergraduate curriculum, graduation with a bachelor's degree in mathematics or physics, and doctoral work within mathematics or physics.

What distinguishes the potential undergraduate math/science concentrators from the actual math/science concentrators? Indeed, who are the potential math/science concentrators? While only about half of the Honors mathematics students went on to major in mathematics or science, their superior background clearly justifies our claim of their potential. At the same time, the Honors mathematics courses are not necessarily intended as direct pipelines to a mathematics concentration.

Academic Preparation: We saw little difference in high school grades between men and women

entering the Honors Mathematics sequences (we will call this group the accelerated students) and no initial gender difference between the actual mathematics and physics concentrators. However, the students who actually graduated in mathematics or physics entered with somewhat higher average overall high school grades than those students who simply entered the Honors mathematics courses as first year students.

The small differences in academic achievement between males and females, either among the accelerated students or among the mathematics/physics graduates, seem insufficient to generate the subsequent differences in perception. Issues other than academic preparation and college achievement must influence their perceptions.

Student Behaviors: Not only do academic abilities fail to strongly differentiate between potential and actual concentrators, but the students were also not especially distinguishable by their individual behaviors in the mathematics classrooms. Our accelerated mathematics students and our math/science concentrators claimed to exhibit similar behavior. The four most frequently noted behaviors — conquering something difficult, feeling that hard work paid off, studying with others, and asking questions in class — were the same for both groups, and were exhibited at nearly identical levels, with little or no gender differences. Regardless of whether they were potential or actual concentrators, both men and women students reported doing similar things in their mathematics classes.

The accelerated mathematics students went on to concentrate in a wide variety of disciplines (one-half in the natural sciences), and so their description of the needed success factors represents a broad, cross-disciplinary view of academic and behavioral prerequisites. Despite the more homogeneous concentration experiences of the actual mathematics/physics graduates, they did not appear to differ substantially in their choice of factors. Those factors deemed helpful by the mathematics/physics majors were comparable to the factors selected by the more diverse group — intrinsic interest, effort, natural ability, and quality of instruction — with males and females exhibiting almost no differences. Both groups cited the same three most harmful factors — understudying, academic anxiety, and the breakup of an important relationship — at comparable levels.

Behavior in the mathematics classroom could not be used as a valid predictor for differing outcomes of the students — some continuing on to graduate in mathematics or physics, others turning completely away from mathematics and the natural sciences. Neither could an argument be based on differences in general academic perceptions.

Gender Issues: When asked if gender in any way affected treatment of students in their department of concentration, over twice as many female Honors students responded with "yes" — 33% in comparison to only 16% of the males. When asked if gender has affected the student personally, 26% of the females responded "yes," in contrast to 8% of the males. Of those students, male or female, who claimed the existence of gender bias, the overwhelming majority felt that the bias was against women.

In the study of mathematics and physics concentrators approximately one-quarter of the students, males and females alike, felt that a student's gender had an affect on his or her treatment in the program. However, 27% of the females, but only 10% of the males, reported that gender had an affect upon them personally in their department.

Encouragement: In both studies the female students perceived less encouragement from faculty than did their male counterparts. When asked if professors had taken a special interest in them as students, 72% of the men as opposed to 46% of the women replied affirmatively. Similarly, female students perceived less encouragement by counselors to pursue accelerated course work. For example, only one of the ten females who were informed about the Honors option felt she had been actively encouraged to take an Honors mathematics course.

Competition: Female students who began in the accelerated mathematics courses viewed a cooperative environment as having helped them and saw competition as a slight hindrance. The males also saw a cooperative atmosphere as helpful, but they saw competition as having little influence on their performance. This general gender pattern was also evident in the responses of the students who eventually chose to major in mathematics or physics.

Plans for Graduate School: Far more of the original accelerated mathematics students than mathematics/physics concentrators were intending to go on to graduate school immediately following college graduation (65% of the women and 74% of

the men). Moreover the gender differences in planned graduate enrollment were much greater among the mathematics/physics concentrators. Only 27% of the female concentrators in contrast to 48% of the male concentrators were intending to pursue additional schooling following graduation. This stands in sharp contrast to the fact that the mathematics/physics concentrators entered college with higher previous achievement. It is believed that the unusually high percentages of former Honors mathematics students contemplating graduate school is a function of their participation in the overall Honors Program (true of almost all the Honors mathematics students). Honors students are part of a small community, are actively socialized into a more academic environment, and are more consistently encouraged to pursue additional post-college education. This socialization may explain not only the higher percentages, but also the reduced gap between males and females.

Among the mathematics/physics majors who were continuing on to graduate school, the men and the women had comparable college grade point averages, both overall and within their majors. However, the college grades of both men and women who chose not to go directly to graduate school were lower than those who did, 3.0 *vs.* 3.5.

In contrast to the undergraduate female majors who saw themselves as not having received much encouragement, many of the graduate women pointed to parents or faculty members who not only encouraged them but fully expected them to succeed.

The Graduate School Experience: What is the situation for women who persist to graduate school in mathematics or physics? Do the influences which seemed important at the undergraduate level affect the graduate school experience? Do new factors emerge?

For graduate women included in the focus group study the decision to go on to graduate school was often shaped by generalized expectations such as "my parents were scientists," or "everybody was going on," or "you just have to in physics." But the matter of *where* to go to graduate school was approached more concretely. Many specifically chose Michigan because it was seen as both welcoming and not impossibly demanding.

In contrast to the undergraduate female majors who saw themselves as not having received much encouragement, many of the graduate women pointed to parents or faculty members who not only encouraged them but fully expected them to succeed. These supportive connections seemed particularly characteristic of the women who came from the smaller undergraduate institutions.

Two influences which were seen by the undergraduate women as detrimental were still perceived as problematic at the graduate level. Women in the focus group study reacted negatively to any low-quality teaching they encountered, and many found the competitive aspects of the environment alienating.

Another source of frustration for the graduate women is their own performance as teachers. It worries them when undergraduates are not getting the best teaching because they, as teaching assistants, are overloaded with responsibilities. These graduate students are concerned about losing the opportunity to do their best in their courses because of being vastly over-extended as T.A.'s. This is expressed as a conflict in the priority given to two very important roles of their graduate education: being teachers and being taught.

In summary, the experiences and perceptions of the three groups of undergraduate and graduate students seem more similar than dissimilar. Academic performance and ability are clearly the factors that served to limit women's persistence and achievement. Student *perceptions* of science and mathematics, of the educational environment, and of their own abilities, play critical roles at various points along the educational pipeline. Encouragement, whether by faculty, family, or peers, appears to be a critical link in the chain that helps build and maintain the self-confidence needed to continue along the desired path to a higher degree in mathematics or science.

IV. Summary and Evaluations of Past Research

A. Summary of Research Results

The existing research reveals significant gender differences in the areas of self-confidence, amount of interaction with faculty, level of faculty

expectations and encouragement, response to competitive situations, response to poor and alienating teaching, and relative chilliness of the scientific climate as a result of gender bias and stereotyping.

There are also small differences between male and female students on measures of problem-solving ability, personality traits of independence and creativity, and attribution patterns.

B. Research Design Limitations

Our review of the research literature reveals five major limitations that should be addressed in future studies.

First, the majority of studies of both personal and environmental determinants of students' choices and achievement in mathematics and science concern the elementary and secondary level. Much less research has been done at the college level, and virtually no systematic research is being carried out on graduate students.

Second, intervention programs have not been accompanied by any long-term studies of effect. Very few programs use random assignment so that effect could be reliably assessed. And the intervention programs often do not appear designed to address the issues raised by the research.

Third, since much of the research has been carried out in single institutions, there is a need for cross institutional research and national studies of students enrolled in a representative sample of different types of institutions.

Fourth, although career choice occurs across time, the research literature on choice of mathematics and science depends almost entirely on cross-sectional rather than longitudinal studies.

Fifth, given the importance of environmental factors, there is a critical need for carefully designed observational studies in which the impact of classroom dynamics, and what is now known as chilly climate, can be studied in depth.

V. Recommendations for Future Research

Despite improvements during the past 20 years in the proportion of women earning degrees in mathematics and physics, the numbers of advanced degree recipients continue to be exceedingly low. Indeed, in 1989-90 in the U.S. only 158 women were awarded Ph.D.'s in mathematics and only 129 in physics! Surely with concerted effort U.S. institutions should be able to at least double these numbers within the decade.

In order to significantly improve these numbers, more research universities must play larger roles. This will require concerted effort on the part of faculty and university administrators coupled with government, foundation, and corporate support for innovative research intervention and research programs.

A. Recommended Types of Research

Carefully designed research is needed to increase our knowledge of the causes of student attrition and to develop effective means of increasing women students' success and persistence. Particular needs include:

1. *Longitudinal studies* which follow students throughout the college years and beyond, and which, in part, emphasize the effects of pipeline and special programs.

2. *National studies* which include a large sample of women, including women of color, women who come from varying socioeconomic backgrounds, and women who attend different types of educational institutions.

3. *Observational studies* which analyze all components of the environment.

4. *Exit interview studies* of women undergraduates who pursued undergraduate majors in mathematics and physics but who chose not to continue on to graduate school, of women graduate students who discontinued their studies before completing the doctorate, and of faculty women who leave the academy.

B. Recommended Topics for Research

1. *Studies of the academic environment* within the physical science and mathematics programs to explore the differential impact of the environment on men and women, and to determine which changes would be beneficial, and how to achieve them. These studies should address: the quantity and quality of faculty student interaction, peer interactions and support, competitiveness, the physical environment, counseling, faculty expectations, discrimination and harassment.

2. *Studies of instructional methods and course content* to determine if there are differential effects of particular methods on men and women and the impact of them on their decisions to pursue science and/or mathematics.

3. *Studies on the selection of subspecialties* within a concentration to determine whether gender differences exist and, if so, why.

4. *Studies of financial support patterns* for men and women within the physical sciences and mathematics at both the undergraduate and graduate level.

VI. Recommendations for Action

A. Establishing Institutional Goals

The literature on women's achievement in the sciences suggests the convergence of a variety of factors which influence women's persistence and achievement in mathematics and physics. These factors include: the importance of encouragement and feedback from parents, teachers, and mentors; the negative effects of lowered expectations for women; the discouraging influence of poor and insensitive teaching; and the importance of connectedness and interaction with faculty.

Programs should be designed, whenever possible, to respond to factors identified in the research literature as potentially critical to women's success. However, we realize that due to the urgency of the problem, we must increase the number and quality of interventions in institutions of higher education before definitive answers to many of our questions are available. It is therefore imperative that interventions be thoroughly evaluated and that longitudinal follow-up studies of intervention programs be conducted.

Increased emphasis must be placed upon interventions at the undergraduate and graduate levels to target the many women who already have the necessary background and ability to succeed in nontraditional fields. Because of the large numbers of these women attending research universities, it is important for these universities to institute programs which will result in institutional change.

With these dynamics in mind, we recommend that mathematics and science departments establish the following institutional goals:

1. To increase women's interaction and connectedness with faculty to provide frequent, clear, and encouraging feedback.
2. To provide an interesting and challenging curriculum taught with greater skill and with more awareness of the environmental factors which affect women's learning.
3. To generate an academic atmosphere in which women are expected to succeed and in which sufficient numbers of successful women are visible at all levels.

B. The Process of Change

There is no reason to underestimate the difficulty of achieving fundamental change in institutions of higher learning. It will require a long-term process which starts with creating an awareness of the importance of a student's total academic experience. Thus, emphasis must be placed not merely on the content to be mastered, but the *methods* by which students are asked to master course content and the *environment* in which they are expected to learn. Both course content and teaching methods will need to be reappraised, and institutions will need to begin "warming" the academic climate.

Until the vast majority of faculty come to understand that a student's actual *ability to learn* is diminished by negative experiences, change will be superficial at best. And faculty will have little incentive to change as long as many of them believe that each student's academic success in science and mathematics is largely predetermined by innate qualities of dedication and brilliance.

Research seems to indicate that the students who are likely to succeed are those who (a) value and enjoy mathematics and science and (b) believe that they can succeed. The faculty's role should be to try to maximize both student learning and commitment rather than to simply locate those who appear to be the most talented and dedicated. In this way the pool of students who select science and mathematics majors and/or careers can be expanded.

C. Strategies for Institutional Change

Ultimately, increasing the numbers of women scientists and mathematicians depends upon the actions of academic departments and colleges. Outlined below are some steps departments and colleges can take that are designed to result in positive institutional change:

1. Systematically assess the present situation, collecting and analyzing comparative data on numbers and rank of women faculty, numbers of women students at each level, levels of available funding for women faculty and students, women's grade point averages and retention.

2. Systematically engage in departmental self-study to determine: which strategies succeed and which fail; which teachers are most successful in working with women students; why are they successful; what are faculty attitudes; why do women leave the program; what elements of the department climate are most supportive; which are not supportive.

3. Analyze the structure and content of advising to broaden the role of the advisor to that of advocate; train advisors to emphasize expectations of competence.

4. *Actively* recruit women faculty, graduate students, majors, and honors program students.

5. Formalize regular means of providing feedback and encouragement to students (e. g., faculty-student conferences, written progress updates).

6. Ensure small class sizes so that instructors are able to give students appropriate levels of attention.

7. Use more experienced faculty to teach introductory courses; use outstanding faculty as master teachers. Restructure the faculty reward system to provide better incentives for teaching undergraduates.

8. Revise the curriculum to emphasize problem solving, model building and the discovery method.

9. Establish more collaborative classroom environments and grading practices; provide students with opportunities for team study with peers and/or more advanced students.

10. Establish regular mechanisms to sensitize faculty to issues of gender and pedagogy and the means of eliminating gender bias in the classroom.

D. Programs to Orient Women toward Graduate School and Mathematics and Science Careers

Research Internships

Most research internship programs have been designed to increase students' experience in conducting research and enhancing their knowledge of the discipline. While meeting these goals is important, internships may be even more critical for women for reasons *other than* the disciplinary knowledge and experience they provide. Because internships give students the opportunity to work closely with faculty, they are an ideal means of providing encouragement and mentoring, increasing women's self-confidence. At the same time they challenge students and impart needed career information and support.

We strongly recommend enhancing research internship opportunities, especially at research universities where opportunities for close interaction between undergraduate students and faculty are all too limited. While successful internship programs can involve a variety of designs (full-time summer programs, part-time placements during the academic year, paid internships, internships involving academic credit), it is essential to build into the internship the means of meeting women students' needs for greater knowledge about education and career paths. There must also be increased awareness of the need for encouragement and the building of self-confidence. As with teaching strategies, it is critical that means of increasing faculty awareness of the dynamics of gender be incorporated into the design of internship programs.

The timing of internship programs should also be given careful consideration. Internships are too often seen as rewards for already successful undergraduate students as opposed to a means of increasing student enrollment and persistence. In addition, timing may vary by discipline. While faculty may initially be skeptical about the ability of young students to contribute to research, our experience has demonstrated that laboratory science internships at the freshmen and sophomore years can be very successful and that this success quickly overcomes faculty skepticism. Involving students at this level is critical if their choice of major is to be affected. This is particularly important in physics where the number of undergraduate majors is extremely small.

The situation with regard to mathematics is somewhat different. Although there are far more undergraduate majors in mathematics, only a very small proportion of these continue on to graduate study. Hence, internships in mathematics might best be geared toward more advanced students with the goal of encouraging students to consider continuing on to graduate school.

"Pipeline" Programs

As mentioned earlier, there is a precipitous drop in mathematics enrollment at each level of the educational "pipeline." While an average of 7,475 women received bachelor's degrees in mathematics

(47% of the total) in the years 1985-89, during that same period the average number of Ph.D.'s awarded to women (18% of the total) was 131. There is strong evidence that women disproportionately elect job-oriented curricula. Thus, programs that encourage women to continue to graduate school are essential. Encouragement and preparation for graduate school should be a natural part of the counseling and guidance provided by faculty beginning with the first year. When this is difficult to accomplish (e.g., possibly because of reliance on teaching assistants), special seminars and programs should be implemented to forge ties between women students who show potential interest in careers in mathematics and science and faculty and counselors who can help them meet their goals.

Specialized Seminars and Summer Programs

In many institutions, the content of the physical science and mathematics courses are prescribed by the need to meet requirements of other disciplines. When this happens, the student interested in physics and mathematics often fails to see the breadth, power and excitement of that discipline. If non-service courses cannot be provided at the elementary level, departments should investigate providing freshmen/sophomore seminars and/or special summer courses and programs where interested students could see this breadth, power and beauty and could pursue less structured, more individualized study. In the short run for mathematics this may be the only way to expose elementary students to problem solving and mathematical modeling.

E. Conclusion

Our review of the literature and our own research studies suggest a complicated interplay between the many forces which erode women's confidence and undermine their abilities.

Although there is a national need for carefully designed research to steer the course of future programs, we cannot afford to wait for research results before beginning to implement institutional change. Each college and university can begin programs to strengthen the interaction and communication between students and faculty, to increase the numbers of women students and women faculty, and to revise the curriculum so that all students are engaged in thoughtful intellectual work.

We believe that the large research institutions, which educate so many women, have an obligation to lead the way. In the conclusion of his January 1990 address to the Sigma Xi Scientific Research Society, James J. Duderstadt, President of the University of Michigan and Chair of the National Science Board, summarized the challenge we face:

> Time is running out. We have two major challenges to address: First, we must plug up the leaks in the education pipeline so that more students manage to make it through the gauntlet by majoring in science and mathematics. Second, over the long term, it is clear that we must reform the educational system, that is, completely rebuild the pipeline to respond to the changing world in which we live.
>
> In our colleges and universities it is time to think about improving what we teach, whom we teach, and how we teach.

ARTICLES OF INTEREST

"Canadian Chemist Takes On Working Women" by Robert P. Crease appears in the February 28, 1992 issue of *Science*. The subhead reads: "An article that criticizes working mothers slipped into a Canadian journal — and many scientists are hopping mad." One of the outraged is our own Lee Lorch, who is quoted in the article as follows:

> This article, which is now in the permanent collection of libraries all over the world, makes Canadian science a laughingstock. Colleagues halfway around the globe kid me about it.

The *Science* article provides an excellent summary of the situation [see also the September-October 1991 *Newsletter*]. Gordon Freeman, a chemist at the University of Alberta, wrote an article for the proceedings of a conference on chaos theory labeled "sociology" and titled "Kinetics of nonhomogeneous processes in human society: Unethical behaviour and societal chaos" [*Canadian Journal of Physics*, 68:794-798]. Freeman applied "wisdom" to his personal observations to conclude that working mothers are the root of most current social evils; if they were home nurturing, where they belong according to Freeman, their children would not be cheating on exams, taking drugs, etc. This lack of "nurturing" is supposedly destroying the ethical fabric of Western civilization.

Freeman's article would be inflammatory, no matter where it appeared, but in a *physics* journal? Feminists are appalled for obvious reasons. Physicists are outraged that the article has appeared in their journal. Social scientists are insulted that Freeman has ignored their literature and by his claim that the method for doing social science should be to use acquired "wisdom" rather than to use scientific inquiry. Also, the fact that the article appeared at all indicates a serious flaw in the editorial process.

From the *Science* article:

> The angry reactions had an effect. Nine issues after the article appeared, in June 1991, the *CJP* published a note from Bruce P. Dancik, editor in chief of the NRC's research journals, saying Freeman's "article does not comprise science and has no place in a scientific journal. The National Research Council research journals and the editor of the *CJP* regret that this article was published." But the critics weren't mollified. For one thing, the apology was only three sentences long and was printed on an unnumbered page, making it difficult to tie it to the original article in electronic databases. What's more, although the note said Freeman's article wasn't science, it didn't repudiate the paper's contents.

Freeman and the editor of the *CJP*, Ralph Nicholls, physicist at York University, remain unrepentant. Freeman claims his paper is "probably the first article in a new era of sociology." And as for Nicholls:

> Nicholls, meanwhile, argues that the protest against Freeman's article is motivated by "political correctness." He calls the "whole affair" a "most interesting and complex mixture of scientific publishing, political correctness, vulgar politics of protest, poor journalism, media manipulation, and government agency damage control." "If C.P. Snow were still alive," Nicholls concludes, "he could make a great novel out of all of this."

Katherine Heinrich and Malgorzata Dubiel of Simon Fraser University have found a novel way to promote mathematics: they have taken a hands-on display called "Mathematics and Magic" to a couple of local malls. Elementary school students were brought to the shows, and curious shoppers also participated.

The show was reported on in *Simon Fraser Week*, Oct. 17, 1991; *Burnaby Now*, Oct. 9, 1991; and *The News Burnaby*, Oct. 9, 1991. The headline in *The News* was "Math profs try to teach women they can do math." From that article:

> Dr. Malgorzata Dubiel has a joke she shares with women. "Of course we're not good at math," she says in a conspiratorial voice. Then she points out all the areas of life where women use the math skills they supposedly don't have: cooking, sewing, shopping and crafts.
>
> ... [The] hands-on display ... show[ed] that mathematics is not always where you expect it to be.

"Women Mathematicians" by Eva Bayer appeared in the bulletin of the European Mathematical Society #3 (1 Mar. 1992), pp. 4-5. She points out that the percentage of women among mathematicians varies from 2% to 50% in different European countries. EMS has created a committee on Women and Mathematics. From the article:

> Unlike the other committees of the society, this one wishes to become superfluous as soon as possible. This will happen when the proportion of women among mathematicians throughout Europe gets close to 50%. For the moment, the main projects of the committee are the following:
>
> 1) To gather statistical information about the number of women mathematicians and the proportion of women among the students in mathematics.... The preliminary results of this survey are very interesting.
>
> 2) To analyze in more detail the situation in Germany (one of the European countries with the lowest percentage of women mathematicians).
>
> 3) To understand the importance of role models in the study of mathematics and in the undertaking of a career as a mathematician.
>
> The members of this committee are: Eva Bayer (Besançon), Ina Kersten (Bielefeld), Ragni Piene (Oslo), Stewart Robertson (Southampton), Barbara Roszkovska (Warsaw), Laura Tedeschini Lalli (Roma), Vera Trnkova (Praha).

For further information about Femmes et Mathématiques, the French association of women mathematicians founded in 1987, contact: Catherine Goldstein, Université de Paris-Sud, Bâtiment 425, Mathématiques, Orsay, France; her email address is cgolds@matups.matups.fr. For more information about the EMS committee, contact: Eva Bayer, Université de Franche-Comté, Faculté des Sciences, Mathématiques, 16, route de Gray, 25030 Besançon, France; email: bayer@frgren81.bitnet.

BRIEF NOTES

Women in Science and Engineering: Increasing Their Numbers in the 1990s, a publication of the National Research Council, National Academy Press, 1991, contains some interesting statistics. In 1985, only 29.1% of the applicants for NSF Graduate Fellowships in mathematics were female; by 1991, this percentage had increased to 40.5%. Over the same time period, the number of mathematics fellowships awarded to women increased from 5.0% to 31.2%. For NSF Minority Graduate Fellowships in physics/astronomy/mathematics, the percentage of women applicants went down from 46.4% in 1985 to 40.6% in 1991. However, the percentage of physics/astronomy/mathematics fellowships awarded to women increased substantially, from 14.3% to 47.1%.

Remember to encourage worthy students and colleagues to apply for the awards they deserve to earn. Sometimes it's hard to put ourselves on the line, but if we don't go for it, we can't win.

The following books are available from AAAS: *Sourcebook for science, mathematics and technology education*, edited by Mary Beth Lennon and Barbara Walthall; *Science assessment in the service of reform*, edited by Gerald Kulm and Shirley Malcom; *Investing in human potential: Science and engineering education at the crossroads*, edited by Marsha Lakes Matyas and Shirley Malcom; and *This year in school science, 1991 technology for teaching and learning*, edited by Shirley Malcom, Linda Roberts, and Karen Sheingold.

To order by phone, call 301-645-5643 (9 A.M. - 4 P.M. ET) and ask for AAAS. To order by mail, write: AAAS Books, Dept. A54, P.O. Box 753, Waldorf, MD 20604.

The National Council of Teachers of Mathematics (NCTM) has recently announced several new publications. *Mathematics Assessment: Myths, Models, Good Questions, and Practical Suggestions* is $8.50. Assessment is the proposed focus of the November 1992 *Mathematics Teacher* (prepublication quantity discounts are available if ordered on or before September 15, 1992). The 1992 Yearbook is *Calculators in Mathematics Education* ($18). It focuses on calculators as a teaching tool for the 1990s in grades K-14. *Mathematical Challenges for the Middle Grades* ($6.25) and *Applications of Secondary School Mathematics: Readings from the Mathematics Teacher* ($21.50) are both collections of articles and activities from the *Mathematics Teacher*. To order any of these publications, call 1-800-235-7566.

The National Council for Research on Women has recently published *Sexual Harassment: Research and Resources, A Report-in-Progress*. The 48-page report was designed for use as a supplemental classroom text, for personnel workshops, or as background information for anyone who wants to "get it." The research summary highlights current legal and scholarly definitions of sexual harassment, the extent of the problem, typical behavior of the harassed, myths about the harassers, anti-harassment policy and procedures, and efforts needed to bring about significant change.

A single copy is $16.00 plus $1.60 postage/handling. Quantity discounts are available. Write: National Council for Research on Women, 47-49 E. 65th St., New York, NY 10021; (212) 570-5001.

The President's Committee on the National Medal of Science annually solicits nominations from the scientific community. Nominations are due by June 30, 1992. For more information and forms, write the Committee at the NSF, 1800 G St., NW, Washington, DC 20550.

Selected Bibliography: Resources for Gender Equity in Mathematics and Technology 1991, compiled by Judith Olson and Robin Thorman, has been published by Women and Mathematics Education (WME), an affiliate of the National Council of Teachers of Mathematics (NCTM). It costs $4 and may be ordered from: WME, c/o SummerMath, Mt. Holyoke College, 302 Shattuck Hall, South Hadley, MA 01075; (413) 538-2608.

The Women's Bureau of the U.S. Department of Labor has recently completed four major studies relevant to the lives of working women. "Increasing Working Mothers' Earnings" concludes that family-related characteristics are not significant predictors of the hourly wages of working mothers. "Gender and Racial Pay Gaps in the 1980's: Accounting for Different Trends" explores reasons for these gaps. "Breaking the Glass Ceiling in the 1990's" examined sex role socialization, career paths and attitudes, the role of mentoring, and career/family considerations. Women employed in

the temporary help services industry were the subject of "Just a Temp: Expectations and Experiences of Women Clerical Temporary Workers."

Single copies of the studies are available free of charge by sending a self-addressed mailing label to: Women's Bureau, U.S. Department of Labor, Box RR, 200 Constitution Ave., Washington, DC 20210. Be sure to specify which study or studies you require.

The Operations Research Society of America now has available a video/software package highlighting the many different career opportunities in the field of operations research and providing real-world case studies and instructional problems. The package includes the 19 minute "Operations Research + You = An Exciting Career" videotape, STORM software for both the IBM and Macintosh with instruction manuals, and a student/teacher guide. The package is geared to students at the secondary and collegiate level and sells for $7.99. Contact: Jennifer Meyer, Operations Research Society of America, 1314 Guilford Ave., Baltimore, MD 21202; (410) 528-4146.

<*Angles*> is the newsletter of the Urban Mathematics Collaboratives. Write: UMC, Education Development Center, 55 Chapel St., Newton, MA 02160.

The Deakin University Press, Deakin University, Geelong, Victoria 3217, Australia has some interesting titles in its mathematics section. Some examples: *Real girls don't do maths: Gender and the construction of privilege*, *Mathematics in a cultural context: Aboriginal perspectives in space, time and money*, and *Mathematics for the minority: Some historical perspectives of school mathematics in Victoria.*

The National Action Council for Minorities in Engineering (NACME), with help from the Advertising Council, is involved in a campaign to sell mathematics and science to children. The plan is to hit the media directed at kids with ads promoting math and science, also giving a toll-free number to call to get a variety of give-away items. A three-year challenge grant from IBM will provide financing. Plans are also under way to produce a video about engineering and another Spider-Man comic. Spidey will team up with some kids and some engineers to defeat a villainous robot.

T-shirts, calendars, puzzles, posters, books, etc., are produced by Math Products Plus. For a free catalog, write them at P.O. Box 64, San Carlos, CA 94070.

FairTest, The National Center for Fair & Open Testing, lobbies against the use of standardized, especially multiple-choice, tests to evaluate students and schools. Such use may, while intended to be objective, discriminate against minorities, women, and those of low income. *FairTest Examiner* is a quarterly newsletter. Subscriptions ($15 individual, $25 institutional) are available from FairTest, 342 Broadway, Cambridge, MA 02139-1802.

Teachers & Writers is a newsletter published five times a year, $15 per year. Write: Teachers & Writers Collaborative, 5 Union Square West, New York, NY 10003.

The Elizabeth Cady Stanton Foundation, a not-for-profit group dedicated to promoting research and education in women's history and the women's rights movements, announces the third bi-annual competition for the Corinne Guntzel Memorial Grant. The grants are intended to support projects and research in women's history. Awards will range from $250 to $500. Proposals should be submitted in the form of a brief letter describing the project, its significance, its intended audience, the time when it will be completed, how the money will be used, and the background of project participants. Proposals are due by September 1 and should be sent to Guntzel Grants, c/o Harlene Gilbert, 5338 East Lake Road, Romulus, NY 14541.

Power Line, For Keeping Current in Elementary Mathematics and Science Teaching, is a new newsletter. Write: Pamela P. Dronka, Director and Editor, Power Line, 2141 Industrial Parkway, Suite 202, Silver Spring, MD 20904.

Women in Communications has released a study, "The Invisible Majority." The study shows, not too surprisingly, that women are substantially underreported in the country's leading news magazines (*Time*, *Newsweek*, and *U.S. News & World Report*). References to women average 13%; percentages in photographs and in bylines were better (around 30%), but still low given that women are 52% of the population. For a copy of the study, call Women in Communications, Inc., at (703) 528-4200.

Deborah S. Franzblau has written a short guide for undergraduates on how to give mathematical talks. It includes practical advice, such as:

> A talk that begins, "let me get some definitions out of the way ... ," followed by three slides covered with tiny writing which the speaker seems to expect you to absorb instantly, is deadly for an audience. It is like trying to follow a conversation in a new language after only one glance at a dictionary. Only define a new term if you plan to use it immediately, and briefly remind the audience of the definition each time you use it.

I know some people beyond their undergraduate days who could benefit from this advice!

For a copy of "Giving Oral Presentations in Mathematics," send a request with a self-addressed mailing label to Deborah S. Franzblau, Dept. of Math., Vassar College, Poughkeepsie, NY 12601.

About Women on Campus is a new quarterly newsletter published by the National Association for Women in Education (NAWE), formerly the National Association for Women Deans, Administrators, and Counselors (NAWDAC). From the first issue:

> Bernice Resnick Sandler, Senior Associate at the Center for Women Policy Studies (CWPS), serves as editor of *About Women on Campus*. Sandler, a long-time member of NAWE, formerly was director of the Association of American College's Project on the Status and Education of Women (PSEW), which she founded in 1971. She edited the PSEW newsletter for nearly 20 years.
>
> *About Women on Campus*, which is being produced in cooperation with the Center for Women Policy Studies, is the first activity of the Association's new Women's Issues Project....

Individual subscriptions are $20 for one year and $35 for two years. Write: Women's Issues Project, NAWE, 1325 18th St. NW, Suite 210, Washington, DC 20036-6511.

The International Commission on Mathematical Instruction Study Series, published by Cambridge University Press, includes some interesting publications. *Mathematics and Cognition: A Research Synthesis*, written by the International Group for the Psychology of Mathematics Education, includes such topics as psychological aspects of learning early arithmetic, language and mathematics, and advanced mathematical thinking. *The Popularization of Mathematics* is edited by A.G. Howson and J.-P. Kahane.

GASAT [Gender and Science and Technology], which has met informally for a number of years, has recently become The GASAT Association, an international organization. For further information, contact Rebecca Lubetkin, 4090 Kilmer-Livingston Campus, Rutgers University, New Brunswick, NJ 08903; (908) 932-2071; FAX: (908) 932-0027.

from Resources for Reading, AWIS Magazine, *Jan./Feb. 1992*

Gender and Higher Education in the Progressive Era by Lynn D. Gordon, Yale University Press, 1990, $29.95. Yale Univ. Press, 92A Yale Station, New Haven, CT 06520-7388; (203) 432-0940.

The Russell Sage foundation has several interesting publications including *Health Care and Gender* by Charlotte F. Muller, 1990, $27.95; and *Women in Academe: Progress and Prospects, 1991*, $14.95. AWIS members get a 20% discount. Send orders to Publications Department, Russell Sage Foundation, 112 East 64th Street, New York, NY 10021; (212) 750-6037. Handling charges are $3.00 for the first book and $.50 for each additional book.

Women of Color in Mathematics, Science, and Engineering: A Review of the Literature, is $17.00 from the Center for Women Policy Studies, 2000 P Street, NW, Suite 508, Washington, DC 20036; (202) 872-1770.

ROUND TABLE: WOMEN AND MATHEMATICS

A Round Table on "Women and Mathematics" will be held during the European Congress of Mathematics, Paris, July 6-10, 1992. It will take place on Tuesday, July 7, from 3:30 P.M. to 5 P.M., in Amphitheatre A4, Pantheon-Sorbonne. There will be five short talks (10 minutes each) and a general discussion.

Moderator: Capi Corrales (Spain); Speakers: Ina Kersten (Germany), Laura Tedeschini Lalli (Italy), Barbara Roszkowska (Poland), Mary Gray (USA, former president of AWM), and someone from the French association "Femmes et Mathématiques."

Announcement

The Department of Mathematics of the University of Kaiserslautern (Germany) is currently accepting applications from qualified mathematicians for the Sonia Kovalevskaya Visiting Professorship in Applied Mathematics.

As the position is dedicated to the promotion of the role of females in applied mathematics, only female candidates from all over the world may apply. It is expected that they will serve as examples to female students through their accomplishments in teaching and research.

Duration of the contract is acceptable for any period not exceeding one year, but should take in either the full summer semester (April to July) or the full winter semester (November to February). Duties include teaching (in German or English) for at least six hours per week in some area of applied mathematics and active participation in the research of the department. Depending on the qualification of the applicants the position will be graded on a German associate or full professor level.

This position will be located at the "Zentrum fuer Techno- und Wirt-schaftsmathematik - STW (Centre for Mathematics in Technology and Business") in the department of mathematics.

Advertisements

SIMON FRASER UNIVERSITY. Department of Mathematics and Statistics. Vancouver, British Columbia. Position in Applied and Computational Mathematics. The Department of Mathematics and Statistics of Simon Fraser University invites applications for a tenure track position in Applied and Computational Mathematics at the Assistant Professor level starting September 1, 1992 or as soon thereafter as feasible(this position is subject to final budget approval). Applicants will be expected to have completed a Ph.D. degree at the time of appointment and to have demonstrated a strong teaching and research potential. The Department is particularly interested in applicants whose research interests are in the areas of Theoretical and Computational Solid Mechanics. However, candidates with expertise in Partial Differential Equations applied either to Continuum Mechanics or Relativity are also encouraged to apply.

Applications, including curriculum vitae, description of research program and statement on teaching should be sent to: Dr. R.D. Russell, Chair, Search Committee, Department of Mathematics and Statistics, Simon Fraser University, Burnaby, BC V5A 1S6, Canada. Please arrange for three letters of reference to be sent directly from the referees.

The successful applicant will join a strong, active group of twelve applied mathematicians working in a wide range of applied areas including Continuum Mechanics, Differential Equations, Elasticity, Fluid Dynamics, General Relativity, Population Dynamics and Numerical Analysis. The Department offers a Bachelor of Science Program in Applied Mathematics as well as a structured graduate program in Applied and

Computational Mathematics leading to the Master of Science and Doctor of Philosophy degrees.

Simon Fraser University is committed to the principle of equity in employment and offers equal employment opportunities to all qualified applicants. In accordance with Canadian immigration requirements, this advertisement is directed to those who are eligible at the time of the application for employment in Canada.

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE. Department of Mathematics. Temporary positions are anticipated starting on August 16, 1992 as Lecturer. Masters degree in mathematics or admission to candidacy required; Ph.D. preferred. Applicants should provide evidence of excellence in teaching and foreign applicants must provide evidence of ability to teach in English effectively. Preference given to applicants with research interests compatible with those of the faculty. The duties will consist of 12 hours of undergraduate mathematics instruction each semester. Closing date May 15, 1992 or until positions are filled. Send applications (including transcripts) to: Temporary Positions, c/o Ronald Kirk, Chair, Department of Mathematics, Southern Illinois University at Carbondale, Carbondale,IL 62901.

URSINUS COLLEGE. Department of Mathematics and Computer Science. Collegeville, PA 19426.
Anticipated one-year position, Fall '92. Rank commensurate with qualifications. Ph.D. desired. Three courses per semester teaching load, full range of courses in the mathematical sciences. Standard fringe benefits. Independent coed liberal arts college with about 1100 students founded in 1869. Campus of 140 acres about 30 miles from Philadelphia. Send application and 3 letters of recommendation to Nancy Hagelgans, Chairperson. Excellent teaching references essential.

Association for Women in Mathematics

Individual Membership Form 91-92

Date.....19.....

Please complete this form and return it as soon as possible. Your membership will be updated immediately. See reverse side to determine what membership category you are eligible for. Subscription to the AWM Newsletter is included as part of your membership. Thank you for taking the time to complete this new form.

Please indicate below how your name should appear in the AWM Membership List.

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Last Name First Middle Initial

Address for all mail:

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Family member name (if applicable):

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Last Name First Middle Initial

Electronic Mail Address (if any): _____

Address Change? _____ New Member? _____

Telephone numbers: Home: ( )_____

Office: ( )_____

Degrees, with institutions and dates:

_____

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Present position: _____

Firm or institution: _____

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City State Zip/Country

Primary Fields of Interest. Select up to five from the list on page 2.

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Please indicate below if you would allow your name, address, and phone number to be included in the AWM Membership Directory.

Check one: _____yes _____no

Signature: _____

Membership Categories

Please read the following to determine which membership category you are eligible for, and then indicate below the appropriate category. AWM membership year is October 1 to October 1.

For individual members joining for the first time, the dues are $15 for each of the first two years. Renewing individual members pay $20 dues. Family membership: $25. Contributing members: $45. Students, retired individuals, and unemployed individuals: $5. Contributions of any size very welcome.

Dues Schedule

Please indicate amount enclosed.

Individual member ..... ____ $15 (first 2 years) ____$20

Family membership ..... ____$25

Contributing member ..... ____$45

Student, retired or unemployed ..... ____$5

Foreign members, other than Canada or Mexico ..... +$8 for postage

Total Enclosed: _____

Fields of Interest

Please consult the list of major headings of the 1991 Math Subject Classification and the categories specific to AWM.

00 General
01 History and biography
03 Mathematical logic and foundations
04 Set theory
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General algebraic systems
11 Number theory
12 Field theory & polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra: matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 K-theory
20 Group theory
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytical spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
39 Finite differences and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations and optimal control; optimization
51 Geometry
52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
73 Mechanics of solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classic thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and behavioral science
93 Systems theory; control
94 Information and communication, circuits

001 Education: K-8
002 Education: 9-12
003 Education: Undergraduate
004 Education: Graduate
005 Gender issues
006 Affirmative action
007 History of women in math sciences
008 Other (please specify):

_____

Association for Women in Mathematics
Box 178 Wellesley College
Wellesley, MA 02181
(617) 237-7517

Travel Grants for Women

sponsored by
National Science Foundation
&
Association For Women in Mathematics

The objective of the NSF - AWM Travel Grant 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 advance 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.

Travel Grants: The grants will support travel and subsistence to a meeting or a 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 three award periods per year, with applications due February 1, May 1, and October 1. Please note the change in dates from previous years. Applicants should send a description of their current research and of how the proposed travel would benefit their program, a curriculum vitae, and a budget to:

Jodi L. Beldotti, Executive Director
Association For Women in Mathematics
Box 178, Wellesley College
Wellesley, MA 02181
(617) 237-7517

NOTE: Please send an original and four copies of your application to AWM.

Alice T. Schafer Mathematics Prize

The ASSOCIATION FOR WOMEN IN MATHEMATICS calls for nominations for the Alice T. Schafer Mathematics Prize of $1000 to be awarded to an undergraduate woman for excellence in mathematics. All members of the mathematical community are invited to submit nominations for the Prize. The nominee may be at any level in her undergraduate career. The letter of nomination should include, but not be limited to, an evaluation of the nominee on the following criteria: quality of performance in mathematics, exhibition of real interest in mathematics, ability for independent work, performance in mathematical competitions at the local or national level, if any. Supporting materials, if any, should be enclosed with the nominations. Nominations must be postmarked no later than April 30, 1992 and sent to:

Jodi L. Beldotti, Executive Director
Association For Women in Mathematics
Box 178, Wellesley College
Wellesley, MA 02181
(617) 237-7517

NOTE: Please send an original and four copies of the application to AWM.

Membership Categories

Please send the following to determine which membership category you are eligible for, and then indicate below the appropriate category. AWM membership year is October 1 to October 1.

For **individual members joining for the first time,** the dues are $15 for the first two years. **Renewing individual members** pay $20 dues. **Family membership:** $25. **Contributing members:** $45. **Students, retired individuals, and unemployed individuals:** $5. Contributions of any size are very welcome.

Dues Schedule

Please indicate amount enclosed.

Individual member	____ $15 (first 2 years)	___ $ 20
Family membership		___ $ 25
Contributing member		___ $ 45
Student, retired or unemployed		___ $ 5
Foreign members, other than Canada or Mexico		+ $8 for postage

AWM

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AWM
ASSOCIATION
FOR WOMEN IN
MATHEMATICS

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