AWM
ASSOCIATION FOR WOMEN IN MATHEMATICS

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PRESIDENT'S REPORT

Awkward Timing

There are many things about to be settled for AWM which I had hoped to be able to report as settled. Not yet confirmed at this writing is our new address. We *are* leaving Wellesley, and a new address should — with luck — appear elsewhere in this issue. Also not ready are final word on the Noether Lecturer and other details for the San Antonio meeting (we will have a panel, on the two-body problem and other "women's" issues of employment versus geography). AWM has applied to NSF and ONR for funding for continuing the program of workshops for graduate students and recent Ph.D. recipients, the next one slated for January 12th at San Antonio; details are in the back pages. Word is trickling in about activities at the meetings this summer in Cambridge and Paris, with ICME in Quebec yet to come and SIAM underway in LA. In the November/December report I should have a *lot* to tell you; writing this report with today's deadline feels like trying to write a paper with half the theorems yet to be proved.

Money Is Everything?

As I reported before, the Executive Committee set new dues for the upcoming year. Our dues and fees have been much too low to cover our costs, but the Executive Committee was still reluctant to set them as high as perhaps we should. Our compromise was to use add-ons, which — although annoying — do allow maximal flexibility for underemployed members. The individual dues really are $40; if that turns out to be too much, then $25 is ok, with the $5 for the Prize fund and the $10 for the General fund optional. The student dues are $8, which covers the cost of the newsletters. At risk of sounding like public radio, I urge you to consider becoming a contributing member ($100 or more). Conversely, if anyone cannot afford the membership, let me or Jodi know. It is never AWM's intention to exclude anyone.

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: 3,100.

AWM Can Count

Not only can we count dollars, but we now can count members, for the first time in a long time. Jodi Beldotti and her assistants have won the battle of the database. Eternal vigilance is the price of having a clean database, but for the moment AWM has the upper hand. Hundreds of out-of-date addresses and files have been deleted, with — we hope — minimal damage to the rest. I was surprised to learn that we have almost as many student members as regular members: roughly 1300 students and 1500 other individual members, with institutions etc. bring the total above 3100. And if you got lost in the shuffle, please help us find you again. Great work, Jodi!

Easily Impressed

Even if the Democratic convention was little more than a pep rally, the women there certainly seemed to be much more than cheerleaders. How many mathematics departments could boast as high a percentage of women as were seen on the floor of the convention, on the speakers' dais, and running for office?

How Bad Are the Mathematicians?

The debate stirred by the *Science* article on women in mathematics rages on, at least in my email world. This issue includes a letter sent to *Science* by eighteen of us in response to the article. But we by no means attempted the last word. Now it's someone else's turn!

Hay Award Nominees

Look around and see who has made a difference in mathematics education. Then write us about her, please, for the third Louise Hay Award. How about some nominees from the student members?

AWM Thanks Go To

- Ron and Geana Little at Fairmount Printing for their valuable cooperation with the newsletter, and also to Brenda McFarland for her ingenuity with photo reproductions
- Deirdre Haskell for volunteer hours in the AWM office
- Joyce McLaughlin for organizing the SIAM panel and also the noontime workshop
- Ann Stehney for presenting the Schafer Prize at SIAM, and Alice Schafer for being there too (and being Alice)
- NSF for support for a mini-workshop/lunchtime activities at SIAM related to the panel

- All the home institutions of Schafer Prize honorees who sent their students to Los Angeles for the award ceremony at SIAM

  and

- WELLESLEY COLLEGE for eleven years of hospitality!

Carol

Carol Wood
Middletown, Connecticut
July 20, 1992

CALL FOR NOMINATIONS: THE LOUISE HAY AWARD

The Executive Committee of the Association for Women in Mathematics has established the Louise Hay Award for Contributions to Mathematics Education, to be given annually to a woman at the January Business Meeting. The purpose of this award is to recognize outstanding achievements in any area of mathematics education, to be interpreted in the broadest possible sense. The awardee will be selected by a committee appointed by the President and will receive a citation at the AWM Business Meeting.

While Louise Hay was widely recognized for her contributions to mathematical logic and for her strong leadership as Head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, her devotion to students and her lifelong commitment to nurturing the talent of young women and men secure her reputation as a consummate educator. The annual presentation of this award is intended to highlight the importance of mathematics education and to evoke the memory of all that Hay exemplified as a teacher, scholar, administrator, and human being.

Nominations for the award should be sent by **November 1, 1992** to: The Hay Award Committee, c/o Jodi L. Beldotti, Association for Women in Mathematics, Box 178, Wellesley College, Wellesley, MA 02181; (617) 237-7517. Please send *five copies*.

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.

MEMBERSHIP AND NEWSLETTER INFORMATION

Membership dues

Regular: $40
Family: $55
Base fees: $25 and $40
Prize Fund add-on: $5
General funds add-on: $10
Student, unemployed, retired: $8
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: leggett@math.luc.edu; LMA24@LUCCPUA.BITNET
Send all material regarding **book reviews** to Cathy Kessel, 2520 Etna, 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

1992 AMS ELECTION

As usual, we have requested all candidates for contested office in the American Mathematical Society (AMS) election to submit statements in support of their candidacies. The letter sent to the candidates stated:

> Topics discussed in the past which you might wish to consider have included the following: the role of the AMS Council, promotion and tenure practices, the David report and its implications, and how to attract more members of underrepresented groups into the mathematics pipeline.
>
> A topic of special concern this year is the following: currently there is a job crisis in the academic mathematical community. What do you think should be done? What can the AMS do to improve the situation?

All statements received by the July 24th deadline are printed below; late statements will appear in the November-December issue. See the AMS pink sheets for further information.

The Council nominated Melvin Hochster and Anil Nerode for Vice-President, one to be elected for a term of three years. The Council nominated the following candidates for Member-at-Large of the Council: James H. Curry, Gloria C. Hewitt, Svetlana R. Katok, Steven G. Krantz, James I. Lepowsky, Peter Li, Kenneth A. Ribet, Phillip D. Wagreich, Jonathan M. Wahl, and Susan Gayle Williams. Five will be elected to serve terms of three years. The Council nominated Roy L. Adler and Richard W. Beals as candidates for Trustee, one to be elected for a term of five years. The President has nominated the following candidates for the Nominating Committee: Jerome A. Goldstein, Vaughan F.R. Jones, Brian J. Parshall, Louise A. Raphael, Yum Tong Siu, and Nancy K. Stanton. Three will be elected. The President has also nominated the following candidates for the Editorial Boards Committee: Bryan J. Birch, Fan R.K. Chung, Paul H. Rabinowitz, and Masamichi Takesaki. Two will be elected. Unless stated otherwise in the affiliations given below, the candidate is a professor in a department of mathematics.

VICE PRESIDENT

Mel Hochster, University of Michigan

The current shortage of academic jobs is of great concern to all of us. If AMS, acting in concert with other mathematical societies, could make sufficiently accurate predictions of the need for mathematicians five to seven years in the future then the institutions producing mathematicians would have guidance as to how many students they ought to be taking. Whether such predictions would be sufficiently robust to withstand the effects of recessions and huge fluctuations in the number of mathematicians emigrating from abroad is surely problematic. Nonetheless, the Society ought to do what it can to provide this kind of information.

It may seem odd to be worrying about recruitment at this moment, but the present situation will surely turn around in the long run. The recruitment of young people into careers in mathematics, both from mathematical minorities and more generally, ought to be a major concern for AMS. The effort to increase representation from minorities cannot begin too early. It is important to provide mentoring and encouragement at all stages of development. The issue can be addressed in part by special programs targeting young people at various levels of education, but this will not be enough. The Society should be working to raise the level of consciousness of all of its members as to the impact that they can have, on a day-to-day basis, on the students and other young people around them.

The recruiting of mathematicians is strongly influenced by the overall attractiveness of mathematics as a career. One of the negatives is that mathematics research is woefully underfunded, a situation that is especially unsettling considering how relatively inexpensive it would be to bring the level of funding for mathematics up to what it should be. This must continue to be of greatest concern to the Society until the deficiency is remedied.

MEMBER-AT-LARGE OF THE COUNCIL

Steven G. Krantz, Pennsylvania State University

I have felt for some time that the affairs of the AMS have been controlled by a limited number of people from a limited number of universities. This situation may exist because of apathy on the part of the rest of us, but it exists. The result is that the AMS Council, and AMS policies in general, have reflected a limited number of viewpoints. Receptivity to innovation and change has been slight. Tolerance of controversy has varied from strained to nonexistent.

While I do not want to see the AMS Council become a strictly political forum, I do want it to be a crucible for change in the professional infrastructure of mathematics. I would like to see it take a more active role in helping young mathematicians to find jobs, and in encouraging young people to seek careers in mathematics. It goes without saying that special attention should be paid in this effort to encouraging traditionally underrepresented groups.

Concomitant with the discouraging lack of opportunities for young mathematicians are the increasingly limited opportunities for more senior mathematicians to obtain grant support. Those in power are insensitive to this situation because they do not suffer from it.

Closely connected to the problems that we have described is our moral obligation to lend assistance to mathematicians from countries which are currently undergoing political turmoil, and to universities in those countries. These are difficult times; resources are limited. A balance must be struck.

I would like to see the activities and decision-making processes of the AMS Council conducted in a manner that is more open, and more responsive, to the general membership of the AMS. Within reason, AMS members should easily be able to obtain the agendas of upcoming AMS Council meetings and should be able to attend these meetings.

In a nutshell, I would like to see an end to the mandarin system that we have now and instead have a professional society of equals.

Jim Lepowsky, Rutgers University

First, I enclose my brief statement for the *Notices*:

In conjunction with its primary goal of fostering innovative research, the AMS should continue, and seek new ways, to: (1) take an active role in the improvement of mathematics teaching at all levels; (2) emphasize to funding sources and to the general public the importance of mathematics — especially the kind of undirected basic research carried out by individual investigators; (3) facilitate interdisciplinary interaction both within mathematics and between mathematics and other fields; (4) strongly encourage talented students, including women and members of minority groups, to consider mathematics as a career; and (5) provide a forum for mathematicians to discuss the relations between mathematics and society.

As we know, among the sciences, mathematics is fundamental, and at the same time, is relatively inexpensive to support. In connection with point #2, I suggest that the AMS should work to find methods to persuade university administrations and such funding sources as the NSF to allocate more of their resources to mathematics.

Peter Li, University of California, Irvine

In the last 2 years, the job market in mathematics seems to have caved in overnight. This sudden

change caught the mathematics community by surprise. It is crucial at this stage to be able to project and accurately assess the future market. In this sense, it should be the responsibility of the American Mathematical Society to set up a task force to effectively deal with this problem.

Ken Ribet, University of California, Berkeley

The mathematics profession has not changed significantly since I was a freshman. Although we sometimes grumble about low salaries and poor working conditions, Society has granted us the freedom to regulate the mix of teaching, research, mentoring and administration which defines our profession.

All of a sudden, things are changing. American taxpayers and parents are demanding more from their universities. Many citizens consider that professors live privileged lives and earn excessive salaries. Junior level positions are drying up, especially at the tenure-track level. Senior positions disappear as administrators attempt to save money through early-retirement incentive plans. Government agencies are supporting fewer researchers. Those of us who have jobs are working harder, and enjoying it less. The situation is grim, and it doesn't seem to be improving.

What role can the AMS play in this crisis? Here are two points that deserve special mention:

> First, the AMS's lobbying activities will take on renewed importance as Mathematics competes with other disciplines for what looks like a piece of a shrinking pie. The AMS's new Washington, DC office has a key role to play.
>
> Second, the ability of the AMS to bring job candidates together with employers, especially non-academic employers, now becomes increasingly valuable. An efficient electronic job bulletin board may make it possible for candidates to advertise themselves without sending bulky applications to scores of universities.

I have been an AMS member for roughly 20 years. Although I have never held an AMS office, I have served on a number of committees. I have no strong political opinions to bring to the Council. Instead, I hope that my background as a working mathematician will help the Council to make informed choices.

Jonathan M. Wahl, University of North Carolina

It is very important for the AMS, through the Council, to be a vigorous proponent with external organizations of our professional interests. The David Report several years ago highlighted the inability of the mathematical community to have the same kind of political clout as other sciences. This problem again arises with recent decisions of the NSF to pursue their own vision of how to spend mathematical dollars, apparently contrary to the best judgment of the mathematical community.

The Council ought to be willing to lobby hard, with good sense and realistically, with the NSF, NRC, and possibly others. Other sciences are not timid about being heard in Washington; neither should we be.

Susan G. Williams, University of South Alabama

I have been pleased in recent years to see women well represented on the AMS Council. It is essential that we maintain a high profile. The "generic" mathematician is still male in the mind of the public and, sad to say, of some in the mathematical community. For example, recently I discovered that an editor of an AMS journal, in correspondence with an author about a paper I had refereed, referred to me as "he" — to protect my anonymity, he assured me.

I also belong to a large segment of the AMS membership chronically underrepresented on the Council: mathematicians doing research at small colleges and universities that have few resources to support their work. This may be a rather ill-defined group, but it is certainly growing as the dismal job market sends more talented young mathematicians to schools with little reputation for research. Meanwhile we who worked hard to foster research in our departments see our gains eroding under the pressure of budget cuts. The AMS must do more to persuade the public and administrators that discovery is a vital part of mathematics at all levels. Research stimulates lively teaching and boosts morale. The battle for public understanding is being fought in small schools across the country. The AMS needs to hear more from the people in the trenches.

EDITORIAL BOARDS COMMITTEE

Masamichi Takesaki, UCLA

Today, the general public, and in particular politicians and university administrators see the value of science in terms of its applications. These applications are very important; however the potential for applications of basic research is not sufficiently well appreciated. Giants such as Gauss, Einstein and more recently Turing did not come to their discoveries through any compulsion to provide applications of theoretical investigations; rather, they came to them as a consequence of intellectual curiosity, and a desire to understand the world.

Mathematics is the language we must use to communicate with and understand nature. Just as with one's spoken mother tongue, we must learn to speak the language of mathematics as a matter of necessity. Since mother nature controls us, it is vital that we learn to speak this language with inventiveness, skill and authority.

I do not believe that we can usefully distinguish any area within mathematics as either good or bad, despite the fact that some areas are fashionable and others not, and the fact that within each area many good results and also many poor papers exist. I have devoted my mathematical energy to operator algebras for the past 35 years, during which time its popularity has varied greatly. I am convinced that inactive or unpopular areas of mathematics often only need some breakthrough or new point of view to assert their value, and that all areas always have the potential to make important progress at any time. In the same way, mathematics should not be the preserve of any one group of people; it should be learned and investigated by men and women and by all ethnic groups.

It is essential that the mathematical community more effectively promote its views and concerns. Too often we have not taken advantage of available opportunities to do this; neither have we been successful in creating an atmosphere in which the true value of our endeavors are recognized. As mathematicians, it is our duty to educate the public by expressing our views directly and clearly whenever possible.

Bryan Birch, Mathematics Institute, University of Oxford

Mathematicians have always been fortunate, because our subject is not a politically sensitive one, and one's nationality was never mathematically relevant. International cooperation has always been possible, and essential, and happily it has now become easy.

In Britain it is a matter of serious concern that so few women take up the academic career for which they appear well qualified; unfortunately, I don't know what to do about this.

NOMINATING COMMITTEE

Nancy Stanton, University of Notre Dame

The mission of the AMS is "to further the interests of mathematical research and scholarship," broadly construed. The recent report of the Strategic Planning Task Force articulates a broad vision of the goals of the AMS in fulfilling its mission over the next few years. This must be done without enlarging the Society's bureaucracy and without making the Society increasingly impersonal. I would try to find candidates who reflect the diversity of the Society's membership, who have a broad view of mathematics, and who have the creativity to help the Society meet its goals. In particular, candidates should be sensitive to critical issues involving mathematics research and support for research, mathematics education, employment for mathematicians, increased participation of underrepresented groups, and public awareness of mathematics.

Louise Raphael, Howard University

My statement to the AMS reads: "I will recommend the best qualified mathematicians, with special care to promote the candidacies of women and minorities for AMS offices, council, committees, and boards in order to ensure that the AMS has the benefit of the best mathematical talent and wisdom of all its members."

We all share AWM's concern for the large numbers of talented mathematicians — both national and foreign — who cannot find academic jobs. This problem is interwoven with providing first rate undergraduate mathematics education ranging from the two year colleges to the elite research universities. Departments of mathematics must make a case that in order that American undergraduates be mathematically proficient, the budgets for faculty positions should be based on the number of enrolled students. In fact the dollars allotted to teach mathematics to one student should be approximately

equal to the cost of teaching science or engineering to one student. This is in keeping with the fact that mathematic departments require large numbers of computers, new software and maintenance contracts. Mathematics budgets should be in accord with the needs of the 20th and 21st centuries.

Moreover, with increased dollars for mathematics teaching positions, faculty can experiment with new curriculum, offer more course variety and provide students with more quality/quantity contact hours. It is time to be reimbursed fairly for the dollars Departments of Mathematics generate. If wisely used, the students will benefit from the increase of faculty positions and so will the mathematical community.

Jerome A. Goldstein, Louisiana State University

My statement to the AMS was as follows:

The business of the AMS is to promote mathematical activity and scholarship at the highest levels. High standards should be maintained while avoiding elitism. All qualified and interested individuals should be encouraged to pursue careers in mathematics and to advance their careers as far as possible. These positions imply advocacy of affirmative action, concern for the welfare of individual mathematicians, concern over educational issues, and advocacy for research support for larger numbers of mathematicians.

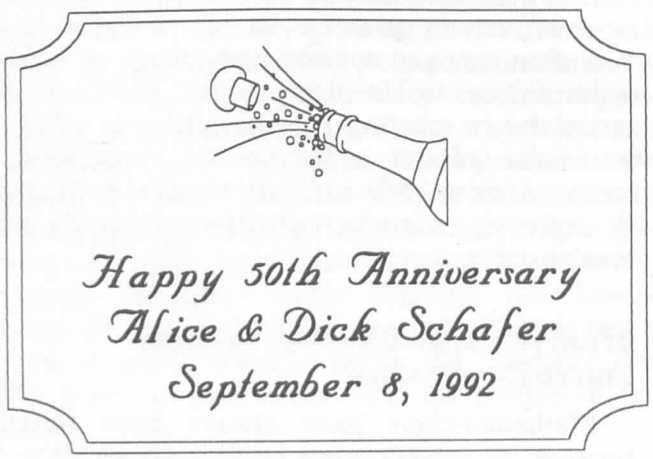
Motivated by your letter I offer some additional comments. The AMS could urge institutions to hire Ph.D.'s to instructorship positions for which master's degree holders were traditionally hired. Armed with AMS backing, department chairs could make a case with their administrators for higher salaries and lower teaching loads for these positions. This could lead to the creation of more teaching positions at this critical time in the job market. I would also like to see many more mathematicians get their research supported at a national level. The number of such people is now around 1700; one could easily justify, based on merit, increasing this number to 3000. When I served on NSF's Advisory Committee for the Division of Mathematical Sciences, I strongly advocated small research grants as a way of increasing the number with research support. For more information on my views on this topic see my article on small research grants [*Notices of the AMS* 37 (1990), 669-671]. I also continue to support strongly the AMS getting seed money and an endowment to create a program of small research grants for individual mathematicians.

AWM-EWM MEETING

AWM and EWM members, through arrangements of AMS and LMS officers and staff, met for lunch on July 1 in Robinson College, Cambridge, England. Mary Gray, the founding President of AWM, greeted the group. The twenty-four attending included several young women, from different countries and across a range of mathematical specialties, who are having difficulty finding permanent academic positions as their postdocs are completed. There was informal discussion of the possible role of the various professional societies in helping to alleviate these problems although the general expectation, which had been expressed in the welcome at the Joint AMS/LMS Banquet the previous evening, was that the situation would not soon improve.

Materials about European Women in Mathematics and its previous and upcoming meetings, and about the Association for Women in Mathematics, were distributed at lunch and were available on a table in the exhibit area throughout the meeting. Copies of *Careers that Count*, the Noether Lecturer brochure, and other AWM materials were of special interest.

Bettye Anne Case, Florida State University



HEARING ON THE HOUSE BILL ON WOMEN IN SCIENCE

On June 25, 1992 the Subcommittee on Employment Opportunities of the House Committee on Education and Labor held a hearing on two bills sponsored by Rep. Connie Morella (R-Md.). As described by Representative Morella, "H.R. 3475, the 'Women in Apprenticeship and Nontraditional Occupations Act,' will provide technical assistance to employers and unions to recruit, train and retain women in apprenticeships and nontraditional jobs.... H.R. 3476, the 'Advancement of Women in Science and Engineering Act,' will set up a commission to research and evaluate successful practices and policies to recruit, retain, and advance women in the fields of science and engineering. The commission would then present much needed information upon which educators and employers can build models for success." The first of these bills would have a one million dollar price-tag, the second would cost the government nothing. At the time of the hearing, the Women in Science bill had no Senate sponsor.

Catherine Didion, Executive Director of the Association for Women in Science, testified that, although it is well documented that women cut short their scientific education at a higher rate than men, there has been no national study on the reasons for this attrition and there have been no wide-scale studies of what intervention strategies might work.

Linda Wilson, President of Radcliffe College, testified that a woman's self-confidence affects her choice of going into mathematics or science; that men are more encouraged, get more information, and have better relationships with their advisors than women do; and that women mathematicians and scientists have more negative experiences than women in other academic fields.

The only mathematician to testify was Jenny Harrison, who is suing the University of California at Berkeley for denial of tenure based on gender discrimination. She described the gender bias that she has encountered and also made the point that women need self-confidence and active encouragement to pursue mathematics. This point was picked up by *Washington Post* staff writer Shari Rudavsky when an article on the hearing appeared in the *Post* on July 1, 1992.

Considering that the title of the hearing was "Sexual Harassment in Male-Dominated Occupations," it was heartening that there was even this much attention to the problems of discrimination based on gender. Although harassment, either gender-based or sexual, certainly exists in the mathematical and scientific communities, it is discrimination based on gender that has affected most of the women mathematicians whom I know. Unfortunately the comments from those few congressmen and congresswomen who attended the hearing showed little awareness of the difference between harassment and discrimination. Furthermore, the indication is that they believe that harassment is the cause of the high attrition rate among women in science and mathematics.

The hearing included three panels giving testimony. The first panel consisted of three congresswomen: Pat Schroeder (D-Col.), Olympia Snowe (R-Me.), and Connie Morella. Their testimony was predictably political, mentioning the Tailhook convention at every opportunity, whether relevant or not. It was made clear, however, that they believed that women were fleeing the scientific community because of the isolation and hostility they met there and that Morella's bill would make a difference.

The second panel consisted of four victims: a neurologist who had been at the National Institutes of Health, a truck driver from Maryland, a maintenance engineer from New Jersey, and Jenny Harrison. The testimony from this panel included some very frightening examples of harassment, including that of the maintenance engineer whose life was threatened. It was unfortunate that Harrison had to testify on this panel, since her description of disparate treatment during the tenure process is not as sensational as an attempt on one's life or a wrecked scientific career because of a refusal to have sexual relations with one's supervisor.

The final panel consisted of the director of the Nontraditional Employment Training Project of Wider Opportunities for Women, the Assistant Director of the Women's Department of the International Union, United Automobile Aerospace and

by Judy Green, Marymount University
This is my report on the hearing conducted by the Subcommittee on Employment Opportunities of the House Committee on Education and Labor on two bills sponsored by Rep. Connie Morella (R-Md.). I attended to represent AWM. (Two other Marymount faculty members, Alice Schafer and June Winter, also attended.) The views expressed in the last paragraph are my own.

Agricultural Implement Workers of America (UAW), Linda Wilson, and Catherine Didion. Although the previous two panels had testified to a full audience, a number of congressional representatives, and four or five video cameras, only the chair of the subcommittee, Carl Perkins (D-Ky.) and Morella, who isn't a member of the subcommittee, remained for this panel. Similarly, most of the press and the audience left after the horror stories were told.

My reaction to this hearing is not optimistic. Before attending I had asked myself why the government needed to study the problem of increasing the number of women in mathematics and science; now I know there is an answer — because Congress, even the women in Congress, have no idea of what the problem is. Furthermore, although at the hearing I was pleased that Harrison and Wilson could pinpoint something that could be done to encourage women in mathematics and science, i.e. raise their self-confidence, upon reflection it appears to me that this lack of self-confidence is just the new popular explanation for women's lack of professional success. Moreover, it seems as if it might now become common to blame women for their lack of self-confidence, despite the fact that many men are hostile to women who exhibit self-confidence. Somehow we need to convince all the men in positions of power in the mathematical and scientific communities that women, and of course minorities, have the same innate abilities and should be treated with the same respect as white males.

AWM STATEMENT

The Association for Women in Mathematics (AWM) was established in 1971 to serve and encourage women to study and to have active careers in the mathematical sciences. We promote equal opportunity and equal treatment of women, and our efforts have led to greater participation and higher visibility of women in the mathematical profession. But our task is far from complete, and we continue to work toward the day when women are fully represented at all levels.

AWM welcomes Congress' attention to matters at the core of our own existence and of our current activity. We stand ready to work with Congresswoman Morella and others, specifically in the context of H.R. 3476, as they strive to address issues of inequity and of career access for women scientists.

For the Executive Committee of AWM,
Carol Wood, President, 22 June 1992

Judy Green presented this statement to the sponsors of H.R. 3476 at the hearing. The Association for Women in Science (AWIS) spearheaded the effort to encourage scientific organizations to support the bill. The Joint Policy Board for Mathematics (JPBM) endorsed the legislation in a letter to Morella; also, a letter was sent to the appropriate subcommittee chair urging him to report the bill.

AWARDS AND HONORS

AWM member James J. Tattersall, professor, Providence College has received the Certificate of Meritorious Service for the Northeastern Section of the MAA. Congratulations to Jim! He served as the Host Coordinator for the Northeastern Section in 1983, as the Program Chair in 1988, and in other capacities. He currently serves as the Section's Historian-Archivist and is writing a series of articles on the history of the Northeastern Section. He has been a Visiting Lecturer for the MAA and has served on the AMS-MAA Committee on Short Courses and the AMS-MAA Committee on Employment and Educational Policy.

Congratulations to the three women who have recently been elected to SIAM office. Mary F. Wheeler, the Noah Harding Professor of Mathematical Sciences at Rice University, has been re-elected to a second three-year term on the Board of Trustees of SIAM. L. Pamela Cook, professor and interim chair of the Department of Mathematical Sciences at the University of Delaware and Joyce R. McLaughlin, professor of mathematical sciences at Rensselaer Polytechnic Institute in Troy, New York, have been elected as members-at-large of the SIAM Council.

LETTER TO SCIENCE

Women in Mathematics

It was difficult to recognize our profession from the 13 March special section of "Women in Science." Are there serious problems in mathematics for women? Yes, and the 18 signers of this letter have spent serious amounts of time addressing them. But there are serious problems for any woman who aspires to excellence in our society, and even professions with large numbers of women (think of the arts) set up serious obstacles for women who attempt to play more than a supporting role.

Furthermore, the emphasis within the article on the role of sexual innuendo seemed quite misleading, distracting from the real issue, which is society's belief that (i) women can't do mathematics, and (ii) if they do, it's by definition not too good. Sexual innuendo is just one (and a fairly minor one in the mathematics community) manifestation of these beliefs, and it is these beliefs that are the major issue.

In spite of all of the hassles, women continue to do good mathematics and *enjoy* it too! The persistence and existence of women mathematicians witnesses this fact. Do they get sufficient recognition for their achievements? Probably not, but they get more recognition now than they did 15 to 20 years ago. Is mathematics worse than chemistry or biology? We just don't know, and the articles in *Science* have not helped us find out.

A reader seeking a more balanced report on the status of women mathematicians might want to begin with the September 1991 issue of the *Notices of the American Mathematical Society* (Vol. 38, No. 7), which was a special issue on women in mathematics. The articles on women in the profession from this issue of the *Notices* are available in bound-together reprint form and can be obtained from the society's office at Post Office Box 6248, Providence, Rhode Island 02940-6248.

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This letter appeared in the July 17th issue of Science.

AWM PANEL AT SIAM

This is a corrected version of the program appearing last issue for the AWM Panel on Research in Government, organized by Joyce McLaughlin for the SIAM meeting and held on Tuesday, July 21, 1992. We regret the errors.

The speakers and their titles were: Pamela Coxson, Lawrence Berkeley Laboratory, "Dynamic Positron Emission Tomography and Diagnosis of Cardiac Heart Disease;" Fern Hunt, NIST and Howard University, "My Research Experiences at NIST;" Suzanne Lenhart, Oak Ridge National Laboratory and University of Tennessee, Knoxville; "Environmental Modeling at Oak Ridge National Laboratory;" Laif Swanson, Jet Propulsion Laboratory, "Coding Theory for Deep Space Communications;" and Alexandra Tolstoy, Naval Research Laboratory, "Applied Mathematics in Underwater Acoustics."

SONIA KOVALEVSKY HIGH SCHOOL MATH DAYS

Greater Cleveland, March 7, 1992

The third Sonia Kovalevsky High School Mathematics Day was held on Saturday, March 7, 1992 under joint sponsorship of the Association for Women in Mathematics, the Thomas H. White Charitable Trust and the Martha Holden Jennings Foundation. It was attended by 120 students, twenty-three teachers and three parents. The schools represented ranged from parochial to suburban to inner-city schools. A promising trend is reflected in the increasingly larger number of minority students, from suburban schools such as Shaker Heights High School and inner-city ones like Collinwood.

The day began with a warm welcome by Professor Cecilie Goodrich, Interim Dean of Arts and Sciences. Her opening remarks centered on innumeracy and its importance in scientific investigation as well as problems in daily life. This was followed by a beautiful rendering of a biographical sketch of Sonia Kovalevsky's life by Amy Fischer of Miami University–Middletown, Ohio. The participants were divided into three groups to participate in a panel discussion of math-related careers. The panels were staffed by women who had achieved success as electrical, metallurgical or aerospace engineers; public accountants; environmental scientists; computer scientists; architects; optometrists; research statisticians and professional mathematicians. Judging from the evaluations, the panels were well-received. However, the young women would like to see more variations of career paths. This is particularly true of students who attended our event more than once during their high-school years.

The students and teachers also participated in two different mathematical activities. The following are the topics covered in the six concurrent sessions: linear programming, graphics calculators, bus routing computer simulation, waves and computer graphics, decision-making, and saran wrap and soap films (minimal surfaces). Every attempt was made to bring students to the forefront of current mathematical theories and their applications.

Most participants lingered over lunch, talking about common experiences. Most of the panelists and mathematical application presenters participated in lunch, providing the students and teachers with the opportunity to ask additional questions and focus on personal concerns. Some of the students expressed an interest in further contact with the panelists. At least two of the panelists have indicated their willingness. We intend to do a follow-up study later in the spring. Due to an announcement in the *Plain Dealer* there was some last-minute interest in the event in the local community, but it did not lead to a significant increase in numbers. Our principal avenue for reaching students is through dedicated teachers and counselors, but next time we intend to make a special effort to exploit the local media. The Greater Cleveland community has a real need for such an event and has embraced it warmly.

We have been able to sponsor a Cleveland teacher to the Mount Holyoke Summer Math Institute for Teachers, and we are planning a half-day conference of Greater Cleveland area teachers in the fall so the experiences at Mount Holyoke can be shared. We hope this will help generate more enthusiasm in such enriching programs.

Pratibha G. Ghatage, Cleveland State University and Janeal M. Oprea, NASA-Lewis Research Center, Organizers

Simmons College, March 26, 1992

On Thursday, March 26, 1992, nearly two hundred young women high school students and fifty high school teachers from thirty Boston area schools met at Simmons College to attend the seventh annual Sonia Kovalevsky High School Math Day. Sponsored by Simmons College with the backing of the Association for Women in Mathematics, this annual event aims to encourage young women to study mathematics and pursue careers in mathematics by giving students and teachers examples of exciting real-life applications and by presenting successful and inspirational women role models.

The morning part of the Sonia Kovalevsky Day consisted of a panel for both teachers and students as well as separate workshops for students and teachers. The panel, titled "Three Mathematical Stories," featured Dr. Deborah Allinger of The Charles Stark Draper Laboratory, Ms. Kathy Maronski from Polaroid and Ms. Leslie Prescott of

Michael Schmidt, Fund-raiser

The MITRE Corporation. The three panelists talked about how they use mathematics in their work. For students there were four workshops: "Statistical Sleuthing" (Leader: Arlene Ashe, Boston University), "Nodes, Edges and You" (Leader: Marianne Lepp, Independent Consultant), "Polls That Predict Presidents" (Leader: Micheal Brown, Simmons College) and "Square Roots: Expensive and Inexpensive" (Leader: David Browder, Simmons College). The teachers participated in two morning workshops: "How To Use Spreadsheets in the Classroom" (Leader: Arthur Dulong, Lexington High School), and "The Mathematics of Lyme Disease" (Leader: Sonja Sandberg, Framingham State College).

Following the morning session, students and teachers joined each other for lunch and were officially welcomed by Professor Anne Coghlan, Dean of Sciences, Simmons College. This year's keynote speaker was Dr. Carole Greenes, professor at Boston University. Dr. Greenes appeared in the character of Sonia Kovalevsky. Dr. Greenes' performance was entertaining, educational and inspirational.

The day was a tremendous success. The student evaluations sum up their experiences:

> I've always wondered how math courses like calculus can apply to any future life. It was interesting to discover how the majority of job careers require an intense mathematical background.
>
> The speakers were all very good. I learned from their experiences. It was fun, educational, but not boring.
>
> Today the people showed us many promising jobs out there in the math field. The lectures encouraged us to take the challenges of math and follow through without being discouraged.
>
> The three mathematical stories gave me the feeling that if they could do math then so could I. After today I felt more encouraged to pursue an occupation in math or engineering.
>
> I never realized how much math is in just about every career imaginable.
>
> The lunch was great!

Support for this year's Sonia Kovalevsky High School Day was provided by the Association for Women in Mathematics, Arthur D. Little Inc., AT&T, Charles Stark Draper Laboratory Inc., MITRE Corporation, and New England Telephone.

Rivier College, April 24, 1992

This is an overview of our fourth annual Sonia Kovalevsky Day. We hosted over 100 participants — students and teachers — from fourteen schools from New Hampshire and northern Massachussetts. Our program began with morning options for the students and two presentations for the teachers. During the first student session, presentations were made by Professor Yvonne Greenleaf, Rivier College, and by Dr. Donald Burleson, Rivier College. Professor Greenleaf's topic "What's Eating You?" investigated the direct and indirect effects of pesticides on food chains by the use of graphs, matrices and matrix multiplication. Dr. Burleson's topic "Playing with Your Brains!!" focused on a brief look at game theory and the serious applications of "playing games." The second student session offered topics on mathematics in environmental studies and on knot theory. Instructor Suzette Smith, Rivier College, presented "Mathematical Applications in Environmental Studies" which explained how field data from the Merrimack Rivier Water Quality Project was processed in order to make some recommendations regarding the environment. Dr. Mary Platt, Salem State College, presented "Is It a Knot, or Not?" which addressed knot theory. She demonstrated, with student participation, the uses of string that topologists have devised to study knots and their practical applications.

Teachers participated in two workshops, "Why Do We Need to Know This Stuff?" and "A Computer in the Hand." The first was a presentation by Dr. Lucy Dechene, Fitchburg State College. She shared sources and examples of interesting applications of high school mathematics and career information. The second was presented by Dr. Joyce Anderson, Salem State College. The teachers explored how high school mathematics courses ranging from algebra to calculus could be enhanced through the hands-on usage of TI-81 graphing calculators.

Our after lunch session "Mixed Bag!!" offered students and teachers the choice of one of five hands-on activities. These included tesselations and Hawaiian Quilting which dealt with symmetry, topology which dealt with the Möbius strip, "Bucky" which dealt with the building concepts of Buckminster Fuller, and origami which dealt with

Jeannette L. McGillicuddy

the Platonic solids. These activities were very popular with the participants.

We also wish to extend our thanks for your continued financial support.

St. John's University, April 3, 1992

On Friday, April 3, 1992, 141 young women high school students and 22 high school teachers from Long Island and New York City area schools met at St. John's University to attend the first Sonia Kovalevsky Day in the metropolitan New York area. Sponsored by St. John's University and the Association for Women in Mathematics, the goals of the day were to encourage young women to study mathematics throughout all four years of high school and to inform them of the many career options available within mathematics and math-related fields.

During the morning session, students and teachers met separately. The student program began with a panel discussion. The panelists were Dr. Lilian Shiao-Yen Wu, an applied mathematician from IBM; Pauline Reimer, an actuarial specialist from Pryor Associates; and Denise Aranda, a civil engineer from Eschbacher and Associates. Each spoke about how she chose her field and gave an example of a problem she might work on. Each student also attended two of six workshops offered for them: "Some Applications of Statistics" (Leader: Ms. Angela Hurdle, Sr. Research Analyst, Market Statistics), "Multi-Media Learning" (Leader: Dr. Barbara Signer, St. John's University), "Computer Applications and Careers at the Port Authority" (Leader: Ms. Marie Steiner, Applications Manager, Port Authority of New York and New Jersey), "Locks, Keys and Threshold Schemes" (Leader: Dr. Donald McCarthy, St. John's University), "Glances at Graphs" (Leader: Dr. Luke Mannion, St. John's University), and "Encoding and Encryption" (Leader: Dr. Debbie Sturm, College of Staten Island, CUNY).

Teachers attended three workshops: "How to Create a Mathematics Research Program" (Leader: Mary G. Gahn, Assistant Principal, John Bowne High School), "An Application of Operations Research" (Leader: Dr. Edward J. Miranda, St. John's University), and "The Many Faces of Careers Based on Mathematics" (Leader: Dr. Margaret H. Wright, AT&T Bell Labs).

Students and teachers joined each other for lunch and were officially welcomed by Dr. Barbara Morris, Academic Vice President. The keynote speaker was Dr. Patricia Clark Kenschaft, Professor, Montclair State College, New Jersey, who spoke on "Women in Mathematics: Past, Present and Future."

Though Professor Kenschaft spoke for more than 45 minutes, in their evaluations the students wrote they wished she had spoken even longer. So much for how difficult it is to hold the attention and interest of today's youth.

At the same time what emerged overall from these evaluations was how important Sonia Kovalevsky Day was to them, because they learned so much about math. As one student wrote, "I think the talks were particularly good and useful. They encouraged those who hate the math to keep the math courses."

Exactly what we were hoping for!

We wish to thank St. John's University, the Association for Women in Mathematics, Addison-Wesley Publishing Co., Brooklyn Union Gas, the Sloan Foundation, and National Westminster Bank USA for their generosity in making this program possible.

Rora Iocabacci and Anne Hughes
SKHSMD Program Coordinators

WATERMAN AWARD

The Alan T. Waterman Award Committee invites nominations for the 1993 Waterman Award. The award is presented annually by the National Science Foundation and National Science Board to an outstanding young researcher in any field of science or engineering supported by the NSF. The 1993 award consists of a citation, a bronze medal, and grants of up to $500,000 over up to three years for scientific research or advanced study.

Candidates must be U.S. citizens or permanent residents. They must be 35 years of age or younger, or not more than five years beyond receipt of the Ph.D. degree by December 31, 1992.

For information and forms, write Mrs. Susan E. Fannoney, Executive Secretary, Waterman Award Committee, NSF, 1800 G St., NW, Washington, DC 20550; (202) 357-7512. Nominations must be postmarked by December 31, 1992.

EDUCATION COMMITTEE

Foundations and scholars have increasingly questioned the underrepresentation of women in the sciences and engineering. While much of this new line of research addresses the relatively low entry of women into these occupations, Preston in "Why Have All the Women Gone?" analyzes a related issue, the relatively high exit rate of women from these same occupations.

Preston, using a national longitudinal data set collected by the National Science Foundation between 1982 and 1989 *(Survey of Natural and Social Scientists*, 1989), finds that in 1982 women accounted for 22 percent of natural scientists, 29 percent of social scientists, and 3 percent of engineers. Furthermore, 19.9 percent of the women employed in the sciences and engineering in 1982 were not employed as scientists and engineers by 1989. On the other hand, only 10.3 percent of the male scientists and engineers had left their profession over the same time period. (These percentages exclude all retirees.)

More detailed statistics reveal that women scientists and engineers are very different than their male counterparts. They are younger, less educated, and more likely to be single and without children. Women are more likely than men to be employed in the nonprofit sector and less likely than men to be employed in the private business sector. With respect to type of work, men are more likely to have management positions, and women are more likely to teach or perform basic or applied research.

Preston estimates the male and female exit rates for several samples of scientists and engineers differentiated by education, work activity, and demographic characteristics. In almost every sample the female exit rate is significantly higher than the male exit rate. The two exceptions where the male and female exit rates are roughly similar are: scientists and engineers with Ph.D.'s, and scientists and engineers 51 years or older. Furthermore, in several samples, the female exit rate is close to two and one half times the male exit rate. These samples include: scientists and engineers between the ages of 21 and 30, scientists and engineers who are married with children, engineers, scientists and engineers engaged in basic research, scientists and engineers engaged in applied research, and scientists and engineers engaged in development work.

Preston further decomposes the exit rate into types of exit: exit to unemployment, exit from the labor force for family reasons, exit from the labor force for other reasons, exit to jobs outside of science and engineering due to a promotion, and exit to jobs outside of science and engineering for reason other than a promotion. The greatest differences in male and female exit rates occur in the categories of exit to jobs outside of science and engineering for reasons other than a promotion, exit from the labor force for family reasons, and exit from the labor force for reasons other than family. However, in relative terms, the most striking difference occurs in the category of labor force exit for family reasons, where the female exit rate is 73 times the male exit rate.

Preston finds that the problem of differential exit is compounded by the fact that reentry rates are lower for women (47% reenter) than for men (63% reenter). The big difference in reentry rates for men and women occurs in the categories of labor force exit. Between 70 and 80 percent of the men who leave the labor force return to science or engineering jobs. However only about 30 percent of the women who leave the labor force reenter the science and engineering professions.

Preston estimates multivariate models of exit behavior to determine the factors influencing exit. These models reveal that in the categories of exit to unemployment, exit to other jobs due to a promotion, and exit to other jobs due to factors other than a promotion, the differential exit behavior of men and women is limited to the fields of engineering and the natural sciences (which include mathematics). The differential exit behavior does not exist for social scientists. However, within all of these fields, women are more likely than men to exit the labor force. The differential rate of exit is greatest for engineers in all categories of exit.

The multivariate models of exit reveal that age is an important determinant of exit. The probability of professional exit is highest at early ages and declines as the career progresses. The rate of decline of the exit probability in the early stages of the career is steeper for women than for men.

Anne Preston (W. Averell Harriman School for Management and Policy, SUNY at Stony Brook) has done research on careers of male and female scientists and engineers. This article summarizes the findings of "Why Have All the Women Gone? A Study of Exit of Women from the Science and Engineering Professions," W.A. Harriman School Working Paper, March 1992.

Therefore, generally, the gender based differentials in exit behavior are highest in the youngest age cohorts, scientists and engineers between the ages of 21 and 30. Preston stresses that the differential exit rates of men and women during this period of the career has lasting effects on the relative number of men and women in the professions.

Preston notes that the strong negative relationship between age and probability of exit in models which control for family characteristics supports the hypothesis that much of this exit is due to a mismatch between the requirements and responsibilities of the occupation and the interests of the individual. Presumably this mismatch becomes evident to the scientist or engineer early in his or her career. Because women have a higher rate of exit than men early in their careers, they may be more likely to perceive occupational mismatches because of a tendency to locate in fields where occupational mismatch is a problem or because of perceptions of discriminatory treatment. Alternatively women may be more likely to respond to occupational mismatch because social norms concerning work are less rigid for women than for men.

Finally, Preston finds that women are more likely than men to leave the labor force at all ages. She notes that, because this differential is not related to age, the conventional explanation that these differentials are a result of child bearing is incomplete. Researchers still need to address the question: "Why are women with highly marketable skills leaving the labor force with very low probabilities of reentry?"

Any comments? Write to:

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

RSC CENSURE OF CJP

The Royal Society of Canada, which is strongly committed to the advancement of women in scholarship, hereby expresses its censure of the *Canadian Journal of Physics*. In publishing the article by Gordon R. Freeman, "Kinetics of nonhomogeneous processes in human society: Unethical behavior and societal chaos" (*Canadian Journal of Physics* 68: 794-798 (1990)), it displayed a lapse of editorial and scientific responsibility. The article is devoid of scientific content, and the title is inappropriate and misleading. The *Canadian Journal of Physics* failed to provide a rigorous review of the article and failed to publish a timely and adequate retraction. The Royal Society of Canada deplores both the insult to working mothers and the denigration of their children implicit in the published article.

QUERY: I'm planning a new course (Writing in Mathematics) for our junior math majors, starting in Spring 1993, to meet our University writing requirement. One project for the students might be to write an essay on the controversies about alleged gender differences in the learning of mathematics. References or reprints of articles would be much appreciated. (Unfortunately, I haven't kept my back issues of the AWM *Newsletter*, where the issue has often been discussed.)

J.E. Humphreys, Dept. of Mathematics & Statistics, LGRT Tower B, U. Massachusetts, Amherst, MA 01003 (jeh@math.umass.edu).

DUES, DUES, DUES, DUES, DUES, DUES, DUES!

Remember that the deadline for paying dues is October 1. As Carol has detailed in her report, we are in a bit of a financial crunch because our dues structure has failed to keep pace with the cost of all the good work we do. Consider becoming a contributing member. Encourage your outfit to become an institutional member. Buy a gift subscription. Encourage potential members to join us. Remember that just like PBS, we have our very own premium (the AWM mug!).

And whatever category you choose, be sure to *pay your dues!*

A NEW PERSPECTIVE ON WOMEN'S MATH ACHIEVEMENT: Part 2 of 3

Hypotheses to Explain Differences Between Traditional and Alternative Views

Differential Experience Hypothesis

Using grades as a measure of mathematics achievement minimizes sex-related differences in experience with math. Using course grades partially controls for number of math courses taken and reduces the importance of math-related experience outside the classroom. The greater number of courses that boys take and their more extensive experience with math outside the classroom may give them an advantage both in knowledge of math and in confidence when taking standardized tests that include information that may or may not have been covered in class. In contrast, grades reflect knowledge of a body of material that has been presented in class. Although extracurricular mathematics activities may facilitate class learning, they are not critical for such learning to occur. Having more mathematics-related experience may increase boys' performance on standardized tests either directly or indirectly. Directly, greater experience with math may provide specific knowledge such as algorithms that can be used to solve problems. Indirectly, greater experience may facilitate performance through general familiarity with mathematical thinking and increased confidence. For example, although calculus is not specifically covered on the SAT–M, having taken calculus may facilitate performance on the SAT–M by allowing one to work more quickly on what seem to be relatively simple problems, to generalize knowledge learned in calculus to individual problems, and to increase confidence that comes from knowledge that one has solved much more complicated problems.

That boys take more math courses has been well documented (Armstrong, 1981; Benbow & Stanley, 1982a; Brush, 1980; Collins, 1985; Elmore & Vasu, 1986; Ernest, 1976; Fennema & Carpenter, 1981; Fennema & Sherman, 1977; Mura, 1982; Perl, 1982; Sells, 1980; Wiggins, 1982). Mathematics experience outside the classroom has not been nearly as extensively studied. However, the studies that have examined it consistently show that boys have more science- and mathematics-related experience than girls (Hilton & Bergland, 1974; Kahle, Matyas, & Cho, 1985; Linn & Petersen, 1986). Even among mathematically gifted students, boys report more math experiences outside the classroom (Benbow & Stanley, 1982b). When the SMPY students were asked a number of questions about their math experience, boys were more likely to report learning math on their own, Specifically, 74% of the boys and 81% of the girls reported learning most of their math in the regular classroom and 23% of the boys and 17% of the girls reported engaging in independent study of math outside of school. Among a group of girls taking accelerated math and science classes, a commonly remembered experience was trouble convincing their parents to buy them toys such as Legos (Casserly, 1980). In particular, chemistry sets had been much desired with little success unless they were only children, the oldest of several girls, or separated from their brothers by a large age span. Although these findings indicate that boys have more math-related experience than girls, much more specific research is needed to determine the range and extent of students' mathematics experiences outside the classroom, the sex-related differences in these experiences, and the relationship of such experiences to mathematics achievement.

A partial test of the differential experience hypothesis is to relate number of courses taken or experience outside the classroom to performance on standardized tests. If sex-related differences disappear or are reduced, then the greater experience of boys may be assumed to account for part or all of the male superiority on standardized tests. Although no one has examined the relationship of experience outside the classroom to performance on standardized tests, several studies have looked at the effect of number of courses taken on performance on standardized tests. The results from these studies offer some support for the hypothesis. In only one sample (Armstrong, 1981 National Assessment of Educational Progress [NAEP] sample) did controlling for the number of courses taken lead to no reduction in the sex-related differences on standardized tests. On the other hand, no study has reported the complete elimination of sex-related differences

by Meredith M. Kimball, Psychology Department, Simon Fraser University, British Columbia V5A 1S6, Canada

when number of math courses is controlled. The most common finding is that controlling for courses taken eliminates some but not all of the sex-related differences studied. For example, the difference is eliminated in some subsamples but not in others (Armstrong, 1981, women in mathematics sample; Fennema & Sherman, 1977), or on some tests but not on others (deWolf, 1981). Two regression studies found that controlling for courses taken reduced a pre-existing sex-related difference by either about one third (Ethington & Wolfe, 1984) or almost two thirds (Pallas & Alexander, 1983). A failure to control for prior quantitative aptitude has been cited as an important flaw in these studies (Benbow & Stanley, 1983a); that is, if greater aptitude leads to greater course taking, especially on the part of girls, the finding that controlling for courses taken reduces sex-related differences on achievement tests would be spurious (Benbow & Stanley, 1983a). Thus Wise (1985) reported an elimination of the sex-related difference in mathematics achievement in a national sample of Grade 12 students when courses taken were controlled. However, because the girls taking more math had higher Grade 9 achievement scores, when Grade 9 achievement was controlled as a covariate, a significant sex-related difference reappeared. Other studies, however, do not report a relationship between prior aptitude and mathematics course taking (Benbow & Stanley, 1982a; Sherman, 1981). Furthermore, Pallas and Alexander (1983) found a relationship between course taking and SAT–M scores even after prior aptitude was controlled for in the regression equation (Alexander & Pallas, 1983). Thus it does not appear that a failure to control for prior aptitude can be used to discount the reduction in sex-related differences that occurs when course taking is controlled.

Even though controlling for courses taken does reduce some of the sex-related difference, it does not in any study eliminate all of the sex-related differences. It is possible that courses other than math courses, in particular science courses, also may be related to differential performance (deWolf, 1981). In support of this, Pallas and Alexander (1983) found that having taken a physics course was positively related to performance on the SAT–M. Also, it is quite possible that experiences outside the classroom could be related to the remaining differential performance.

Although the differential experience hypothesis appears to be able to explain at least some of the male superiority on standardized tests, it is much less clear how it might be applied to female superiority in grades. It would be logical to expect that boys' greater experience outside the classroom would facilitate their interest in classroom material and their performance on classroom exams in relation to that of girls, and it is puzzling to say the least to see how girls' lesser experience outside the classroom can be used to explain their better performance in the classroom. Perhaps girls do work harder in the classroom because they have less confidence and this lesser confidence is somehow related to their lack of mathematics-related experience. Or perhaps boys find classroom material more boring in comparison to their outside experience, and thus their motivation to perform well in the class is decreased. In order to test these or related possibilities, we need to know a great deal more about the nature of children's experience with math outside the classroom and how this experience relates to both classroom and standardized measures of achievement. It would be particularly interesting if experience outside the classroom was related to performance on standardized tests but not to classroom grades.

It is clear that an adequate explanation of female superiority on classroom measures as well as of male superiority on standardized measures will require the consideration of factors other than differential mathematics experience. In an attempt to do this, I will next examine the nature of the potentially different learning styles of the sexes and possible differential responses to familiar and novel testing materials.

Rote Versus Autonomous Learning Hypothesis

According to this hypothesis, boys have a more autonomous approach to learning math that facilitates performance on standardized tests, which require one to apply or generalize mathematics knowledge to new or unfamiliar problems. Girls, on the other hand, take a rote learning approach to mathematics that proves an advantage in classroom exams, which are based on the more routine use of rules or algorithms learned in class.

In order to evaluate this hypothesis, I will first review the evidence that girls learn math in a rote fashion, whereas boys are more autonomous in their approach. Then I will examine the evidence that these differing styles of learning facilitate performance on different kinds of achievement measures.

There is no direct evidence for a sex-related difference in mathematics learning style. However, several authors have hypothesized that girls' greater dependence, teacher orientation, and focus on being good in the classroom are related to a rote learning style (Fennema & Peterson, 1985; Grant, 1985; Ridley & Novak, 1983). In addition, it is assumed that girls are less encouraged to engage in math and science activities outside the classroom, which makes the material they are learning in class more arbitrary and increases the chances that they will rely on rote learning and memorization (Ridley & Novak, 1983). Boys are thought to rebel against the teacher, resist the solutions provided by teachers, and develop their own independent solutions to math problems, which leads to further autonomous learning (Grieb & Easley, 1984). Furthermore, these sex-related differences are thought to accumulate over time in the fashion of compound interest so that even though girls may continue to take math courses, the material becomes increasingly arbitrary to them and they increasingly approach math learning in a rote fashion (Grieb & Easley, 1984; Ridley & Novak, 1983).

Girls' greater orientation to good behavior and boys' greater rebellion and independence in the classroom are processes assumed to underlie the differences in learning styles. Teachers are assumed to respond differentially to these student behaviors by directing more of their negative remarks and criticisms, especially procedural criticisms, to boys (Brophy, 1985). Several studies have shown that teachers direct more negative comments to boys even in the absence of greater male misbehavior (Eccles & Blumenfeld, 1985: Pintrich & Blumenfeld, 1985). Teachers' specific encouragement of autonomy may be more necessary for girls than for boys. Green and Foster (1987) compared control-oriented and autonomy-oriented elementary classrooms. The children answered questions concerning their preferences for challenging work in the classroom. The preference for challenging work revealed a Sex x Orientation interaction. Specifically, boys did not differ across the two kinds of classrooms, but girls had significantly higher challenge scores in the autonomy-oriented classrooms than in the control-oriented classrooms.

In order for this hypothesis to work, not only must girls and boys differ in their learning styles, but the learning styles must be related to differential performance on classroom and standardized measures of achievement. A major theoretical explanation (Fennema, 1985b; Fennema & Peterson, 1985) of sex-related differences in mathematics achievement has proposed that differences in autonomous learning behaviors directly cause sex-related differences in mathematics achievement (as defined by performance on standardized tests). Both internal and external factors are assumed to lead to differences in autonomous learning behaviors that in turn lead to differences in achievement. Autonomous learning behavior is defined as working independently on high-level tasks, persisting with difficult problems, choosing high-level tasks, and achieving at these tasks (Fennema & Peterson, 1985). Fennema and Peterson (1985) argue that autonomous learning behavior may be a particularly important skill for success at high-level mathematics. One of the internal beliefs that is hypothesized to relate to autonomous learning behavior is the congruency of sex-role identity with achievement in math. The perception that achievement in math is incongruent with femininity is thought to decrease autonomous learning behavior. In terms of my hypothesis, a further distinction may be useful. It may be that memorization or rote learning of mathematics is perceived to be less incongruent with femininity than a more autonomous, independent, and even perhaps aggressive approach to the subject.

Empirical evidence linking specific learning styles to performance on specific achievement measures is meager and mostly indirect. Koehler (1985/1986) related teaching styles that foster autonomous learning behavior to gains in algebra achievement for both boys and girls. A common finding that is consistent with the hypothesis is that girls tend to do better on tests of computation (Armstrong, 1981; Fennema, 1974; Fennema & Carpenter, 1981; Fennema & Sherman, 1978; Fennema & Tartre, 1985; Marshall, 1984; Threadgill-Sowder et al., 1985), whereas boys score better on tests of problem solving, applications of mathematics, and math reasoning (Armstrong, 1981; Fennema, 1974; Fennema & Sherman, 1978; Marshall, 1984). Ridley and Novak (1983) reported that in a university-level science course there was no sex-related difference on recall of information but that men did better on problems that required application of knowledge. P. L. Peterson and Fennema (1985) found that elementary boys and girls both did equally well on low-level math problems but that the boys did better than the girls ($p < .10$) on high-level problems. Furthermore,

different teacher-student interaction factors influenced boys' and girls' performance on low-level and high-level problems. Boys' achievement on both kinds of problems (with prior achievement controlled for) was negatively related to time spent with the teacher and help by the teacher. For girls, high-level performance was related negatively to amount of social activity and time spent waiting for the teacher. These findings are consistent with a view of a more autonomous style in boys.

The autonomous versus rote learning hypothesis is consistent with much theory and some data in the literature. However, much further evidence is required before we can evaluate its potential to explain sex-related differences in classroom and standardized achievement measures. First, it is necessary to operationalize autonomous and rote learning styles. Although the theoretical formulations in this area are interesting and useful, we must also be able to reliably observe behaviors that relate to the concepts. Fennema and her colleagues (Fennema & Peterson, 1985; Koehler, 1985/1986) have begun the work of operationalizing autonomous learning behaviors and teacher styles that encourage autonomous learning behavior. Second, it is necessary to demonstrate that boys and girls do approach the study of math differently. Third, the link between learning styles, performance on classroom measures, and performance on standardized measures needs to be demonstrated. Specifically, better performance on classroom measures and worse performance on standardized measures should be related to rote learning styles, and the reverse achievement pattern should be related to autonomous learning styles. Furthermore, if more advanced math courses require a more autonomous approach in order to learn the material and girls use a less autonomous approach, then the sex-related difference favoring girls in classroom achievement should decrease with age. Although we do not have sufficient information to draw a conclusion one way or the other, it certainly is not clear that sex-related differences favoring girls decrease with age.

Novelty Versus Familiarity Hypothesis

According to this hypothesis, girls are motivated to do well and are confident when dealing with familiar material but are less confident and sometimes debilitated when dealing with novel material. Thus they do better on classroom math exams that cover relatively more familiar material, but they do less well on standardized tests that are more likely to contain novel material and are a more unusual testing situation. On the other hand, boys are motivated to do well and are more confident when dealing with novel or challenging material or situations but are less motivated to perform well when faced with familiar material. Thus they do better on standardized tests, which offer more of a challenge, but do less well on classroom exams, which appear to be less of a challenge and perhaps not worth the effort.

This hypothesis rests on the assumption that standardized tests are relatively more novel or unfamiliar than classroom exams. They are more novel in two ways. First, the standardized test is a more novel situation in that it occurs less often, sometimes a stranger comes into the classroom to administer the test, and occasionally (SATs) the test is given outside of class time and in a strange environment. On the other hand, exams are taken several times within a course with the same group of people, are given by the same person, and occur in the same physical environment. Second, the material or problems on a standardized test are more likely to be novel or unfamiliar to the student taking the test. Standardized exams are not designed to cover what has been learned in class, but exams are. A "fair test" in the classroom emphasizes what has been emphasized in class. Furthermore, the student may be given hints or information about how to prepare for a classroom exam, told what kind of problems will be on the exam, or told what the exam format will be.

Why should girls do less well than boys on the relatively more novel standardized tests and do better than boys on the relatively more familiar classroom exams? The work of Dweck and her colleagues (Dweck, 1986; Elliot & Dweck, 1988; Licht & Dweck, 1983) on achievement goals provides some possible answers to this question. Two different achievement goals are proposed by Dweck. If performance is the goal, then achievement tasks are approached as a test of one's ability. Because any failure reflects negatively on one's ability, the goal is to choose tasks to maximize success and minimize failure. If learning is the goal, then achievement tasks are approached as a learning opportunity. Success and failure are not important per se but rather are cues that one has or has not mastered what one wants to learn. Because one would expect and does find (Diener & Dweck, 1978, 1980; Dweck, 1986) large within-sex

differences in achievement orientation and because any one person may vary in achievement orientation or goals over different achievement tasks, I do not predict a sex difference in overall orientation. However, Dweck's model includes different predictions for people with high or low confidence within the performance orientation. A person with a performance goal and high confidence will choose moderately difficult tasks to demonstrate his or her ability and will respond to a difficult task with a mastery orientation. The person with a performance goal and low confidence will be most concerned with avoiding failure, which would demonstrate low ability, and thus will avoid confusing, difficult, or novel tasks and will respond to a difficult task with negative affect and deterioration of performance. For the learning orientation, people with both high and low confidence will choose tasks that are perceived to provide good learning opportunities, even if mistakes are likely, and will respond to a difficult task with persistence and mastery behavior (Dweck, 1986; Elliot & Dweck, 1988).

Although girls may be no more likely to be performance oriented toward math than boys, I would predict that for math there may be more girls than boys who fall in the category of performance orientation and low confidence. The evidence to support this prediction comes from the consistent finding that girls are less confident of their math ability than are boys (Eccles et al., 1984; Fennema & Sherman, 1977, 1978; Meece, Parsons, Kaczala, Goff, & Futterman, 1982; Mura, Kimball, & Cloutier, 1987; Perl, 1982; Sherman, 1983). Thus among children who are performance oriented, girls more than boys should show avoidance of confusing, novel, or difficult tasks and negative affect and deterioration of performance in difficult achievement situations. Hudson (1986) asked junior high students to verbalize while solving NAEP math problems. Girls more than boys verbalized difficulty in solving the problems, lower confidence, and more negative affect and were less confident that their final solutions were correct. The girls' verbalizations in this study were similar to those made by the helpless children in Diener and Dweck's (1978) study. Eccles et al. (1984) found that only among low-expectancy children and only on a number sequence task did girls more than boys attribute their failure to ability.

Direct evidence that more girls than boys approach math with a performance orientation and low confidence is not available from the literature. Dweck and Licht (1980) argued that more girls than boys express a helpless orientation as opposed to a mastery orientation with adult but not with peer evaluators. Other studies found that women more than men respond to failure in a verbal task with attributions and expectancies that are consistent with a performance plus low confidence orientation (Hughes, Sullivan, & Beaird, 1986; La Noue & Curtis, 1985; Miller, 1986). Also there is evidence that it is among the highest ability girls that this response to failure is the strongest (Dweck, 1986; Michael, 1983; Stipek & Hoffman, 1980). Licht and Dweck (1984) found a positive relationship (r = .47) between self-estimates of intelligence and performance of girls in the straightforward condition but found a negative (and significantly lower) correlation (r = –.38) in the confusing condition. On the other hand, several studies found no sex-related differences in orientation (Diener & Dweck, 1978, 1980; Eccles et al., 1984; Elliot & Dweck, 1988). However, because of the design of these latter studies, it is often difficult to infer that sex-related differences do not exist. Some match boys and girls on achievement orientation (Diener & Dweck, 1978, 1980), and others create experimental conditions designed to enhance different orientations (Elliot & Dweck, 1988). Thus any naturally occurring sex-related differences may be masked. Another problem with the work in this area is that primarily verbal or discrimination learning and not mathematics achievement tasks have been used. Thus we do not know how results might vary if math problems were used. Most of the studies finding no sex-related differences have used elementary school children for whom sex-related differences in mathematics performance do not exist. The exception to this pattern is the work of Eccles (Eccles et al., 1984), who found very few sex-related differences in the achievement-related behaviors of Grade 8, 9, and 10 children working on either anagrams or number sequence problems. In order to know if sex-related differences in achievement orientation exist for mathematics, much more research must be done that uses math problems, does not experimentally induce achievement orientations, and studies older as well as younger children.

Math more than verbal subjects may create difficulties for students with a performance orientation and low confidence. Mathematics, especially in junior high and beyond, is more likely than verbal subjects to present students with new concepts and confusing material. Each new area (algebra,

geometry, trigonometry, calculus) begins with the introduction of new concepts. Even the fact that each area has a new name may increase the sense that one is dealing with a new and different learning task. Math also is an area in which there is a high probability of error, and one's errors are highly visible (Dweck & Licht, 1980; Licht & Dweck, 1983). These characteristics make math a subject that children with a performance orientation and low confidence will tend to avoid. Verbal subjects on the other hand have a more subjective component and errors or weaknesses in one area may be compensated for in other ways (Dweck & Licht, 1980; Licht & Dweck, 1983). Students with a performance orientation and high confidence, on the other hand, actually may prefer math to verbal subjects because of the high probability of demonstrating one's ability with clear successful solutions to problems.

I would add a further distinction within math between different types of achievement measures. The standardized test with its greater likelihood of novel problems and confusing material will lead to greater debilitation of girls in comparison with boys because of the greater probability that girls with a performance orientation will approach the task with low confidence in their own ability. In contrast, in classroom exams the greater familiarity of content and context and the possibility of preparation may lead these same girls to overprepare in order to avoid failure and the resulting implication of low ability.

In addition to the possible sex-related differences in achievement orientations, it is also probable that the two achievement situations differ in the extent to which they induce performance concerns in the students who take them. Given that math is seen to be more ability-dependent than English (Eccles et al., 1984; Ruthvan, 1987) or even than science subjects (Ruthvan, 1987), any math test may be perceived as more of an ability test than exams or tests in other academic areas. However, I would argue that the standardized math test in relation to the classroom exam is more likely to be perceived as a measure of one's ability. The isolated and special nature of the standardized test may contribute to the perception that it is an ability measure. Mention or knowledge of national norms may also lead students to think of standardized tests as particularly good or important measures of ability. Receiving feedback in which one's score is presented in terms of a percentile among all those taking the test (SATs) would certainly contribute to the perception of an ability measure. On the other hand, exams may be presented by teachers as a measure of how hard one has studied. They can be viewed more easily as a measure of how much one has mastered or learned the material presented in class. To the extent that standardized exams induce relatively more of a performance orientation and classroom exams relatively more of a learning orientation, girls' lower confidence should put them at more of a disadvantage on the standardized exam. On the other hand, to the extent that the classroom exam induces relatively more of a learning orientation, girls' assumption that their effort is primarily responsible for their success (Deboer, 1986; Fennema, 1985a; Lyons-Lepke, 1986; Mura et al., 1987; Ryckman & Peckham, 1987; Wooleat, Pedro, Becker, & Fennema, 1980) and their resulting hard work may give them a relative advantage.

The empirical evidence that is consistent with this hypothesis falls into three areas: (a) evidence that girls are not disadvantaged on standardized tests that are designed to reflect classroom content; (b) evidence that girls' confidence and math achievement behaviors are consistent with an avoidance of or lack of confidence in novel situations; and (c) evidence from classroom observation studies that girls are more forthcoming when dealing with well-prepared or familiar material and do not learn math as well in classrooms that emphasize competition.

The first category of evidence comes from studies that have used a standardized testing format but have purposely designed the content of the tests to reflect material covered in classrooms. Senk and Usiskin (1983) compared sex-related differences on a standardized geometry achievement test to those found on a test that required students to generate geometric proofs. The authors found that boys did better on the standardized test but that there were no significant sex-related differences on the proofs tests. They argued that geometric proofs are a high-level cognitive task that are unlikely to be encountered outside the geometry classroom. Galbraith (1986) designed mathematics achievement tests using "thoroughly familiar mathematical content" (p. 423). Grade 8, 9, and 10 students' performance was scored both on the correctness of their answers and on the validity of their mathematical reasoning used to explain their answer. Girls scored significantly higher than boys. Smith and Walker (1988) analyzed sex-related differences on

the New York Regents examinations. These exams are designed to reflect the content of the high school curriculum, and teachers design their math classes to cover what will be on the exams. They found no sex-related differences for Grades 9 and 11 and a sex-related difference favoring girls for Grade 10. Hudson (1986) in an analysis of sex-related differences on NAEP items found that the male advantage was larger on more unfamiliar items, more difficult items, and items assessing spatially related topics. Perhaps the most extreme example of standardized tests that contain unfamiliar or novel material is Benbow and Stanley's (1980) use of the SAT–M tests with Grade 7 students, a procedure that results in large differences favoring boys.

The second category of evidence consistent with the hypothesis involves girls' avoidance or lack of confidence in novel situations. One finding is that there is no sex-related difference in confidence that one can do well in a current math course but that girls are less confident that they can do well in future math courses (Meece et al., 1982; Mura, 1987; Parsons, Adler et al., 1982). Hanna and Sonnenschein (1985) also found that although Grade 8 girls scored as well as boys on three prealgebra tests, they predicted lower algebra grades for themselves. The following year, they actually achieved higher algebra grades than the boys. A related kind of evidence is that girls, if given the option, make more omission errors than boys on standardized math tests (Hanna, 1986) or use "I don't know" choices in responding to math or science items (Hudson, 1986; Linn, De Benedictis, Delucchi, Harris, & Stage, 1987). In working in small groups of peers in mathematics classes, girls tend, especially of boys, to ask general questions (How do you do this?) or make general statements (I can't get this one; Webb & Kenderski, 1985). These kinds of statements as opposed to more specific questions (Does $x = 64$ in the first problem?) may represent a lack of confidence in dealing with novel or difficult material.

The third category of evidence comes from studies of classrooms. Within the classroom, boys and girls are differentially active in ways that would be predicted by the hypothesis. Boys consistently are more active in giving unsolicited answers or call-outs (J. R. Becker, 1981; Brophy, 1985, 1986; Eccles & Blumenfeld, 1985; Fennema & Peterson, 1985; Good et al., 1973; Stallings, 1985). No differences are found in the number of volunteered answers (Stallings, 1985) or student-initiated interactions (J. R. Becker, 1981) in geometry classes. Girls do not often dominate in classroom participation, but Morse and Handley (1985) found that girls in Grade 7 and 8 science classes dominated in only one class of responses, those based on prepared homework or reports. Furthermore, girls' and boys' achievement and confidence in math classrooms is related to classroom teaching styles. Eccles and Blumenfeld (1985) found that girls had the lowest math expectations in relation to boys in classrooms that involved high teacher criticism and a public teaching style. P. L. Peterson and Fennema (1985) found that girls' math achievement was negatively related to a competitive classroom style and positively related to a cooperative one. The competitive classroom is likely to require the student to respond on the spot to novel math problems. Peterson and Fennema gave the example from one math classroom of a game that the teacher called "around the world." In this game, Student A stood by Student B's desk, the teacher presented a math problem, and whoever answered first went on to Student C's desk. Under this or similar competitive situations, not only must the student deal quickly with novel (in the sense that one cannot prepare them beforehand) math problems but also she or he must do so in an atmosphere that emphasizes social comparison cues. Thus a competitive classroom atmosphere in relation to a more cooperative one may be more likely to induce a performance orientation. Under these conditions, girls' lower confidence in their math ability would put them at a disadvantage in comparison with boys. The cooperative classroom, in contrast, is more likely to involve the teacher working privately with a single student or with small groups of students, a situation that may induce more of a learning orientation and allow students time to prepare their answers before sharing them with an evaluator.

Although there is some theoretical and empirical support for this hypothesis, more empirical evidence is necessary to evaluate it. How sex-related differences in math performance vary with changes in novelty is a critical test of the hypothesis. Not only should sex-related differences vary between standardized tests and classroom measures of achievement, but variations in novelty and familiarity within standardized tests and within the classroom should relate in predictable ways to patterns of girls' and boys' performance. The relationship between classroom performance and performance on standardized tests for both boys and girls is also

of interest. Kissane (1986) found that teachers were much less accurate in nominating high math achievement girls (measured by the SAT–M) than in nominating high math achievement boys. Benbow and Stanley (1982a) found that the correlations between SAT–M and grades were somewhat higher for boys (.31 to .41) than for girls (.17 to .27). Correlations among standardized tests also might vary depending on the degree to which novel material was incorporated. Another important area to investigate empirically is that of the perceptions of boys and girls of standardized tests and classroom exams. Do students' perceptions of standardized and classroom measures of math achievement vary in terms of novelty, the degree to which they measure ability, and the degree to which they reflect performance or learning goals? As was mentioned earlier, it is also important to test with mathematics material the possible existence of sex-related differences in achievement orientation, particularly the incidence of performance orientation and low confidence in both sexes.

DIVERSITY INCREASING IN PROFESSIONAL WORKFORCE

Despite a drop in the traditional college age population (18-22 years), the number of degrees awarded by American colleges and universities in 1990 continued to rise. But interest in science and engineering as career opportunities continued to decline, according to a recent publication of the Commission on Professionals in Science and Technology. This was particularly true for bachelor's degree recipients in the natural sciences and engineering, whose numbers have decreased by 41,349 (19.3%) since 1985, compared with an increase of 58,777 (5.9%) in total bachelors' degrees awarded during the same period.

In 1990, more than half (53%) of all bachelors' and masters' degrees were awarded to women, and they earned 36% of all Ph.D.'s. In natural science and engineering, their representation was less pronounced; there they received 28% of the bachelors' degrees, 24% of the masters, and 20% of the doctorates. In contrast, women earned a majority of the first professional degrees in pharmacy and veterinary medicine, and more than a third of those in medicine, law, and optometry.

Overall, women are continuing to increase their presence in the U.S. labor force. They now fill 40% of the executive, administrative, and managerial jobs. They make up 39% of college faculty (though only half are tenured in comparison with 70% of men) and are 85% of those in health assessment and training occupations, but only eight percent of engineers.

Hispanics are the fastest growing racial/ethnic group in the United States. Although they are expected to make up more than 9% of all high school graduates by 1995, more than one third of today's U.S. Hispanics ages 14-34 are high school dropouts. Less than one third of Hispanic high school graduates enroll in college, so that only 3.1% of 1990 college graduates were Hispanic. Their presence in science and engineering is even less.

Non-Asian minority students continue to show slow progress in their pursuit of professional course work, particularly in science and engineering curricula. Those earning bachelor's degrees increased slightly in 1990, with blacks earning almost 5%, Hispanics 3% and American Indians less than 1% of the natural science and engineering degrees. The number of black Ph.D.'s in any field, though still very small, jumped nearly 14% from 821 in 1989 to 933 in 1991. Ph.D.'s among Hispanic Americans increased even more, by some 21% during the same years, from 582 to 708. Such increases may provide more black and Hispanic faculty in coming years.

The largest increase in Ph.D. recipients in natural science and engineering was recorded by foreign nationals, who accounted for 41% of these awards in 1991 as compared with only 31% in 1985. In many cases, foreign doctorate recipients from earlier years have stayed in the United States, adding to the rich diversity of our doctoral workforce.

These are some of the principal findings displayed in more than 300 tables and 35 charts in the all-new tenth edition of *Professional Women and Minorities: A Total Human Resources Data Compendium.* It is available for $75 to members of the Commission on Professionals in Science and Technology and $100 to non-members. $5 shipping/handling applies to orders that are not prepaid. Write: CPST, 1500 Massachusetts Ave., NW, Suite 831, Washington, DC 20005; (202) 223-6995; fax (202) 223-6444.

ARTICLES OF INTEREST

"Women in Science and Engineering" by Stephen G. Brush appeared in *American Scientist*, Vol. 79, September-October 1991, 404-419. The subtitle "Women are still seriously underrepresented in the sciences, and they have made comparatively little progress in the past five years. Why?" gives the thrust of the article.

Brush gives an outline of some factors that he identifies as particularly important in discouraging women and girls from participating in science. These factors are: the stereotypical scientist portrayed in American popular culture, textbook portrayals of scientists and engineers, publicity about the supposed "mental inferiority" of females, inadequate preparation in high school, bias of the Scholastic Aptitude Test, coeducation, cutbacks in financial aid, inappropriate teaching methods, sexist attitudes of professors and students, combative interactions among scientists, and the glass ceiling.

Brush then proposes a number of remedies. They are: de-emphasize the SAT, publicize recent research on cognitive sex differences, fund intervention programs for the long haul, revise the tenure system, refute the arguments of some feminists that women should not go into science, and compromise on competitiveness.

The conclusion of the article follows.

> Why aren't women going into and staying in science and engineering as much as we might hope? We should consider the possibility that the young women who "leak out of the science and engineering pipeline" are behaving more intelligently than those who want to recruit them but refuse to provide adequate incentives, such as reasonable working conditions and promotion opportunities. The pipeline metaphor in itself is a clue to the problem: it suggests a factory-management attitude that treats people as raw material to be made into products, without regard for their own wishes or well-being. The reason that women are not rushing into technical fields may be that other professions, newly available to them, are more attractive. This is generally admitted to be a major reason why fewer women are choosing careers in teaching. Is the same thing happening in science and engineering?
>
> Much effort has been devoted to recruiting women but, as I have tried to show, much less has been done to prevent them from dropping out of educational programs and professional careers at later stages. Universities and corporations have not dismantled the structural barriers that effectively deny rewards to women, ranging from the SAT to promotion systems that conflict with family life or allow women to rise no further than a glass ceiling. If those leaders who are now trying to *push* women into science and engineering would devote the same energy to creating conditions that would *pull* them into technical careers, everyone's interests would be better served.

"Mathematical References in Literature" by John S. Lew in the *Humanistic Mathematics Network Journal #7*, April 1992, 26-47 gives lists of references Lew has been collecting for many years. He includes a number of those given by Joan Hutchinson in the July-August book review in this newsletter. Collections, novels, plays, general nonfiction and short stories, remarks on others' views of mathematics, science fiction short stories, poems, real mathematicians in literary works, autobiographical memoirs, films, and songs are his categories; one line comments are included for many of the individual works listed.

"Not Getting the Award, Grant, or Job? Check Those References!" [*AWIS Magazine*, Vol. 21, No. 1, January/February 1992, 7-12 is a provocative case study of four recommendation letters written by one professor during a one-year period.

The article begins:

> While overt discrimination against women in graduate school is becoming a thing of the past, many forms of subtle discrimination still exist. Generally speaking, a graduate student will never see the letters of recommendation written for her by her advisor or by other faculty members in her department. Yet these letters are of extreme importance to the student. They can contain many subtle statements that discourage the recipient from thinking the student should get the fellowship or job. Furthermore, advisors can subtly discriminate against female students by writing letters that are less enthusiastic and more critical than those they write for male students.

It then gives the text of the four letters, the credentials of the four students (two male, two female), and several analyses of the letters. All the reviewers agreed two of them were better than the others; these were the letters written for the men. "And these letters were written by a male professor who believes himself supportive of his female students!"

BRIEF NOTES

Science-By-Mail is an international science outreach program that teams children with scientists in creative, problem-solving exercises. Over half of the 24,000 students who participate are girls. As a volunteer Science-By-Mail scientist, you will be asked to correspond with up to five small groups of children at least three times per year. If you would like to volunteer, write St. Louis Science Center, 5050 Oakland Ave., St. Louis, MO 63110 (314-289-4462) for an application form. Applications are due by October 15, 1992. Donations for the Scholarship Fund are welcome (the group membership fee is $44).

The new address of the Math/Science Network is Preservation Park, 678 13th Street, Suite 100, Oakland, CA 94612.

$(MS)^2(SM)$ is the Middle School Mathematics & Science at California State University San Marcos program. Each year, low-income underrepresented sixth grade students will be selected to participate in a four-week summer institute. These minority scholars will be given year-round educational opportunities and personal support until they graduate from high school. Summer 1992 is the inaugural class of $(MS)^2(SM)$. For more information, write or call $(MS)^2(SM)$, California State University San Marcos, San Marcos, CA 92096; (619) 752-4090.

On Friday, September 18, 1992, the Schools of Education and Liberal Arts of Glassboro State College, Glassboro, NJ will be sponsoring a symposium for women on mathematics and science, "America 2000: A Woman's Perspective." The symposium has been designed to be a source of communicating to females an awareness of their capabilities to be successful in studying mathematics and science and the possibilities available to them to pursue career-related opportunities.

Application forms for Research Professorships (due September 30, 1992) and memberships (due November 30, 1992) at the Mathematical Sciences Research Institute for the 1993-94 academic year are available from MSRI, 1000 Centennial Drive, Berkeley, CA 94720. The forms are also available by email; send the message get program app.ascii (or app.TeX) to info@msri.org. The areas of special emphasis are differential geometry (Riemannian geometry/geometric structures; geometry and physics) and dynamical systems and probabilistic methods for PDE's.

MSRI will host a one-week workshop on Diophantine geometry from March 29 to April 2, 1993. Requests for financial support should be received by November 15, 1992. A two-week conference on universal algebra and category theory will be held July 12–23, 1992. Requests for financial support should be received by March 1, 1993. Students, recent Ph.D.'s, women and minorities are encouraged to apply.

Several data sets on women in the sciences and mathematics, including information from studies of children, high school students, college students, postdoctoral researchers, medical students and doctors, are available from Henry A. Murray Research Center, Radcliffe College, 10 Garden Street, Cambridge, MA 02138; (617) 495-8140.

Teaching Faculty Members to Be Better Teachers: A Guide to Equitable and Effective Classroom Techniques gives information on how to conduct workshops on the classroom climate on your campus. It is available for $10 (prepaid) from Publications Desk, Association of American Colleges, 1818 R St., NW, Washington, DC 20009. A videotape, "Breaking the Silence: Equity and Effectiveness in College Teaching," is available for use with the guide. It is available for $195 plus $5 s/h from N.A.K. Productions, 1422 Fenwick Lane, Silver Spring, MD 20910; (301) 565-0355.

UME Trends still needs more subscribers ($12 per year). Contributions are badly needed. Send them to AMS, P.O. Box 1571, Annex Station, Providence, RI 02940, or make a MasterCard or VISA payment by calling, toll-free, (800) 321-4267.

Help Your Child Learn Math ($.50, #412Y) and *Help Your Child Improve Test Taking* ($.50, #411Y) are available from the U.S. Department of Education.

Science Education News is a free four-page flyer published ten times a year by the AAAS. To get on the mailing list, write: Directorate for Education and Human Resources Program, AAAS, 1333 H St., NW, Washington, DC 20005-4792; (202) 326-6620.

AWM WORKSHOP

Pending funding from the National Science Foundation and the Office of Naval Research, an AWM Workshop will be held Tuesday, January 12, 1993 in conjunction with the AMS/MAA Joint Mathematics Meetings in San Antonio, Texas. The Joint Mathematics Meetings will be held from January 13–16, 1993.

Pending the NSF/ONR funding, grants for travel, subsistence, and registrations fees will be available for ten women graduate students and ten women postdocs to attend the AWM Workshop and the Joint Mathematics Meetings. The Workshop will provide opportunities for women to discuss their research and to participate in a number of other events during the day. There will be a panel, a luncheon, and a special program and dinner where participants will have the opportunity to meet established women mathematicians.

The mathematical community is invited to attend the entire program. Departments are urged to help graduate students and postdocs (beyond the twenty with tentative NSF/ONR funding) to obtain institutional support to attend the workshop and the Joint Mathematics Meetings that follow.

To be eligible for the pending funding, a graduate student must have begun work on a thesis problem. She should write a brief (one page) letter describing her research area and problem. A letter of recommendation should be obtained from the thesis advisor or department chair.

To be eligible for the pending funding, a postdoc must have received her Ph.D. within approximately the last five years. She should write a letter describing her area of research.

Each applicant should submit *five copies* of her curriculum vita and of the letters described above. Applications are due by **November 1, 1992** and should be sent to Jodi L. Beldotti, Executive Director, AWM, Box 178, Wellesley College, Wellesley, MA 02181; (617) 237-7517.

GRANT DEADLINES

October 15: Postdoctoral Science Scholars Fellowship Program, Bunting Institute of Radcliffe College, Fellowship Program, 34 Concord Ave., Cambridge, MA 02138 (617) 495-8212; Mathematical Sciences Postdoc Research Fellowships, NSF, Div. of Mathematical Sciences, Office of Special Projects, 1800 G St., NW, Room 339, Washington, DC 20550, (202) 357-3453.

October 20: Undergrad Science and Engineering Research Semester Program, U.S. Department of Energy, Office of Energy Research, RM 3F-061, Forrestal Bldg., 1000 Independence Ave., SW, Washington, DC 20585, (202) 586-8949.

November 2: NATO Postdoctoral Fellowships in Science, NSF, NSF-NATO Postdoctoral Fellowships in Science & Engineering Programs, Education & Human Resources Director, Washington, DC 20550, (202) 357-7536.

November 15: Dissertation Fellowships, American Postdoc Fellowships, AAUW, Educational Foundation, 1111 16th St., NW, Washington, DC 20036, (202) 728-7603; NSF Visiting Professorships for Women, NSF, Div. of Human Resource Development, Visiting Professorships for Women, Washington, DC 20550, (202) 357-7456.

December 1: International Graduate/Postgraduate Fellowships, AAUW, address and phone above under November 15.

CALL FOR NOMINATIONS: ALICE T. SCHAFER MATHEMATICS PRIZE

The Association for Women in Mathematics calls for nominations for the Alice T. Schafer Mathematics Prize in the amount 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. An institution may have more than one nominee.

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, and performance in mathematical competitions at the local or national level, if any.

Supporting materials should be enclosed with the nominations. Please send *five copies* of the letter and other materials. Nominations are due by **March 31, 1993** and should be sent to Jodi L. Beldotti, Executive Director, AWM, Box 178, Wellesley College, Wellesley, MA 02181; (617) 237-7517.

Announcements

A brochure is now available for the NSF Visiting Professorships for Women (VPW) program. Brochures can be ordered electronically by sending e-mail to pubs@nsf (Bitnet) or pubs@nsf.gov (Internet). The request should include the title of the brochure (NSF Visiting Professorships for Women), the publication number (NSF 92-66), number of copies desired, your name, and complete mailing address.

MATHEMATICAL SCIENCES POSTDOCTORAL RESEARCH FELLOWSHIPS - The National Science Foundation's (NSF) Mathematical Sciences Postdoctoral Research Fellowship program is designed to permit recipients to choose research environments that will have maximal impact on their future scientific development. Awards will be made for appropriate research in pure mathematics, applied mathematics and operations research, and statistics at an appropriate nonprofit United States institution.

The fellowships will be offered only to persons who: (1) are citizens, nationals, or lawfully admitted permanent resident aliens of the United States as of January 1, 1993; (2) will have earned, by the beginning of their fellowship tenure, a doctoral degree in one of the mathematical sciences; (3) will have held a doctorate for no more than five years as of January 1, 1993; and (4) will not previously have held any other NSF postdoctoral fellowship. Subject to the availability of funds, it is expected that in FY 1993, thirty to forty awards will be made. The evaluation of applications will be based, in part, on ability as evidenced by past research work and letters of recommendation, likely impact on the future scientific development of the applicant, and scientific quality of the research likely to emerge. Applicants' qualifications will be evaluated by a panel of mathematical scientists. Women and minorities are strongly encouraged to apply.

For copies of the application brochure or further information, contact the Office of Special Projects, Room 339, Division of Mathematical Sciences, National Science Foundation, 1800 G Street, NW, Washington, DC 20550; (202) 357-3453; email msprf@nsf.gov (internet) or msprf@nsf (bitnet) or the American Mathematical Society; (401) 455-4104; email nsfpostdocs@math.ams.com. The deadline for applications is October 15, 1992.

Advertisements

BRYN MAWR COLLEGE - Applications are invited for positions in Mathematics and Computer Science, starting September, 1993. They should be sent to the appropriate committee, Department of Mathematics, Bryn Mawr College, Bryn Mawr, PA 19010. MATHEMATICS POSITIONS: One tenure track assistant professorship and one three-year renewable lectureship. Candidates must have completed a doctorate in a mathematical science by the starting date, and must show promise in research and a serious commitment to undergraduate and graduate teaching. All fields are acceptable, with a preference for applied mathematics or geometry. Please send a vita, research plan and three letters of recommendation to the Mathematics Search Committee. COMPUTER SCIENCE POSITIONS: Three-year renewable lectureship. Candidates should have completed a doctorate in computer science or a related field by the starting date, and must display a commitment to both teaching and scholarship, and an interest in curriculum development in a joint program with Haverford College. Please send a vita and three letters of recommendation to the Computer Science Search Committee. Bryn Mawr College is an equal opportunity affirmative action employer. The college particularly wishes to encourage applications from individuals interested in joining

a multicultural/international academic community. Minority candidates and women are especially encouraged to apply. CLOSING DATE: 1 January, 1993 (late applications may be considered). Telephone: (215) 526-5348. Email:msearch@cc.brynmawr

DARTMOUTH COLLEGE - John Wesley Young Research Instructorship, 2-yrs., new or recent PhD's whose research overlaps dept. members'. Teach 4 ten-week courses spread out over 2 or 3 quarters. $34,000 for nine months; $7,556 summer research stipend. Send application letter, resume, research/thesis description, graduate transcript, and 3 (prefer 4) references (1 discussing teaching) to Phyllis A. Bellmore, Mathematics and CS, Dartmouth College, 6188 Bradley Hall, Hanover, NH, 03755-3551. Files complete Jan. 15 considered first. Dartmouth is committed to affirmative action and strongly encourages minorities and women to apply.

DAVIDSON COLLEGE - DEPT. OF MATHEMATICS, PO Box 1719, Davidson, NC 28036, E-mail: math@apollo.davidson.edu - Applications are invited for an entry level tenure track position in the Mathematics Department beginning August 1993. Completion or near completion of PhD is required. A candidate must be committed to outstanding teaching and continuing scholarly activity. Some computer science background is desirable. Teaching load will average 5.5 courses per year. Davidson is a liberal arts college with a Presbyterian heritage. Applications consisting of a statement of professional aspirations and goals, resume, graduate and undergraduate transcripts, and 3 letters of reference (at least one about teaching) should be sent to the attention of Prof. L.R. King, Chair, at the address above. Applications received by December 4, 1992 will receive first consideration. Davidson College is an Equal Opportunity Employer; women and minorities are encouraged to apply.

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS, MINNEAPOLIS, MINNESOTA - EMERGING APPLICATIONS OF PROBABILITY PROGRAM - Research Associate. Conducting a search for individuals interested in Postdoctoral Memberships & Senior Memberships for a one-year program with three parts: (1) Fall: September 10 - December 20, 1993, Probability and Computer Science, (2) Winter: January 2 - March 31, 1994, Mathematical Genetics; Queuing Networks; (3) Spring: Spring: April 1 - June 30, 1994, Probability in Geo-Systems. Postdoctoral Memberships: All requirements for a doctorate should be completed by September 1, 1993. Applicants must show evidence of mathematical excellence, but they do not need to be specialists in the field. The following materials must be submitted (all material should arrive by January 15, 1993): (1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in the Emerging Applications of Probability Program (This is an essential part of the application.) (2) Curriculum vitae and a list of publications. (3) Three letters of recommendation, to be sent directly to the IMA. Senior Memberships: Preference will be given to supplementary support for persons with sabbatical leaves, fellowships, or other stipends. All correspondance should be sent to the Visiting Membership Committee, Institute for Mathematics and it Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street, SE, Minneapolis, MN 55455-0436.

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS, MINNEAPOLIS, MINNESOTA - POSTDOCTORATES IN INDUSTRIAL MATHEMATICS - IMA announces at least 4 one-to-two year positions in Industrial Mathematics, effective September 1, 1993. These appointments are in addition to the regular program on Emerging Applications of Probability and are funded jointly by the NSF and participating industries. They are designed to prepare mathematicians for research careers involving industrial interaction. Applicants should have fulfilled requirements for a PhD in Mathematics or Applied Mathematics by September 1, 1993. Familiarity with pde and/or numerical analysis is desired, but no knowledge in engineering is

required. Postdoctorates (the actual hiring title will be research associate) will spend 50% effort working with industrial scientists on one of the following topics: (1) Signal processing and computational ocean acoustics; (2) Diffractive optics; Maxwell equations in periodic structure; (3) Computational fluid mechanics; (4) Scattering of electro magnetic waves from complex objects; (5) Magneto-optic recording media; the writing process; (6) Semiconductors; (7) Solid state physics & computational chemical physics; (8) Problems in mathematical photography; (9) Air quality modeling; (10) Control theory; (11) Imaging analysis; (12) Micromagnetics; (13) Near infrared imaging; and 50% effort in the regular IMA program on Emerging Applications of Probability. All requirements for a doctorate should be completed by September 1, 1993. Applicants must show evidence of mathematical excellence, but they do not need to be specialists in the field. The following materials must be submitted (all material should arrive by January 15, 1993): (1) Personal statement of scientific interests, research plans, and reasons for wishing to participate in the Emerging Applications of Probability Program (This is an essential part of the application.) (2) Curriculum vitae and a list of publications. (3) Three letters of recommendation, to be sent directly to the IMA. All correspondance should be sent to the Industrial Mathematics Postdoctorate Membership Committee, Institute for Mathematics and it Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street, SE, Minneapolis, MN 55455-0436.

JOHNS HOPKINS UNIVERSITY - DEPARTMENT OF MATHEMATICAL SCIENCES - Applications are invited for 3 anticipated faculty positions within the areas of Numerical Linear Algebra (Senior applicants preferred), Statistics, Operations Research, Applied Discrete Mathematics. Selection is based on demonstration and promise of excellence in research, teaching, and innovative applications. Minority and women candidates are encouraged to apply. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Applicants are asked to furnish a curriculum vitae, transcripts (junior applicants only), reprints (if available), a letter describing professional interests and aspirations, and to arrange for three letters of recommendation to: Prof. John C. Wierman, Chair, Department of Mathematical Sciences, 220 Maryland Hall, The Johns Hopkins University, Baltimore, Maryland 21218-2689. Applications are requested by January 15, 1993. Applicants whose primary research is in algebra, analysis, geometry, logic, number theory, or topology will not be considered.

MICHIGAN STATE UNIVERSITY - Department of Mathematics. The Department is seeking applicants for several tenure track positions: openings are available at each of the Assistant, Associate, and Full Professor levels. Preferred areas are: "Partial Differential Equations", "Algebraic Geometry", and "Lie Groups, Algebras, and Representations." Strong candidates in other areas will also be seriously considered. Excellence in research and teaching is essential, and two or more years of experience beyond the Ph.D. will generally be expected. Please send a resume and arrange to have three letters of recommendation sent to HIRING COMMITTEE, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027: e-mail 21144hiring@msu.edu. It would be helpful if resume included (if possible) an electronic address. Applications received by Dec. 1, 1992 will be given more attention. Women and minorities are strongly encouraged to apply. Michigan State University is an affirmative action/equal opportunity employer.

MICHIGAN STATE UNIVERSITY - Department of Mathematics, East Lansing, MI 48824-1027. Professor Richard E. Phillips, Chairperson. One or more Postdoctoral fellowships in Mathematics. The appointment is for two years. Duties include teaching three (3 credit) semester courses each year with the expectation that the fellow will devote remaining time to research. These fellowships are normally offered to persons (regardless

of age) who have had their doctorate less than two years. There will be some instructor positions available also. Please send a resume, a brief statement of research interests and arrange to have three letters of recommendation sent to: THE HIRING COMMITTEE, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027: e-mail 21144HIRING@MSU.EDU. Application deadline, December 1, 1992. MSU is an Affirmative Action/Equal Opportunity Institution.

NORTHWESTERN UNIVERSITY, DEPARTMENT OF MATHEMATICS - 2033 Sheridan Road, Evanston, Illinois 60208-2730. Applications are invited for one or more anticipated tenure-track positions starting September, 1993. Priority will be given to young, exceptional research mathematicians; however, more senior candidates with very exceptional credentials may be considered for a tenure-track position. Fields of interest within the department include Algebra, Analysis, Dynamical Systems, Probablility, Partial Differential Equations, and Topology. Northwestern is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Candidates should arrange that at least three letters of recommendation be sent to Prof. C. Robinson, Chair, Personnel Committee, Department of Mathematics, Northwestern University, Evanston, Illinois 60208-2730. Alternatively, applications and supporting documentation can be sent via e-mail to "hiring@math.nwu.edu". In order to receive full consideration, applications should be received by January 1, 1993. Hiring is contingent upon eligibility to work in the United States.

NORTHWESTERN UNIVERSITY, MATHEMATICS DEPARTMENT - 2033 Sheridan Road, Evanston, Illinois 60208-2730. The Mathematics Department will sponser an Emphasis Year in probablility and stochastic analysis. This program will include two-year assistant professorship positions starting September, 1993 and possible visiting positions for more senior mathematicians for part or all of the academic year. Applications should be sent to Professor Mark A. Pinsky at the department address and include a curriculum vitae and three letters of recommendation. In order to ensure full consideration, an application must be received by January 1, 1993. Northwestern University is an affirmative action, equal opportunity employer committed to fostering a diverse faculty; women and minority candidates are especially encouraged to apply. Hiring is contingent upon eligibility to work in the United States.

THE OHIO STATE UNIVERSITY - DEPARTMENT OF MATHEMATICS - The Department of Mathematics of The Ohio State University hopes to have available several positions, both visiting and permanent, effective Autumn Quarter, 1993. Candidates in all areas of applied and pure mathematics including those with demonstrated interest in pedagogical matters, are invited to apply. Significant mathematical research accomplishments or exceptional promise, and evidence of good teaching ability, will be expected of successful applicants. Please send credentials and have letters of recommendation sent to Professor Dijen-Ray Chaudhuri, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of resumes will begin immediately. The Ohio State University is an Equal Opportunity/Affirmative Action employer. Qualified women and minority candidates are encouraged to apply.

OREGON STATE UNIVERSITY - DEPARTMENT OF MATHEMATICS - Assistant Professor of Mathematics Education. The Department of Mathematics at Oregon State University invites applications for a tenure-track position at the assistant professor level in the area of mathematics education. It is a full-time appointment based on an academic year (September 16 thru June 15) with a salary range between $37,000 and $40,000/year. Appointment begins Sepember 16, 1993. The closing date for applications is December 1, 1992. For complete job description, list of faculty research areas, statement of selection criteria, and application

materials, write to: Ronald B. Guenther, Chair, Staff Selection Committee, Department of Mathematics, Oregon State University, Corvallis, Oregon 97331-4605. Oregon State University is an Affirmative Action/Equal Opportunity Employer and has a policy responsive to the needs of dual-career couples.

OREGON STATE UNIVERSITY - DEPARTMENT OF MATHEMATICS. Assistant Professor of Mathematics. The Department of Mathematics at Oregon State University invites applications for up to three (3) tenure-track positions at the assistant professor level. These positions are in mathematical areas that would be compatible with current faculty interests. These are full-time appointments based on an academic year (September 16 thru June 15) with a salary range between $37,000 and $40,000/year. Appointments begin September 16, 1993. The closing date for applications is December 1, 1992. For complete job descriptions, list of faculty research areas, statement of selection criteria, and application materials, write to: Ronald B. Guenther, Chair, Staff Selection Committee, Department of Mathematics, Oregon State University, Corvallis, Oregon 97331-4605. Oregon State University is an Affirmative Action/Equal Opportunity Employer and has a policy of being responsive to the needs of dual-career couples.

PURDUE UNIVERSITY - DEPARTMENT OF MATHEMATICS - Several tenure-track or two-year research assistant professorships beginning August 1993. PhD by September 1993, exceptional research promise, and excellence in teaching required. Possible positions at the Associate Professor/Professor level beginning August 1993. PhD and excellent research credentials required. All applicants must mention at least one Purdue faculty member with whom they expect to have common research interests. Send resume and three letters of recommendation (one addressing teaching for assistant professorships) by January 8, 1993 to: Leonard Lipshitz, Head, Department of Mathematics, Purdue University, West Lafayette, IN 47907-1395. Affirmative Action/Equal Opportunity Employer.

STATE UNIVERSITY OF NEW YORK AT BUFFALO - The Department of Mathematics anticipates the appointment of several tenured or tenure-track faculty members beginning September 1, 1993. Salary will be competitive. We seek applicants in all areas with excellent research accomplishments/potential and a strong committment to teaching. Applicants should send supporting information, including a c.v. with a list of research interests, and have four letters of recommendation sent to: Search Committee Chairman, Department of Mathematics, SUNY/Buffalo, 106 Diefendorf Hall, Buffalo, New York 14214. The deadline for applications is November 1, 1992. Late applications will be considered until positions are filled. SUNY/Buffalo is an Equal Opportunity/Affirmative Action Employer. We are interested in identifying prospective minority and women candidates. No person, in whatever relationship with the State University of New York at Buffalo shall be subject to discrimination on the basis of age, creed, color, handicap, national origin, race, religion, sex, marital or veteran status.

TEXAS A&M UNIVERSITY - HEAD, DEPARTMENT OF MATHEMATICS - Texas A&M University is a major coeducational institution, serving over 40,000 students, and ranks in the top ten nationally in research funding, number of National Merit Scholars, and value of its permanent endowment. The College of Science has a research and teaching budget of approximately $40,000,000 and comprises the Departments of Biology, Chemistry, Mathematics, Physics, and Statistics and the Cyclotron Institute. The Mathematics Department is large, energetic, and committed to excellence. Its dynamic faculty, representing pure and applied mathematics, is actively involved in research and both graduate and undergraduate education. The position of Head will be filled by a

person with an outstanding record of achievement in research and teaching and with demonstrable administrative skills. Effective communication, a talent for management , and ability to provide visionary leadership are especially important. Applications, consisting of a resume and the names of five persons from whom we may request letters of reference, will be accepted until November 1, 1992, or until the position is filled. Women and minorities are expecially encouraged to apply. Texas A&M University is an equal opportunity, affirmative action employer. Respond to: Dr. Jon Pitts, Chair, Mathematics Department Head Search Committee, College of Science, Texas A&M University, College Station, TX 77843-3257, Phone: 409-845-7361, Fax: 409-845-6077, E-Mail: search@math.tamu.edu

UNIVERSITY OF ARIZONA - Department of Mathematics, Tucson, Arizona 85721. The Mathematics Department at the University of Arizona will have tenure-track and postdoctoral positions available beginning Fall, 1993. Tenure track positions: Excellent research record or potential, strong commitment to teaching required. Fields should complement but not duplicate existing department research strengths in arithmetic geometry, computational science, dynamical systems, differential geomentry, nonlinear science and number theory. Postdoctoral Fellowships (Research Associates): Applicants with strengths in all areas compatible with department interests are encouraged to respond. In addition, special Center of Excellence Awards in nonlinear optics and fluid mechanics are available. The Mathematics Department may also have several visiting positions for next year. We encourage early application. Deadline will be December 15, 1992 or whenever positions are filled. Women and minority applicants are especially welcome. Send application, which should include a letter of interest, curriculum vitae with a list of publications, and a minimum of three (3) letters of recommendation (enclosed or arrange to be sent), to: Personnel Committee, Department of Mathematics, University of Arizona, Tucson, Arizona 85721, USA. The University of Arizona is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF AUCKLAND - NEW ZEALAND - A Chair in Pure Mathematics (Department of Mathematics and Statistics) - Vacancy UAC.197 - Applications are invited for a Chair of Pure Mathematics. The successful applicant will have an outstanding academic and research background in some branch of Pure Mathematics with personal qualities and experience which will enable her/him to contribute significantly to the continuing development of Pure Mathematics at Auckland both in research and teaching. This position is one of four established Chairs in the Department of Mathematics and Statics, two being in Pure Mathematics and one in each of Applied & Computational Mathematics and statistics. Three other staff hold Personal Chairs. The Department has research strength in a number of areas of Pure Mathematics, including logic, group theory, discrete mathematics, finite geometry, functional analysis, summability theory, complex analysis, quasiconformal analysis, topology and differential equations. The Department of Mathematics and Statistics at the University of Auckland is the largest Department of the largest University in New Zealand. It is in the process of boosting its graduate student enrolments. The Department has an undergraduate computing laboratory currently being enlarged and has a collection of Macintosh microcomputers and Sun workstations. The Pure Mathematics collection of periodicals in the University Library is the best in the country and includes a number of journals obtained by exchange with the New Zealand Journal of Mathematics (formerly known as the Mathematics Chronicle), produced locally in collaboration with the New Zealand Mathematical Society. Commencing salary will be established within the range $NZ80,080 - $NZ94,840 per annum. Further information, Conditions of Appointment and Methods of Application, whould be obtained from the Assistant Registrar, Academic Appointments, Telephone 64-9-373-7999, Fax 64-9-373-7454. Three copies of applications should be forwarded to

reach the Registrar by 20 November 1992. Please quote Vacancy Number UAC.197 in all correspondence. An Equal Employment Opportunity Employer.

UNIVERSITY OF CALIFORNIA - OAKLAND - PRESIDENT'S POSTDOCTORAL FELLOWSHIP PROGRAM 1993-1994. The University of California offers postdoctoral fellowships to enhance the competitiveness of outstanding minority and women scholars for academic appointments at major research universities such as the University of California. Awards are for one academic year with the possibility of renewal for a second year pending demonstration of satisfactory progress. Stipends are $26,000 plus health benefits and up to $4,000 for research expenses. Applicants must be US citizens or permanent residents, and hold a PhD degree from an accredited university. Preference is given to minority and women candidates historically under-represented in their disciplines in higher education. Applications are encouraged from African Americans, American Indians, Asian Americans, Filipinos, Mexican Americans and Latinos, and from all women in Physical Sciences, Mathematics and Engineering. Further information and application material will be available in the fall. Application materials may be obtained from: President's Postdoctoral Fellowship Program, 300 Lakeside Drive, 18th Floor, Oakland, CA 94612-3500 (510) 987-9500. The application deadline is December 14, 1992. An Equal Opportunity, Affirmative Action Employer.

THE UNIVERSITY OF THE SOUTH - DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE: Tenure-track position in mathematics, to begin Fall 1993, at a highly selective church-related (Episcopal) liberal arts college of 1100 students located on a 10,000-acre forested domain in the Tennessee uplands. Applicant should have an appreciation for the liberal arts and some interest in computing. Applications from women and minorities are especially encouraged. The position is at the level of assistant professor, with excellence in teaching and continued interest in research expected. A complete application will include a letter stating one's professional aims, a resume, graduate and undergraduate transcripts, and three recommendations. All should be sent to Sherwood F. Ebey, The University of The South, 735 University Avenue, Sewanee, TN 37375-1000. Applications received by November 27 will have first consideration.

WILLIAMS COLLEGE - DEPARTMENT OF MATHEMATICS - Williamstown, Massachusetts, 01267. One or possibly two anticipated positions, one of them preferably in statistics, probably at the rank of assistant professor, for Fall, 1993. Strong committment to both teaching and scholarship is essential. Please have a vita and three letters of recommendation on teaching and research sent to Hiring Committee. Formal evaluation of applications will begin November 15, 1992, and continue until the postions are filled. AA/EOE.

UNIVERSITY OF FLORIDA - The Department of Mathematics invites applications for one or more anticipated tenured or tenure-track appointments in mathematics, effective August 1993. In the case of junior candidates, preference will be given to applicants with post-doctoral experience who have made substantial research contributions beyond the doctoral dissertation. Senior candidates are expected to have demonstrated leadership in research. The Department especially welcomes applications from women and minority candidates. All applicants should forward a curriculum vitae, a list of publications, and a small number of reprints and/or preprints to Chair of Search Committee, Department of Mathematics, University of Florida, Gainesville, FL 32611-2082. Candidates should supply evidence of commitment to teaching and arrange for at least three letters of recommendation to be forwarded. Full consideration will be given to candidates whose materials arrive by December 31, 1992.

Association for Women in Mathematics

Institutional Membership
Date.....19.....

Please fill out this application and return it as soon as possible. Your institution will be updated on our membership list upon receipt of the completed application and payment of member dues or receipt of postal order. See below to determine which membership category you wish to choose. Subscription to the AWM Newsletter is included as part of the membership. Institutional members receive two free advertisements per year. All institutions advertising in the AWM Newsletter are Affirmative Action/Equal Opportunity Employers.

Indicate below how your institution should appear in the AWM Membership List.

_____

_____

_____

_____

Address change? _____

Department Telephone Number: _____

Chair: _____
Last name First Middle initial

Telephone number: _____

Electronic mail address: _____

Membership Categories

Please read below and indicate the category for which you are applying. AWM membership year is October 1 to September 30th

Dues Schedule
Indicate amount enclosed.

_____ Sponsoring, Category I (may nominate 10 students for membership): $120

_____ Sponsoring, Category II (may nominate 3 students for membership): $80

List names and addresses of student nominees on opposite side of this form.

Institution: _____

Student Nominees: **Please list name and mailing address.**

Name: _____ Name: _____

Name: _____ Name: _____

Name: _____ Name: _____

Name: _____ Name: _____

Name: _____ Name: _____

Each student will receive notification of her/his membership and begin receiving the AWM Newsletter.

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

Association for Women in Mathematics

Individual Membership Form

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.

_____

Last Name First Middle Initial

Address for all mail:

_____

_____

_____

Family member name (if applicable):

_____

Last Name First Middle Initial

Electronic Mail Address (if any): _____

Address Change? _____ New Member? _____

Telephone numbers: Home: ( )_____

Office: ( )_____

Degrees, with institutions and dates:

_____

_____

_____

Present position: _____

Firm or institution: _____

_____

City State Zip/Country

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

_____ _____ _____ _____ _____

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 September 30th

NOTE: ALL CHECKS MUST BE DRAWN ON US BANKS AND BE IN US FUNDS

Dues Schedule 1992/1993 (Please note changes from last year):
NOTE: Membership year runs from October 1, 1992 through September 30, 1993.

Regular Membership.....$40 _____

Family Membership.....$55 _____

(Base dues $25 Regular, $40 Family plus $5 Prize Fund and $10 General Fund)

Contributing Membership.....$100 _____

Student, Retired, or Unemployed Membership.....$8 _____

All Foreign Memberships INCLUDING CANADA & MEXICO add $8 _____

TOTAL DUES: _____

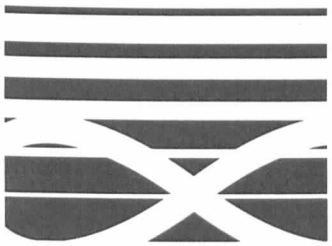
Fields of Interest

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



MATHEMATICAL SCIENCES RESEARCH INSTITUTE

1000 CENTENNIAL DRIVE, BERKELEY, CALIFORNIA 94720

The Institute solicits applications for membership during the 1993-94 year, which begins on September 7, 1993. In 1993-94 two programs will be featured. Although these areas will be emphasized, applications from candidates in all fields will be welcome.

DIFFERENTIAL GEOMETRY. A full-year program with greater activity in the Fall term. The following two areas will be emphasized:

Riemannian Geometry/Geometric Structures. (Main Area) Topics will include:

1. Curvature and topology; 2. Minimal submanifolds and harmonic maps; 3. Spectral geometry (including analytic torsion and Quillen metrics); 4. Spaces of Riemannian manifolds (compactness, collapse, F-structures, etc.); 5. Geometric inequalities (including isoperimetric and isosystolic inequalities, filling radius, simplicial volume, etc.); 6. Spaces of non-positive curvature (structure at infinity, rigidity, buildings, etc.); 7. Einstein spaces and reduced holonomy; moduli; 8. Conformal, affine, and symplectic geometry; Thurston geometries.

Geometry and Physics. (Secondary Area) Topics will include:

1. Gauge field theory, Donaldson theory, Floer homology, the Chern-Simons functional, monopoles, elliptic cohomology;
2. Gravity and twistor theory; 3. Riemannian geometry in infinite dimensions; quantum field theory.

The program committee consists of: W. Ballmann, R. Bott, R. Bryant, C. Gordon, M. Gromov, K. Grove, B. Lawson (chairman), R. Schoen.

DYNAMICAL SYSTEMS AND PROBABILISTIC METHODS FOR PDE'S. The aim of the 1994 program will be to bring together mathematicians, applied mathematicians, physicists, numerical analysts and experimentalists working in related areas, to explore common interests. The program will include workshops devoted to specific scientific areas, such as water waves and nonlinear optics. Topics in the program will include:

1. The emergence of statistical methods, as well as dynamical systems methods, in the analysis and numerical study of evolutionary PDE's; 2. Recent developments in infinite dimensional KAM problems, in the stability, scattering and long-time asymptotics of nonlinear waves, and in the use of renormalization methods for evolutionary PDE's; 3. Fundamental successes, such as the theory of completely integrable soliton equations and the theory of inertial manifolds.

The program will run at least from January to June, 1994. Funding is being sought to extend it through July.

The program committee consists of: P. Deift (co-chairman), P. Holmes, J. Hyman, D. Levermore, D. McLaughlin (co-chairman), C. Wayne.

POSTDOCTORAL FELLOWSHIPS

We anticipate making approximately 20 awards of postdoctoral fellowships. The stipend for 1992-93 is $30,000 and it will be at least that for 1993-94. In addition there is an award for round trip travel. The candidate's Ph.D. should be 1988 or later. Candidates are asked to solicit three letters of recommendation. Most awards are for a year, but a shorter period is possible. The deadline for applications is November 30, 1992.

RESEARCH PROFESSORSHIPS

These awards are intended for midcareer mathematicians; the applicant's Ph.D. should be 1987 or earlier. There is an earlier deadline for applications: September 30, 1992. Candidates may apply for both a Senior Membership and a Research Professorship (but only one award will be made per candidate).

GENERAL MEMBERSHIPS

Applications are invited for part or all of 1993-94. Letters of recommendation are encouraged but not required. It is expected that members at this level will come with partial or full support from other sources. The deadline for applications is November 30, 1992.

FURTHER REMARKS

Starting with applications for 1993-94, MSRI is introducing application forms. If you are interested in applying, you should request an application form. Write to: Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley CA 94720, or send email to: `info@msri.org` with the message: `get program app.ascii` (or `app.TeX`, if you prefer). Women and minority candidates are especially encouraged to apply.

Candidates are asked to make sure that their application materials and letters of reference arrive by the deadline (September 30, 1992 for Research Professorships and November 30, 1992 for the others). Late applications cannot be assured a complete consideration. Awards will be announced by early December, 1992 for Research Professorships and by mid-February, 1993 for the others.

AWM

Newsletter

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AWM
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