

Association for Women in Mathematics

Volume 20, Number 2

NEWSLETTER

March-April 1990

PRESIDENT'S REPORT

The AWM activities at the Louisville Joint Meetings were a great success. The panel on affirmative action was lively, and there were lots of comments from the audience at the end. I would like to thank the panelists for their participation. Bhama Srinivasan gave an outstanding Noether Lecture which was a fitting memorial to Louise Hay to whose memory it was dedicated.

The Executive Committee, after much serious discussion and consideration of a number of alternatives, passed the following resolution:

It is with regret that, in view of the current situation in China, the Association for Women in Mathematics withdraws its official sponsorship of the People to People China delegation. Individuals should make their own decisions as to whether or not to participate.

A second resolution thanked Alice Schafer for her time and effort in planning the trip. The monies donated to AWM for travel grants to China were, after consultation with the donors, transferred to Alice who will distribute them according to the awards made last year. A third resolution was passed congratulating NAM on its 20th anniversary.

Plans for our 20th anniversary celebration in January 1991 are beginning to gel. There will be a Noether lecture, as usual, and an invited address sponsored jointly by the AWM, AMS and MAA. We are also hoping to have a special session entitled "The Future of Women in Mathematics." If you have any suggestions for the organizing committee, please let me know. I also hope that in 1991 we might be able to sponsor a program at the annual meeting of the American Association for the Advancement of Science (AAAS) in honor of our 20th anniversary. Beth Ruskai and Mary Gray will be preparing a proposal to submit to AAAS.

In July of 1990 we will have our first program at a SIAM National Meeting. The panel will consist of five women applied mathematicians — Ann Stehney (IDA Center for Communications Research), Linda Kaufman (AT&T Bell Labs), Rosemary Chang (Silicon Graphics), Catherine Willis (Kidder, Peabody, & Co.), and Marjorie Stein (U.S. Post Office). They will speak about the work they do and the mathematics they use and will perhaps touch on some of the open questions in their application areas. Carol Wood will be organizing a program for the 1990 International Congress of Mathematicians that will be held in August in Kyoto.

At the business meeting Lee Lorch brought to our attention the senseless murder of 14 women engineering students at the University of Montreal. At the request of those present at the meeting, I have written a letter to the Rector, on behalf of AWM, expressing our grief and also our outrage at this insane act of violence against women who were targeted because they had chosen to pursue a traditionally male-dominated career. On a more pleasant note, I was pleased to announce at the business meeting that the AMS will be awarding a prize for the best research paper by a woman during the past five years. It will be presented biannually and will be called the Satter Prize in honor of the memory of Joan Birman's sister, Ruth Satter. [See Joan's article about her sister on pages 3-4.] Joan donated the funds to endow the prize. The AWM has been invited to select one member of the prize committee.

It seems that the Putnam exam is a hot issue these days, so let me follow up on my remarks in the last newsletter. First, I would like to thank those of you who shared with me your opinions on the contest. Some of your comments appear below as letters to the editor. Julian Stanley, of the infamous Stanley and Benbow study on the effect of gender on mathematical ability, wrote a letter to the editor of *The Chronicle of Higher Education* [January 10, 1990 issue, p. B4], in response to an article by Judith Turner entitled "More women are earning doctorates in mathematics, but few are being hired by top universities." Stanley's thesis was that "much more evidence of competitive quality is needed before bias is alleged" because almost no women score high on the Putnam exam. Yikes! Perhaps I'd better turn in my degree, I never even took the Putnam. Rhonda Hughes and I have written a response to Stanley's letter pointing out that if success in the Putnam were a requirement for tenure at the math departments in the top universities, then a number of women and men would be out of jobs. Our letter follows this article.

I would like to close somewhat pensively. Before the Noether lecture we held a brief memorial for Louise Hay. Carol Wood spoke about Louise as a mathematician, Rhonda Hughes spoke about Louise's influence on her while Rhonda was a student at Chicago Circle, and Dick Larson, Louise's husband, spoke about her role as an administrator. I closed with a few of Louise's own words from her article in the *AWM Newsletter*; they are thoughtful and inspirational, just as she was.

If there is a moral to this tale of how I became a mathematician, it is that sources of inspiration and opportunities to change your life can come unexpectedly and should not be ignored; and that you should not neglect the dictates of your own career, taking some risks if necessary, since you never know what the future will bring.

Jill Mesirov
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LETTER TO THE CHRONICLE

It is difficult to fault Julian Stanley's observations regarding the strong performance of Chinese and Bulgarian women on international mathematics competitions as compared with that of Americans. Nevertheless, Dr. Stanley belies a rather narrow view of mathematical ability when, in light of the fact that men significantly outperform women in the Putnam and other competitions, he questions, "...why should Ms. Turner and others assume that many of them [female Ph.D.'s] are promising enough in that field to gain tenure in mathematics departments 'described by many as among the nation's best'?"

We invite Dr. Stanley to find any major mathematics department in the country that would require or expect performance on a competitive examination as a condition for hiring or promotion of faculty. While many top mathematicians excelled on the Putnam, just as many seriously question its predictive value as an indicator of future success as a mathematician. Indeed, many first-rate mathematicians did not do well, or even take, the Putnam, while many who do well on the Putnam fail to sustain careers in mathematics.

Stanley's statement, "...no U.S. woman has qualified during the 15 years from 1974 onward that our country has fielded a team [in the International Mathematical Olympiad]," in conjunction with his previous statement, leaves us at a loss to explain the success of those women mathematicians who have been granted tenure and promoted at prestigious institutions in the past decade and a half.

Surely the Putnam measures something, but there is little consensus in the mathematics community about its value as a predictor of mathematical success. We applaud Dr. Stanley's invitation to learn from other nations how to better nurture our young women's mathematical talent, but we urge him to broaden his view of what constitutes that talent.

Jill P. Mesirov
Rhonda J. Hughes

RUTH LYTTLE SATTER

by Joan S. Birman, née Joan Sylvia Lyttle

My sister Ruth Lyttle Satter died in August 1989 at age 66 after a seven-year battle with leukemia. Ruth and I were very close to one another, and as my sense of personal loss was very great I felt the need to create a tribute to her. Ruth was a dedicated scientist and in her own particular way was very much a feminist. She loved her work, which was of very high quality and was internationally recognized, but she also knew very well the special obstacles which women faced in realizing their full creative potential. She helped many of her women students and colleagues, by her teaching and by her example and in many personal ways. Thus a prize which would recognize and publicize the very high quality work being done by women scientists would be in the spirit of her life and a meaningful way to honor her.

I would like to tell you a little bit about Ruth's life and her work. We were a family of four girls. Neither of our parents finished high school, but their pride in our academic achievements was manifest. As long as we were studying it was good — they didn't seem to realize that math might not be for girls, and so we didn't either! Helen, Ruth and I were math majors in college. (Helen was awarded the math prize when she graduated.) Ruth went on to a job on the technical staff at Bell Labs, where there was an enormous need during World War II, and so opportunities for challenging work even without a graduate degree. Two things brought that phase of Ruth's career to an end. First, the war ended, and she was fired from Bell Lab (after being told by her boss that he had big problems with returning veterans and couldn't handle the extra problems of having women in the lab!). The second was marriage and four children. In those days high-quality day care was not an option, the man in the family was the breadwinner, and unless you had lots of money or were indifferent to their welfare (or grandma came to the rescue), you cared for your children yourself.

Ruth resumed a career, little by little. She had always loved plants, and she began to experiment in her home garden. The experiments became more serious and interesting, and they led her to the systematic study of botany at the University of Connecticut at Storrs. As her children grew up she was able to spend more time studying. I was doing pretty much the same thing in New York, but I went back to my original love, math. We got our Ph.D.'s at roughly the same time — she at age 43 in Botany, and I at age 41 in Mathematics.

A career begun in mid-life is exhilarating, but not always easy. We agreed on that, although the details were very different for her and for me. Ruth was fortunate when she obtained an excellent postdoctoral position at Yale. Her work was on biological clocks in plants. She studied leaf movements which followed apparent 24 hour rhythms, and she asked about the mechanisms which controlled them. She studied the attendant hormone cycles. She learned how potassium moved across certain membranes and initiated the motions. Her work elicited much interest; it was published and recognized. She was invited to speak many times at conferences here and abroad, was on various review panels, and began to work with young students and to do joint work with colleagues at Yale and elsewhere. Eventually she was elected to the Board of Governors of the Biological Society. In short she had all the signs of academic success.

Troubles began when her scientific interests gradually diverged from those of her faculty sponsor, whose grants supported her laboratory. She really didn't care particularly about a faculty position as long as she was able to continue her work without it, but she wanted the freedom to follow her own evolving interests. That meant the freedom to *apply for her own grants*, but *that* was against the rules at Yale if you did not have a faculty appointment. A different, unspoken rule made the postdoc of an individual faculty member an unlikely candidate for a faculty position. She fought the first rule to the top, but lost the battle and had no alternative but to continue as a Research Associate or to leave Yale.

She was invited to spend a year as a Visiting Associate Professor at Cornell under a local version of what mathematicians know as the NSF-sponsored VPW program. It was a crucial year in two ways. First, she found it wonderful to be in a leadership position, even if only for a year. Second, she learned that neither the weekend commute between Ithaca and Hartford nor the alternative of separation from husband and home were acceptable to her. It was equally unacceptable to go back to the position at Yale. The possibilities were limited, even if she and her husband split the commute. She resolved her problems when she joined the Biology Department at UConn, Storrs. Her position there was a compromise. She was supported on soft money, i.e., she had to write all the proposals and get the grants, but she would then be the PI and so it would be her own money, to spend as she saw fit. Unlike

the situation at Yale and Cornell, there was no natural base of activity in her own area at Storrs, so it was up to her to recruit students and postdocs, invite visitors and organize the seminars. She was able to teach, as she wished, even if only as an Adjunct. Her formal position was very much beneath what she should have had, given the recognition she received within the scientific community, but she wasted no energy on that. She was a supreme realist, and there was much interesting work to be done and complaining was not part of her nature.

Ruth's own experiences and her natural warmth and relatedness to people led her to seek out and help other women scientists, both by her interest and encouragement and in more concrete ways. As one example, she learned that one of her women students had left a young child behind in Korea when she and her husband came to the US to study. Ruth provided the ticket to bring the child here, so that he could be with his parents. (I learned of that from her student, who spoke openly of it.) That was one of many such instances.

I thought of establishing this prize in botany, but I don't know that field or the people who work in it as I know mathematics and mathematicians. It's clear to me that there are deep and important theorems being discovered by women, and I feel certain that the prize will be genuinely meaningful. Also, Ruth loved beauty, and good mathematics is supremely beautiful. I look forward with great interest to see the work which will be honored, and I know it will be a suitable tribute to Ruth.

NSF-AWM TRAVEL GRANTS FOR WOMEN

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

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

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

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

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

LETTERS TO THE EDITOR

To the editor:

The November-December issue of the AWM *Newsletter* contained a story about the rescheduling of a planned visit to China by an AWM delegation. That visit had originally been scheduled to take place during the summer of 1989. It was evidently cancelled because of the events of June, 1989. Nevertheless, I read in my newsletter that in September, 1989, when Beijing was under martial law, the leader of the proposed AWM delegation went to China and arranged to reschedule the visit of the delegation for the summer of 1990.

Most of China is still under martial law, and colleagues there are suffering from terrible repression. The proposed trip lends legitimacy to a repressive regime. In my view the visit should be

postponed until martial law is lifted and the climate improves. If the trip goes ahead in spite of what I am suggesting, I hope it will go as a visit of individuals, not as an AWM delegation.

The matter is neither a small one nor a remote one. Many American mathematicians know colleagues in China personally. Most American graduate schools have large numbers of Chinese mathematics students. Many of those students will go on to become our colleagues and friends. They, in turn, have teachers, families, friends, etc., back in China. The chain of human contacts is very concrete and immediate and real.

I hope that the AWM will reconsider its sponsorship of this visit.

Sincerely,

Joan Birman, Professor of Mathematics
Columbia University

To the editor:

At colleges and universities around the country there seems to be an increasing use of the raw numbers from student ratings in making decisions on promotion, tenure, and salaries. Many professors (non-mathematicians for the most part) and administrators seem to have unwavering confidence in these numbers as an objective measure of quality of teaching. As chair of my department's teaching evaluation committee, I am uneasy about this.

In particular, it seems likely that student ratings discriminate against women. For example, some students may be more resentful against an instructor for being demanding or for having minor personal eccentricities if that instructor is a woman.

Have any studies been conducted on this question? I would be interested in receiving any references — or even anecdotal information — about whether students in math courses tend to judge male and female instructors differently on the rating forms. My postal address is Department of Mathematics GN-50, University of Washington, Seattle WA 98195, and my e-mail address is koblitz@entropy.ms.washington.edu.

Sincerely,

Neal Koblitz, Professor of Mathematics
University of Washington

To the editor:

In the president's report in the January-February 1990 issue, there was mention of the lack of interest and lack of success by women on the William Lowell Putnam math competition. As a female undergraduate mathematician, I have noticed this lack of interest, but not lack of success.

For the last two years, I have been the only woman at the University of Florida to take the Putnam exam. This fact has disturbed me. As the vice-president of our Pi Mu Epsilon chapter, I have given myself the responsibility of encouraging other female math majors, not only to take part in the Putnam, but to become more involved with mathematics and the mathematics community. I have had little success.

As for using the Putnam as a measure of success, it should not be done. I am not ashamed to say that I have not had a high score on the Putnam exam. I consider myself to be good at what I do. To take twelve problems from diverse topics and have people work through them in six hours is not a measure of their abilities as mathematicians, but rather their abilities as fast problem solvers.

To me, the Putnam competition has been a way for me to learn more mathematics. This has been my goal as an undergraduate. I hope that the person who wrote the article in *Science* (which was quoted in the president's report) does not fault me or others like me for having this goal.

Sincerely,

Jenny H. Ehrlich, Undergraduate
University of Florida

Dear Dr. Mesirov:

By an interesting coincidence, I received the AWM *Newsletter* just as I was finishing the enclosed paper on writing the Putnam. (This is based on a talk I gave at the conference "Mathematical Thinking and Problem Solving," which was organized by Alan Schoenfeld and held in Berkeley last month.) The issue of women's performance on the Putnam came up after my talk; since this discussion, suitably revised, will also appear in the Conference *Proceedings*, I did not put my comments into the body of the paper. You are welcome to use parts of the paper, as well as this letter, in the *Newsletter*; section four considers the true importance of the Putnam. (I must add that these are my personal opinions; I no longer have any official ties to the Putnam organization.) [Ed. note: excerpts from the paper will appear in a future issue.]

All we know for sure is that women seldom seem to rank in the top hundred. (Many Asian-surnamed contestants have first names which do not correlate easily with gender.) This does not necessarily mean that women do worse on the exam than men, since there are more than two thousand contestants. Perhaps women are equally unrepresented among the bottom third (who get essentially no credit), so that men and women have the same medians. I am confident that the Putnam people do not keep records on this.

Nevertheless, few (if any) women have ever ranked among the Top Five. I think that excellent female math majors are less likely to participate than excellent male math majors. I have known two female undergraduates who had a decent shot at ranking in the top twenty (if not much higher), but declined to take the Putnam. (Since only a hundred names are published, there is no operational way to distinguish a lesser performance from non-participation.) Could it be that advisers push the Putnam less forcefully onto female math majors? Could it be that women professors do the same, maintaining the cycle? Is there something which makes a six hour math contest less attractive to women than to men?

This paragraph is tricky. Might the "Putnam temperament" be less frequently found among women than men? In the paper, I noted with a plausible explanation that Putnam winners are often afflicted with (and afflict others with) a compulsive wordplay. Based on book reviews, I have observed that many more fiction writers with this trait are male than female. The only really well-known female punster is Dorothy Parker; for wordplay, there's also Gertrude Stein. As a "recovering punster," I can tell you that social reinforcement plays no role whatever: you receive nothing but scorn and hostility. It is hard for me to imagine that female punsters could be rejected more decisively than male punsters, except possibly as little children.

I fully concur with your dismissal of the importance of the Putnam. The studies of past top five winners, which can be found in the two MAA Putnam books, show that many are not currently mathematicians. The 1972 Caltech team finished first in the country in a rather spectacular way; two members ranked 1st and 2nd, and I ranked 7th. Based on the method for computing team score (summing ranks), we beat the rest of the world put together ($1 + 2 + 7 < 3 + 4 + 5$). The other two people, each of whom was in the top five more than once, both received Ph.D.'s in mathematics from Caltech. Both are currently working in the computer industry. They may be doing great research, but I don't know about it.

I'll end this letter with a quotation from the paper: "The Putnam plays a valuable, but ultimately inessential, role in undergraduate mathematics. This is a test, this is only a test."

Sincerely yours,

Bruce Reznick, Professor
University of Illinois at Urbana-Champaign

SOME STATISTICS: Cathy Kessel sent me some info on the NSF Graduate Fellowship Program from the NSF *Report on Women in Science and Engineering Careers*. In mathematics, for '85, '87, '87, and '88, the percentages of women *applicants* were 29.1, 29.3, 29.5, and 25.1, respectively, while the percentages of women *recipients* were 5.0, 11.1, 4.5 and 10.7. I thought we didn't do as well because we didn't apply in large enough numbers?? Applied math numbers were 32.8, 32.0, 47.1, 43.7 against 6.7, 11.1, 33.3, 23.5: a much better trend, but still room for improvement.

REPORT OF THE TREASURER

DECEMBER 1989

Accounting for the period June 1, 1989 through December 31, 1989

BALANCE as of June 1, 1989	\$31,535.45
Washington Water Power, 5 shares valued at	111.88
Reserve Funds	18,000.00
ATSchafer Award Fund	10,465.00
Total Assets as of June 1, 1989	\$60,112.33

RECEIPTS

Dues- Individual	\$14,411.00
Family	1,225.00
Institutional	7,792.00
NSF Travel Grant for half-year	10,000.00
EXXON Education Foundation Grant for AWM	10,000.00
EXXON Resource Center Grant	30,000.00
Raytheon Grant for AWM-Simmons Summer Institute	10,000.00
AWM/People-to-People International	
China Delegation Contributions ¹	15,100.00
ATSchafer Prize Contributions	2,770.00
Advertising	315.00
Publications	119.19
Contributions	1,193.00
Interest and Dividends	1,075.47

TOTAL RECEIPTS \$104,000.66

EXPENSES

Wages and FICA for Executive Director ²	\$17,233.40
Operating Expenses ²	6,407.90
Newsletter Expenses	4,399.89
Bulk Mailing	1,400.00
AWM National Meetings ²	332.79
Dues & Fees: CBMS, Massachusetts Incorporation Fee	187.50
Consultants	315.00
EXXON Grant Expenses: Meetings, SKHSDay Awards	5,380.16
NSF Grant Expenses	9,351.39
AWM-Simmons Summer Institute	10,000.00
ATSchafer Prize Expenses	305.68

TOTAL EXPENSES \$55,303.71

TRANSFER to CD¹ \$15,100.00

BALANCE as of December 31, 1989 \$65,132.40

- (1) Money was returned from People-to-People International and invested.
- (2) Amounts are less expenses charged to NSF and Exxon grants.

Respectfully submitted,

Jenny A. Baglivo, Treasurer
 Mathematics Department, Boston College
 Chestnut Hill, MA 02167

AWARDS AND HONORS

Phyllis Zweig Chinn has been named Humboldt State University's Outstanding Professor for 1989-1990, a recognition that mirrors her dedication to exemplary teaching through individual discovery and creativity.

While juggling professional interests and family life, Chinn has been a member of Humboldt's faculty for 15 years and is known for her academic scholarship and service to the university and community. She is a professor of mathematics, director of the Redwood Area Mathematics Project, a member of the Women's Studies faculty and the Teacher Preparation Program, a researcher and scholarly author, public speaker, and student advisor. As if she doesn't juggle enough professional activities, she's even found time for a hobby — juggling.

In 1975 Chinn came to Humboldt from Towson State University. She received a bachelor's degree from Brandeis University and earned master's degrees from Harvard University and the University of California, San Diego. She was awarded a Ph.D. in 1969 from the University of California, Santa Barbara. All of her degrees were in mathematics.

During her career, Chinn has learned that a combination of concentration and relaxation is the key to discovery and insight — for herself and her students. She utilizes a guided-discovery approach to teach math that enhances learning and encourages exploration and creativity in students. That approach includes the use of dice, spinners, tangrams, blocks to model number systems, geometrical shapes, and mathematical puzzles.

Primarily interested in graph theory, she leads classes to a treasure-trove where students discover a definition of abstract graphs from a series of handouts on graphs and non-graphs. In small groups, students develop suitable definitions of a graph, then work independently or in small groups to create additional definitions, examples, conjectures, and theorems concerning graphs.

"Basically, graph theory involves models where every line in a collection of things joins two different points. An example would be a genealogy chart where people represent points and family relations represent the connecting lines. Also, a telephone system is basically a graph where phone lines connect the points of transmitters and receivers."

Chinn's own experience as a student influenced her direction in teaching. She began as a chemistry major, but was negatively influenced by one of her professors who stated "you girls might as well forget about getting good grades because the guys need them..."

Consequently, Chinn actively encourages women to pursue careers in math and science. Frequently she addresses junior high and high school girls on careers in math and is actively involved with the Association for Women in Mathematics. She was also a member of the California State University Chancellor's Task Force on the Status of Women in Science, Mathematics and Engineering.

"I'm opposed to teaching by intimidation — implying that solutions to problems are obvious," Chinn said. "When teachers do that, students feel stupid if they ask questions. Instead, I prefer to reduce the stress some students have about math."

Since 1985 she has been on the advisory board of the Redwood Area Mathematics Project (RAMP), one of 16 sites funded by the State of California to improve the teaching of math at the kindergarten through junior college level. She was named director of RAMP in 1989.

Chinn has published more than 30 articles in professional journals and is frequently invited to speak at universities and conferences in the United States and abroad.

Chinn and her husband, Daryl, are the parents of 16-year-old Allison and 13-year-old Wesley, who are both enrolled in math courses at Humboldt. Daryl recently had his first book of poems, *Soft Parts of the Back*, published by the University of Central Florida Press.



"Sunley Receives Presidential Rank Award," *AMS Notices*, November 1989

Judith S. Sunley, Director of the Division of Mathematical Sciences (DMS) at the National Science Foundation (NSF), has received the Presidential Rank Award, one of the highest awards at the Senior Executive Service level of government. Sunley's rank of Meritorious Executive, which carries a stipend of \$10,000, recognizes sustained accomplishment during her executive career. Awards are made to executives throughout the government, but this is the first time such an award has been conferred on a member of DMS staff.

Sunley has made many contributions to the management of NSF and has shown outstanding leadership of the DMS both in her current position as Director, which she has held since 1987, as well as in her previous position as Deputy Director. In 1986, she received the first NSF Director's Award for Equal Opportunity Achievement.

According to an internal NSF document on Sunley's nomination for the award, her leadership has been characterized by a flexible approach to dealing with infrastructure concerns within the mathematical community, uniformly excellent management of the Division, exceptional success in recruiting and training high-quality program staff, and a strong commitment to equal opportunity. The document ends by stating, "Her understanding of the mathematical sciences community, her commitment to the goals of the NSF, and her ability to meld these into a forceful plan for action make her an outstanding asset to the Foundation."

Sunley originally came to the Foundation in 1980 as a program Director in Algebra and Number Theory. She received her Ph.D. from the University of Maryland and was on the mathematics faculty of American University for 10 years.

"Luce Fund for Women Scientists," *AMS Notices*, November 1989

The Henry Luce Foundation has announced the establishment of the Clare Boothe Luce Fund, a \$70 million endowment that will provide professorships, fellowships, and scholarships to women scientists in higher education. The fund is intended to respond to the historic underrepresentation of women in the physical sciences, engineering, and mathematics.

The fund sets aside \$3 million for each of 14 educational institutions designated by the late Clare Boothe Luce, whose bequest created the fund to encourage women in fields where there have traditionally been obstacles to their advancement. The awards range from \$225,000 to \$430,000 over a five-year period.

One of the program's professorship awards went to Vanessa Job, who has been named Clare Boothe Luce Professor of Mathematics and Computer Science at Marymount University in Virginia. Job has done research in the area of polyadic codes and is especially interested in coding theory, combinatorics, supercomputing, and complexity theory. She will be the first female appointment to Marymount's computer science department.

Each institution receiving an award will use the income on the funds to support the advancement of women in science and engineering. The designated institutions are: Georgetown University, University of Notre Dame, Boston University, Colby College, Creighton University, Fordham University, Marymount University (VA), Mount Holyoke College, Mundelein College, Santa Clara University, St. John's University, Seton Hall University, Trinity College (DC), and Villanova School. In addition to the professorships, the Clare Boothe Luce Fund has made possible fellowships in research at the Institute for Advanced Study in Princeton.

The remainder of the income from the fund will be distributed in specific grants for professorships, fellowships, and scholarships for women in science and engineering at other institutions. ... Only institutions, not individuals, will be invited by the Luce Foundation to submit applications for these awards.

Congratulations to the following women, who have received fellowships from the AAUW Educational Foundation for 1989-1990. Dissertation Fellows: Wilhelmina Claus, Mathematics, University of Texas, Austin, Kleinian Groups and 3-Manifolds; Josephine Micallef, Computer Science, Columbia University, Interactive Language-Based Environments for Programming-In-The-Many. Selected Professions Fellowship: Sylvana Vester, Mathematics, University of Central Florida. International Fellowship (for graduate study): Lie-Ju Hwang, Taiwan, Statistics, Texas A&M University. Project Renew Recipient: Linda S. Rising, Computer Science, Arizona State University.

BOOK REVIEW COLUMN

Women of Academe: Outsiders in the Sacred Grove, by Nadya Aisenberg and Mona Harrington. The University of Massachusetts Press, 1988. Paper, 207 pages. ISBN 0-87023-607-5.
Reviewer: Cathy Kessel

The institutionalized forms of discrimination against women in academe are gone — we may attend lectures without sitting behind screens or in closets, we may receive degrees from universities, we may hold academic jobs. However, we all know that women haven't achieved professional equality. The reasons for this situation aren't easy to describe or sometimes even to be aware of. The most illuminating study of this problem I've read is *Women of Academe*.

Women of Academe is the result of a study similar in methodology to that of *Women's Ways of Knowing*. The authors interviewed women with Ph.D.'s in various fields, twenty-five tenured and thirty-seven "deflected" (off the normal tenure track), and carefully analyzed the transcripts to identify common patterns of experience. They were "astonished to find less difference than commonality in the stories of tenured and deflected women" and found recurring in the interviews themes depicting "an experience of professional marginality and of exclusion from the centers of professional authority." The thesis of the book is that "the common patterns consist of the play in all women's lives of social norms that are constructed to cast women in subordinate, supportive roles in both their private and public lives."

The first chapter is a discussion of these social norms and how they reach women throughout their lives via friends, relations, society, and academe. For example:

A philosopher speaks of the astonishment she felt when, after many years in her field, her eye fell on a remark of Kant's that women should not worry their pretty heads about geometry — that they might as well have beards. "I looked at this and said 'What does having a beard have to do with geometry?'" ... [S]he went on to find similar comments in many of the great philosophers.

The majority of the book is a discussion of the effect of these internalized messages on the lives and work of academic women, illustrated by quotations from the interviews and scholarly articles and by examples from history, mythology and literature. (Some readers may find the references interesting in their own right. For instance, the most detailed narrative of a woman's graduate experience in the hard sciences I've discovered was in *Working It Out*.)

I found the chapter on "the voice of authority" to be the most relevant to my own life. The authors begin with an analysis of the old norm that "women should not speak with authority, because they should not be holding authority" and contrast the images of speaking ("either silly or nasty") with those of "praiseworthy" women who practice "the virtue of silence." This conflicts with the requirements of academic life — we must lecture to classes, give talks, and publish papers. One reaction is writing blocks: "The refrain of 'I decided it wasn't good enough,' 'I didn't submit,' 'I redrafted and redrafted it thirty-seven times' appears in dozens of stories." "A related reaction is apologizing ... the prefatory disclaimer ... is common ... such remarks aim at self-effacement..."

The last chapter, "Countervalues and Change," sketches the values held by the interviewees as well as many women in academe and suggests ways in which women can cope with the conflict between the old norms and these values.

I think this is a very valuable book for women in mathematics, particularly for graduate students. We won't overcome the barriers to professional equality without becoming aware of their existence. *Women of Academe* offers us a mirror of our world.

Afterword

During the time I was writing the above review I had borrowed from the library Martin Gardner's book *Wheels, Life, and Other Mathematical Amusements*, which is a collection of his columns for *Scientific American* together with responses from readers. It's worth noting that these columns were twice edited, by *Scientific American* during the 60's and 70's and by W. H. Freeman in the 80's. I think the following extracts speak for themselves for the most part, so I've made only a few comments.

Here are all the references made to girls and women in the first article "Wheels."

Imagine a girl whose bare waist is a perfect circle. Rolling around her waist, while she remains motionless, is a hula hoop with a diameter twice that of her waist. When a point on the hoop, touching the girl's navel, first returns to her navel, how far has that point traveled? Since the point traces a cardioid, this is equivalent

to asking for the cardioid's length. It is not hard to show that it is four times the diameter of the hoop or eight times the diameter of the girl's waist.

The cusped curve that one often sees on the surface of tea or coffee in a cup, when slanting light falls across the liquid from a window or other light source far to one side, is a good approximation of a nephroid cusp. Pleasant approximations are also frequently seen on photographs that appear in girlie magazines.

George Lefenstey wrote to say that although he enjoyed my column on the wheel, it ruined his day: "The trouble is, I've been sitting here wasting the better part of the afternoon imagining that gorgeous blue-eyed blond girl of yours in the hip huggers and halter top, twirling that hula hoop around her perfectly-formed golden middle. Please try to be more considerate in the future."

In the article "Plaiting Polyhedrons" Jean Pederson is introduced [p. 106] as "a mathematics teacher at the University of Santa Clara" and referred to thereafter as Mrs. Pederson. The effect of this usage is that the reader is sure Pederson is married and female but perhaps not quite certain Pederson is a mathematician. However, Donald Knuth is "a mathematician at Stanford University" [p. 119], Solomon Golomb is a "professor of engineering and mathematics at the University of Southern California" [p. 152], H.S.M. Coxeter is "a geometer at the University of Toronto" [p. 168], and so on. The only other person I found described as a teacher in this book is "Gilbert W. Kessler, a mathematics teacher in a Brooklyn high school." [p. 22] Men are referred to by first name or initials followed by last name or by last name only.

The rest of the book is no better.

I checked a later collection of Mr. Gardner's columns, *Time Travel and Other Mathematical Bewilderments*, published by W.H. Freeman in 1988. Here are all the references made to girls and women in the article "Tangrams, Part I":

A different theory about the name [tangrams] has recently been advanced by Peter Van Note in his introduction to a Dover reprint of Loyd's fanciful book. Chinese families who live on riverboats are called *tanka* and *tan* is a Chinese word for prostitute. American sailors, taught the puzzle by tanka girls, may have called it tangrams — the puzzle of the prostitutes.

"One remarkable thing about ... Tangram pictures," wrote Dudeney [in *Amusements in Mathematics*], "is that they suggest to the imagination such a lot that is not really there. Who, for example, can look ... at Lady Belinda ... without soon feeling the haughty expression...?"

Four classical examples, all devised by Loyd, are a woman pushing a baby carriage, a runner being tagged out at home plate, two Indian braves, and a man with a wheelbarrow.

Here are the only references to women and girls in "Tiling with Convex Polygons":

James's tessellation can be varied in ways that have been analyzed in a 1978 paper by Doris Schattschneider of Moravian College, Bethlehem, Pa. ...

The discovery of new types of tiling pentagons did not end with James's finding. Marjorie Rice, a San Diego housewife with no mathematical training beyond the minimum required in high school, began a systematic search for new patterns. In 1976 she discovered a tenth type ..., two more types later that year, and still another the following year, bringing the total number of types to thirteen. A fourteenth type was found in 1985 by Rolf Stein, a mathematics graduate student at the University of Dortmund in West Germany. ...

Doris Schattschneider gives a brief account of Mrs. Rice's fantastic achievements in her 1978 paper, and a more detailed account in her contribution to *The Mathematical Gardner*. The latter paper includes three color plates of beautiful Escher-like tessellations (bees, fish, and flowers) that Mrs. Rice based on her new tiling patterns ...

Earlier in the article we learn that James is "a computer scientist with the Control Data Corporation." [p. 171] We are never told Schattschneider is a mathematician, but we are told how much mathematical training Rice and Stein have received. Note also that more detail is given about the work of Rice than about the work of Schattschneider, which has the effect of making us more likely to remember Rice than to remember Schattschneider.

CORRECTION: In Claudia Zaslavsky's review of Washburn and Crowe's *Symmetries in Cultures* last month, on p. 10, l. -6, "pma2" should read "pmm2".

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EDUCATION COMMITTEE COLUMN

Teaching Mathematics in an External Degree Format

Sally I. Lipsey, chair

In the following article, Ellen Cunningham (St. Mary-of-the-Woods College, St. Mary-of-the-Woods, IN) reports on an unusual program for external degree students, generally women who have been out of school for some time before undertaking a college program, and whose circumstances preclude regular attendance at classes.

Those of us who have been striving for years to encourage women in mathematics may find that the phrase "connected teaching" describes well what we try to do. The humane attitudes and behaviors of educators thus capsulized by Belenky, Clinchy, Goldberger and Tarule in *Women's Ways of Knowing* [1986, Chapters 9 and 10] have a great deal of application to the college mathematics classroom. Today's college students, however, are found not only in traditional classrooms; they are also in external degree programs — the separated students. Teaching mathematics to these students provides special challenges and special opportunities, and the connected teaching concept provides a useful framework for exploring some of them.

External delivery system

Since many readers may be unfamiliar with the external degree method of course delivery, or confuse it with correspondence courses, I will describe the external method as found in the Women's External Degree (WED) program at Saint Mary-of-the Woods College, an early standard-setter for true external degree programs. Semesters begin, at essentially any time of the calendar year, with an on-campus residence which includes a meeting between the student and the instructor for each course she will take. During this meeting, the student discusses her own goals and progress in the WED program and hears about the goals of the course and any procedures she needs to know. She receives her copy of the module, which is a detailed list of assignments for the semester along with goal statements, commentary, and information on the textbooks and any other materials. With this in hand, she and the instructor set up a calendar of due dates. The student then goes home, works through the material, and sends the first installment of written work to the instructor. The instructor reviews the work and returns it with comments; the student responds and revises as required, and this cycle continues throughout the semester. (The amount of revision which is appropriate or feasible varies with the discipline and to some extent with the instructor's philosophy; I will say more on this below.) Phone calls may be exchanged if the student has questions on the material or if delays in submitting or returning assignments occur. There are no examinations; grades are based on the quality of the student's written work or other projects submitted.

WED instructors are conscious of their obligation to respond promptly to the student, whose isolation often generates a high degree of anxiety about her work. For this reason also, most instructors are as encouraging as possible to the students, while insisting on college-quality work. Calendar revisions and extensions beyond the five months are fairly common as work and family crises arise in the student's life.

External mathematics courses

Fundamental of Mathematics, using Jacobs [1982], and Statistics, using Brase [1987], comprise most of the mathematics teaching done in our external degree program. The former is used to fulfill the general studies requirement and also helps students prepare for Statistics, which is required by the most popular majors and fulfills the new general requirement. (We have no mathematics majors, and little demand for higher-level math courses, in the WED program.)

In mathematics, our practice is to require the student to revise the work until it is correct. In the actual situation, I find this usually works as follows: if the student's first submission of a problem is not correct, I return it indicating what *is* correct and supplying a hint, leading question, or page number of an example. Generally her second submission will be correct. If not, back it goes. Almost always the third attempt is correct, but in case it is not, most likely the original problem has been beaten to death by now, and I assign an alternate one. The number of problems assigned in the Statistics module is considerably less than I would assign between classes in a resident course, but the student is likely to do a number of practice problems and to pore over textbook examples with an attention unknown to most resident students before submitting the final correct writeup.

Insofar as connected teaching is an ideal, this isolated manner of learning may seem far removed from it. In some ways this is the case — such an education is in some aspects “separate and unequal.” There are, however, aspects of connected teaching which the external degree format can achieve at least to an extent, and others which can be better achieved in the external degree format than in the usual mathematics class — in these aspects the external format is “separate but equal — or better.”

Separate and unequal

One drawback is inevitable and major. The ideal of *nurturing groups* — quite central and very attractive in *Women's Ways of Knowing* [pp. 219-223] — is practically impossible to realize in the external format. These “long-distance learners” seldom have contact with one another, certainly not the extended kind of contact that would really enable them to nourish one another's evolving ideas. Electronic networking will soon make contact more feasible, but I suspect there will not be any significant group formation, simply because of the lack of time in the students' overcrowded lives. They should and generally do have a nurturing dialog with the instructor; and certainly they have at least a theoretical knowledge of a connection with others, whether they envision the “others” as a community of scholars or as fellow victims of oppression via math requirements!

A related lack is the image of the *teacher as struggler* — the student's need sometimes to see the teacher fail to solve a problem [Belenky, pp. 215-217]. The external degree student is likely to see only the impeccable reasoning of the textbook. (The comparison here may actually be moot, as it is unlikely that the classroom teacher will exhibit a genuine struggle with mathematical concepts at this level.)

Separate but equal — or better

Emphasizing understanding over assessment is a goal that is achievable in the external format, and we certainly feel that we accomplish it in the mathematics area with the practice that states, in effect, “revise until you understand.” The discussion in *Women's Ways of Knowing* concerning assessment and the idea of objective standards [pp. 205-213, esp. 208-209] is ambiguous. Our system comes down on the side of competency-based assessment for the eventual grade, but is definitely not impersonal. It avoids the intimidating experience of tests and competition.

There is more *time flexibility* and *provision for the student's own pace*, reflecting a “midwife” model of teaching [Belenky, pp. 217-219]. Finding the hours in the day is generally more difficult for the external student, who most likely has a full time job and family responsibilities. However, both the initial assignment calendar and the daily or weekly decision of when to do the assignments are hers to make in light of the demands of her own life and personal preferences. Even more flexibility is afforded by the extra length of the semester — five months instead of the usual four — and the fact that most courses may be begun at any time of the year.

At a deeper level, respect for the student's own pace and the evolution of her thought is afforded by the policy of “revise till you understand.” When told about this by an instructor at the outset, many students are cautiously excited about the prospect of finally understanding something in mathematics!

Connection with real life and first-hand experience seem to be aspects of learning which women especially crave [Belenky, pp. 198-204]. Here it is not so much the delivery format, but the maturity level of the typical student, which makes the practical connections more visible for the nontraditional student. Women who have been in the business world for some years, who have been reading newspapers, keeping up with mortgage payments, and making decisions about their children's education, naturally have more firsthand experience to bring to a mathematics class than prototypical, younger students. Their final projects in Statistics require them to gather data and use a statistical test that will help them in their work (whether paid employment or homemaking.) On the Fundamentals level, the inductive approach used by Jacobs [1982] seems to appeal to the older student.

This leads into what Belenky *et al.* would seem to identify as the most vital aspect of education for women, “*confirmation of the self as knower*” [pp. 193-195]. To some extent it may be argued that mathematics itself carries an aspect of self-validation. *Everybody Counts* declares that mathematics provides “one of the few disciplines in which the growing student can, by exercising only the power inherent in his or her own mind, reach conclusions with full assurance” [National Research Council, 1989, p. 4]. Since by all reports “math anxiety” is alive and well, one can only conclude that this intrinsic validation is not often experienced by the typical college student who “tries” the odd-numbered problems, checks answers in the back of the book, gets a study buddy to help clear up the algebra mistakes, and then has the teacher “go over” any recalcitrant ones the next day in class. I

suspect that the external student who works in isolation, who faces a delay due to mailing, who knows that two-thirds or three-fourths correct will *not* be "good enough," and who wants to avoid spending time on revision, may more quickly come to knowledge of this inner authority.

It is, however, almost a certainty that she will not have this knowledge at the outset. *Women's Ways of Knowing* reveals that "worry [over their ability to learn] was especially acute among older women returning to college or entering it for the first time" [p. 195]. The authors insist that a woman student "needs to know that she is capable of intelligent thought, and she needs to know it right away" [p. 193]. Thus the most striking positive aspect of a good external degree program is the affirmation of the individual. Students registering for our Fundamentals of Mathematics course have typically not had good experiences with mathematics, dread the course, and are incredulous when an instructor tells them "this will be fun." Most report that it *is* fun; they are amazed at how well they do, and many finally believe in their ability to do math.

The most nurturing classroom will still have the vocal students and the quiet ones. In the external format, every student must "speak," and every student is assured of being "heard." There is an intriguing use of the term "objectivity" in Belenky [pp. 224-225] to describe the connected teacher-student relationship, which sounds more like the "long-distance" than the "local" connection. I found it well-reflected in the comment of a veteran mathematics teacher who is an enthusiast for the external format when she spoke of "the intimacy you gain from struggling with a student over her work."

Conclusion

External degree programs have empowered thousands of women by making college degrees attainable, yet are sometimes underrated by faculty and students as a poor second best to traditional formats. I have tried to show that long-distance teaching and learning of mathematics, if practiced by dedicated faculty within a carefully structured system, can offer some of the best opportunities for women to discover their "ways of knowing."

References

1. Belenky, Mary Field, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule. *Women's Ways of Knowing*. New York: Basic Books, 1986.
2. Brase, Charles H. and Corrinne P. Brase. *Understandable Statistics: Concepts and Methods*, 3rd edition. Lexington, MA: D.C. Heath, 1987.
3. Jacobs, Harold R. *Mathematics, a Human Endeavor*, 2nd edition. San Francisco: W.H. Freeman, 1982.
4. National Research Council. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*. Washington, DC: National Academy Press, 1989.

READER SURVEY: If you know of other interesting programs for external degree students, or for those women who are called "returning students," please forward information to the AWM Math Education Committee, c/o Sally I. Lipsey, 70 East 10th St., #3A, New York, NY 10003.

MATHEMATICS AWARENESS WEEK

Mathematics Awareness Week, April 22-28, 1990, is our national and annual celebration of the beauty and creativity of mathematics and our observance of the relevance of mathematics in everyday life. The theme for Mathematics Awareness Week 1990 is "Communicating Mathematics." We selected this theme so that our activities would coincide with the mathematical community's 1990 Year of National Dialogue which is a special national vehicle for discussion of the state of American mathematics and education. Consequently, our 1990 MAW theme provides a broad base for you to plan a wide variety of activities.

For example, you can sponsor a mathematics competition for students in a nearby high school; you can offer a colleague as a guest speaker to a nearby elementary, middle, junior high or senior high school; you can fly a banner proclaiming Mathematics Awareness Week above the door of your department; you can sponsor a public forum where members of your community can discuss proposed

changes in mathematics education; or you can hold a mathematical art contest for students in your department or in your geographic area.

Kathleen Holmay, Public Information Director, Joint Policy Board for Mathematics, Office of Governmental and Public Affairs, 1529 18th St., N.W., Washington, DC 20036, would be happy to hear from you with questions and comments — especially regarding your ideas for your local celebrations of Mathematics Awareness Week 1990.

Audiovisuals can provide focal points for MAW events. An updated listing of films and tapes follows.

You Can Count On It, 15 min., \$8.75 fee includes UPS charge. Ideal for middle through high school classrooms. A project of the Mathematical Association of America and the National Council of Teachers of Mathematics with support from Texas Instruments. Levco Marketing, 2809 Ross Ave., Dallas, TX 75201. 1-800-527-2156 outside Texas; 1-800-441-0145 in Texas.

Theorem of Pythagoras, 15 min., \$25 for the film, which includes 1 notebook. Additional notebooks are \$4 each for 1-9, \$2 each for 10 or more. Mathematical Association of America, 1529 18th St., NW, Washington, DC 20036.

Square One TV. Half-hour programs can be taped from the television series and used for up to three years. Teacher manuals for Square One TV are available for \$2 each; and for Math Net, \$3.95 each. Children's Television Workshop, One Lincoln Plaza, NY, NY 10023. 212-595-4770.

For All Practical Purposes, 26 half-hour lessons, 5 lessons per tape, \$29.95 per tape with \$350 for full series. The Consortium for Mathematics and its Applications (COMAP) produced these lessons as an introduction to contemporary mathematics. The 26 lessons are divided into 5 categories: management science, statistics, social choice, geometry, and computer science. This series is ideal for individuals without a mathematics background. To order and get information or preview tapes, call 1-800-LEARNER.

The Challenge of the Unknown, 7 20-minute videos about problem solving for junior and senior high school students. Videos along with a training guide are available free to teachers for two-week periods. Karol Media, 22 Riverview Drive, Wayne, NJ 07470.

The Emergence of Greek Mathematics, The Liberation of Algebra, The Birth of Calculus, The Vernacular Tradition, The Birth of Modern Geometry. Media Guild, 11722 Sorrento Valley Road, Suite E, San Diego, CA 92121. 619-755-9191.

Math Anxiety: We Beat It, So Can You!, color, 29 min. (16 mm or videotape), \$35 rental fee for 3 days. EDC Distribution Center, 55 Chapel St., Newton, MA 02160.

Mathematics of the Honeycomb, 13 min., \$55 for a 3 day rental. Shows that honey bees build honeycombs of optimum structural design. Powers of Ten, 9 min. This film is an entirely new color remake of the original film. Illustrating the relationship between the number ten and the size of the physical universe, the film takes as its reference frame the square meter view of a couple picnicking on the grass of Soldier Field in Chicago. The camera zooms outward; time and distance increase in increments of ten, until we reach the outer galaxies. Returning to Earth, we proceed from the human scale into the microworld of cells, DNA molecules, and the nucleus of the atom. Pyramid Films, P.O. Box 1048, Santa Monica, CA 90406.

Mathematical Peep Show, 11 min. Using clever animation and photography, the film conveys basic principles of Eratosthenes' method of abstract measurement of the earth, of topology, symmetry, functions, and exponents. Encyclopedia Britannica Educational Corp., 415 N. Michigan Ave., Chicago, IL 60611.

Flatland, 12 min. An animated film based on the short novel by Edwin Abbott. Moody Institute of Science, 12000 E. Washington Blvd., Whittier, CA 90606.

The Beauty and Complexity of the Mandelbrot Set, 1 hour, \$59, order code VIDHUBBARD/N. Chaos, Fractals and Dynamics: Computer Experiments in Mathematics, 1 hour, VHS format, \$59, order code VIDDEVANEY/NA. Narrated by Robert L. Devaney for college level and beyond, this Science Television Production is a clearly presented and richly illustrated instructional tool. American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901. 1-800-321-4AMS.

Following is a partial list of 16-mm sound films available for sale or rent from Wards Natural Science Establishment, (Modern Learning Aids), 5100 W. Henrietta Rd., Rochester, NY 14692. Contact: Steve Hubright, 716-359-2502. Theory of Limits — Part I, b/w, 30 min., Parts II & III, b/w, 38 min. Limit, color, 11 min. Nim and Other Oriented Graph Games, b/w, 63 min. Can You Hear the Shape of a Drum?, color, 49 min. Who Killed Determinants?, b/w, 57 min. Cycloidal Curves or Tales from the Wanklenberg Woods, color, 22 min. The Gauss-Bonnet Theorem, color, 25 min. Newton's Method, color, 10 min. Infinite Acres, color, 11 min. Pits, Peaks and Passes, color, 48 min.

AAAS PRESIDENTIAL LECTURE: VOICES FROM THE PIPELINE part 2 of 2

by Sheila E. Widnall, Abby Rockefeller Mauze Professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology

This article is based on her lecture at the AAAS annual meeting on February 14, 1988, in Boston, MA.

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Results from Student Surveys

In the various student surveys, students commented on their personal experiences in graduate school. Most of the comments were complaints about the current system. There were subtle differences in the responses of men and women. The men most often expressed anger, even rage, at the system and suggested ways that it should be changed, whereas the women more often described the effect that the current system had on them and expressed feelings of frustration and discouragement. For example, the following comments were made by students from the same department when asked what hindered their graduate education [10]:

1) From a man: "The absolute insensitivity of the professors, department, and university to the inevitable depression experienced by young scientists when their research doesn't work so well. The ... university's ... willingness to ignore all graduate students but the ... top 10% elite."

2) From a woman: "Despite denials, as a woman in ... science ... I had something to prove — and yet the most difficult part about it is that I don't know what it is or how to prove it. There is just the knowledge that I have at least one more test to pass than my male counterparts. Or maybe it's one more test to pass daily."

As revealed by student surveys, the issues affecting minority, foreign, and women students are related to their differences from the majority, their feelings of powerlessness, and feelings of increased pressure and isolation. For example, significantly larger percentages of women students than men students in both the Stanford and the MIT studies reported that the environment was detrimental to their health [8,10]. In the Stanford survey, 23% of the women versus 9% of the men reported that they thought they were on the verge of a nervous breakdown. The data on minority students are too sparse to draw any conclusions, but it is likely that graduate school is an extremely stressful environment for them.

Women students are not a minority at the undergraduate level in our colleges and universities. Yet the effect that education has on them sets the stage for their minority presence in graduate school. Studies indicate that the self-esteem of women students is lowered in college, while the self-esteem of male students is raised.

The Illinois Valedictorian Project [11] was a study that followed a group of 80 students (46 women and 34 men) who had graduated in 1981 at the top of their high school classes. The group continued their high academic performance, with the women earning a final grade point average of 3.6 and the men an average of 3.5 for their college years. In spite of this objective record, when this group was surveyed at several points in their educational careers concerning their self-estimate of intelligence relative to their peers, ... [t]he shift of self-esteem to lower ratings [was] quite evident for the women students. At the end of high school the groups were quite comparable, but females suffered a significant loss of self-esteem in the sophomore year of college. At the senior year of college, no women had a self-estimate in the highest category, whereas 25% of the men did, even though the grade point average of the women was higher than that of the men. In contrast, the self-esteem of the men increased slightly during the college years. Even though women in science have degree completion rates above those of the men and carry on to graduate school at about the same rate, these results suggest that they arrive at graduate school with some uncertainty about their abilities, even though their academic records and test scores are equivalent to those of the men.

A second trend noted in this study [11] was the lowering of career ambitions by the women students. The researchers linked lowered career ambitions in part to the unresolved dual-career problem: that is, the student's uncertainty about how to combine career and family responsibilities. One of the most effective antidotes for these uncertainties about career goals was the opportunity for successful professional experiences: independent research, professional employment, opportunity for interaction with graduate students, and the support and encouragement of a faculty mentor. Most women scientists of my generation can probably point to a single individual who was supportive at the undergraduate level without whose encouragement they would not have gone to graduate school.

Without such opportunities a woman student may carry through with excellent performance in classes but be unsure about her actual potential as a professional. She may also develop the well-documented "impostor" syndrome with its accompanying fear of eventually being "found out." This insecurity shows up in several ways. In spite of objective data indicating that women in graduate school have academic backgrounds comparable to their male peers, a significantly higher percentage of women in the Stanford survey [8] reported that their preparation for graduate school was inadequate. In the MIT survey [10], women students reported more difficulty in acquiring research skills. Whether these self-assessment reports are true or represent women students who downgrade their capabilities is not clear from the data. The reports could also be related to the student's interactions with her research adviser. In some cases the process of acquiring research skills may be unconsciously set up for women to fail: women may be given too much help on easy skill-building problems (because it is perceived that they cannot do the work alone) and then are left to flounder on the more difficult problems. In the Stanford survey, 82% of the men and 73% of the women reported being satisfied with their programs; 72% of the men and 61% of the women reported that they believed they were progressing as well as other students [8].

For the women students themselves, as well as the departments in which they study, some serious attention to these issues is warranted. Objective discussions between adviser and student about the academic background required to undertake certain lines of research should take place, and ways to fill in any weak areas should be identified. Discussions of the expectations of the department for graduate student performance beyond the classroom, identification of objective criteria that should be met on the way to independent research, and some specific attention to methods of acquiring research skills are suggestions to deal with these issues.

Studies of objective evaluations of the potential and the accomplishments of women give quite discouraging results. Such studies in which male or female names are applied to résumés, proposals, and papers that are then evaluated by both male and female evaluators consistently show that the potential and accomplishments of women are undervalued by both men and women, relative to the same documents with a male attribution [12-15]. I believe that graduate admissions officers are aware of this and attempt to correct for it in the admissions process, but I would be surprised if individual, hard-pressed faculty were immune from this behavior.

Lower expectations by an adviser, whether conscious or unconscious, are quickly perceived by the student. This perception may occur more often with women students, who need additional feedback because of their tenuous position. The student surveys show that women meet less frequently with their research advisers; a smaller percentage of women than men meet weekly; a larger percentage of women than men report meeting rarely with their advisers. Also, more women report that these interactions with faculty do not provide helpful feedback on their research progress. There seem to be qualitative differences in the type of feedback that some women students are looking for. To quote one woman from the MIT survey [10]: "My adviser tells me whether it's right, not whether it's important." Women reported less frequently than men that they felt free to disagree with their advisers or that their ideas were respected by their advisers [8]. The issue of barriers to effective communication needs to be examined by both advisers and their women students.

Many faculty socialize extensively with their graduate students through sports and informal get-togethers and may unintentionally leave out their women students or even suggest that they are unwelcome at such gatherings. Women students often conclude that this is a direct reflection of the quality of their research [10]. Perceived lowered expectations lead directly to a loss of self-esteem and over time to a lower performance — a self-fulfilling prophecy. Women students give their advisers a great deal of power in assessing their ability, and women are apt to internalize and validate their perceptions of this assessment.

On all of the questions in the Stanford survey designed to elicit the level of self-confidence in the academic setting, the women students scored consistently, and in some cases alarmingly, lower than the men: 30% of the women versus 15% of the men questioned their ability to handle the work; 27 versus 12% found criticism difficult to accept; only 30% of the women versus 57% of the men felt confident speaking up in class; and 33 versus 9% feared that speaking up would reveal their inadequacies [8]. In view of the importance of the hidden agenda that uses structured professional experiences to elicit independence in the student, some significant fraction of the women students is less equipped to seek out, to engage, and to profit from these experiences. Explicit attention to structuring positive professional experiences for all graduate students will improve the environment for women students.

In the Stanford survey, more women (20%) than men (6%) reported never having had major responsibilities within their research group [8]. In both the Stanford and MIT surveys, women reported less opportunity to publish, or less frequently being the first author on publications [8,10]. However, these results differed across departments, with the most encouraging results obtained in those departments that had high percentages of women students.

Environmental Issues

Women graduate students report being subject to inappropriate treatment by faculty and student colleagues. Inappropriate treatment in the context of graduate school is any treatment that emphasizes the student as a woman first and a student second. It is any treatment that stresses the social nature of the interaction rather than the professional or educational nature [12-16]. Many women students report the necessity to continually fend off such inappropriate behavior in order to be allowed to concentrate on the professional issues of graduate school. This continual need to respond to such treatment can seriously interfere with the self-esteem and productivity of women graduate students [15].

Even today, there are still a few faculty members in science and engineering who publicly, or in discussions with faculty colleagues, take the position that women do not belong in graduate school. These individuals are at the least tolerated and seldom publicly challenged by their colleagues. Female graduate students quickly become aware of such feelings; although such actions cannot be attributed to an entire department, one wonders how such behavior can be tolerated in a university environment. It is particularly unfortunate if the individual involved would otherwise be the most appropriate adviser for the student on the basis of the student's research area.

Studies of group meetings involving men and women reveal that women are at a disadvantage with respect to male norms in groups [12-16]. Women are interrupted by men much more frequently than are other men. A woman's contributions are often ignored or attributed to one of the men in the group. Many women students report discomfort at the combative style of communication within their research groups. Studies of men and women in group situations reveal differences in their modes of communication and tension in their intersexual interactions [12-16]. Men often feel comfortable with a communication style that seeks to reduce one of the protagonists to rubble in the course of a scientific discussion. After the storm is over, they quickly forget about the incident. For many women this style of interaction is unacceptable, either as giver or receiver. A woman student may take weeks or months to recover from such an interchange, and it may contribute to a permanent loss of self-esteem. Women report that a process in which points are won only at the expense of putting someone else down is to them an unacceptable mode of scientific debate. They are looking for a mode of interaction that is other than a zero-sum game.

Women students report being much less satisfied with the information available from departmental channels on issues such as the structure of qualifying exams and financial support policies. They also report not being as well integrated into the student network (where copies of past exams, for example, can be obtained). For access to such resources, the acceptance of women students as colleagues by their male peers is essential.

A disturbing percentage of women in the MIT survey reported that their gender is a significant barrier to access to academic resources [10]. The quantitative results ranged from 16 to 30% across the various departments in the School of Science. This was true even in those departments where women students had high self-esteem. In the Stanford survey, 13% of the women (compared to 1% of the men) reported that the sex of their adviser had a negative impact on them; 40% of the women (compared with 30% of the men) reported having had some negative experience with faculty members, whereas 20% of the women (versus 7% of the men) reported experiencing some form of discrimination [8].

Women students have raised some fundamental issues about the quality of graduate education for all students. The continued dropoff in the percentage of B.S. degree holders who eventually attain the Ph.D. may be related directly to the current environment seen by graduate students. If we are to escape the projected dramatic decrease in the number of graduate students, some improvement in graduate education for all students is necessary.

With respect to improving the environment for women students, an increased sensitivity on the part of faculty to the seriousness of women as professionals and the willingness of faculty to structure the research environment to enhance self-esteem and provide positive professional experiences are the most important features. A willingness by the faculty to publicly challenge professional colleagues who make prejudicial or inappropriate remarks about women students would improve the climate. An

effort by faculty to make the group interaction a positive-sum game for all students, while being no less insightful and scientifically critical, would enhance the graduate experience. The positive comments on the student surveys by both men and women reported the beneficial effects of such an educational environment. Such suggestions, if more widely followed, would improve the professional and human climate of our graduate schools for all students.

References and notes

1. *Human Talent for Competitiveness*. NSF 87-24, National Science Foundation, Washington, DC, 1987.
2. *Professional Women and Minorities: A Manpower Data Resource Service*. Commission on Professionals in Science and Technology, Washington, DC, ed. 7, 1987.
3. *Professional Women and Minorities: A Manpower Data Resource Service*. Commission on Professionals in Science and Technology, Washington, DC, ed. 6, 1986.
4. B. M. Vetter, personal communication.
5. *Summary Report, 1985 Doctorate Recipients from United States Universities*. National Research Council, Washington, DC, 1986.
6. *Demographic Trends and the Scientific and Engineering Workforce*. Office of Technology Assessment, Washington, DC, December 1985.
7. *Changing America: The New Face of Science and Engineering*, interim report of the Task Force on Women, Minorities, and the Handicapped in Science and Technology. Washington, DC, June 1988.
8. L. T. Zappert and K. Stanbury, "In the pipeline: A comparative analysis of men and women in graduate programs in science, engineering, and medicine at Stanford University." Working Paper 20, Institute for Research on Women and Gender, Stanford University, Stanford, CA, 1984.
9. "Report of the 1986 graduate student survey." Academic Projects and Policies Committee of the Graduate Student Council, MIT, Cambridge, MA, November 1986.
10. "Survey of graduate students." Presidential Committee on Women Students Interests, MIT, Cambridge, MA, 1987.
11. K. Arnold, "Retaining high-achieving women in science and engineering." AAAS Symposium on Women and Girls in Science and Technology, University of Michigan, Ann Arbor, July 1987.
12. "The classroom climate — a chilly one for women." Project on the Status and Education of Women, Association of American Colleges, Washington, DC, 1982.
13. "The classroom climate revisited: Chilly for women faculty, administrators, and graduate students." Project on the Status and Education of Women, Association of American Colleges, Washington, DC, October 1986.
14. R. M. Hall and B. R. Sandler, "Out of the classroom: A chilly campus climate for women?" Project on the Status and Education of Women, Association of American Colleges, Washington, DC, 1984.
15. J. K. Ehrhart and B. R. Sandler, "Looking for more than a few good women in traditionally male fields." Project on the Status and Education of Women, Association of American Colleges, Washington, DC, January 1987.
16. M. P. Rowe, "Hypotheses about the effects of subtle discrimination at work and in education." MIT, Cambridge, MA, 1986.

CIES PROGRAMS

The Council for International Exchange of Scholars has announced the opening of competition for 1991-92 Fulbright grants in research and university lecturing abroad. The awards for 1991-92 include about 1000 grants for periods ranging from three months to a full academic year. There are openings in over 100 countries and, in many regions, the opportunity exists for multicountry research. Fulbright awards are granted in virtually all disciplines, and scholars in all academic ranks are eligible to apply. Applications are encouraged from retired faculty and independent scholars. Application deadlines vary from June 15, 1990 to January 1, 1991, depending on type of award.

The Indo-U.S. Subcommittee on Education and Culture is offering twelve long-term and nine short-term awards for 1991-92 research in India. These grants will be available in all academic disciplines except clinical medicine. The application deadline is June 15, 1990.

For more information and application forms for Fulbrights or Indo-American Fellowships, write to Council for International Exchange of Scholars, 3400 International Drive, Suite M-500, Washington, DC 20008.

DON'T GIVE UP ON TORONTO

by Chandler Davis

Maybe women mathematics students have figured the University of Toronto as a chilly environment for them to do Ph.D. studies. I wouldn't blame them. The number of tenure-stream women professors has never been higher than one — the present figure — since I've been here: 28 years. (It can't go much higher soon, at best, because we have trouble getting authorization to make any new appointments at all.) There are fine women mathematicians in tenure stream at the University, you understand. Some in Computer Science, one in Statistics, two in Economics — real mathematicians, but consistently not in the Department of Mathematics. Finding a woman mathematician to hire has seemed to be a task the cognate departments could do better than ours could. This gives an appearance of an unwelcoming attitude.

It's true, but it's not true.

The true part is that it wasn't just bad luck that women just happened to turn down our offers. No, it's true that we didn't make many offers to women in those 28 years; much fewer than some of us wanted. It's true that there was no effective affirmative action policy to counteract the feet-draggers. You'd conjecture, seeing this sorry record, that sexist preconceptions have sometimes been expressed explicitly around the Department. I'm afraid that's true too.

But on the other hand, a few of our male professors actively supported programs to encourage school girls to go into mathematics; a number of us went out of our way to encourage those women who *did* enter our community, as temporary professors, post-docs, and students. A woman graduate student who made a point of finding a supervisor she could work with could have a good experience here — ask Marta Pojar, Carol Kitai, Asia Weiss, Nina Zorboska, or some of the others.

Some women are still finding the courage to study in this apparent male bastion, though I wouldn't blame a woman who chose another Canadian math department, most of which have much more equal sex ratios than ours. But our female percentage among graduate students is still lower than the percentage of women among North Americans *completing* Ph.D. work (24%). We could use more.

This is a broadcast appeal to women aiming to become mathematicians; please pass the word. We'd really like to have you apply here. Your application will be read by a sympathetic committee. There are enough potential supervisors that you will surely be able to find a congenial one. Honest. And if after you get here you find you want to agitate against U of T's sexism, some of us will welcome you all the more.

SEX EQUITY HANDBOOKS

Two important handbooks in the field of sex equity will be reprinted through a special grant from the Carnegie Corporation. The *Handbook for Achieving Sex Equity Through Education* edited by Susan Klein and the *Sex Equity Handbook for Schools* by David and Myra Sadker are considered classics in the field of sex equity. A limited number will be made available at no charge to organizations that plan to use them the most effectively.

The Carnegie Corporation, an organization committed to equity and excellence in education, has financed the publication of these handbooks because they are such widely acclaimed tools for educators working towards eliminating the barriers of sex discrimination. The *Handbook for Achieving Sex Equity Through Education* is a major reference book for educators interested in understanding sex equity in a wide variety of contexts ranging from early childhood to social studies education. The *Sex Equity Handbook for Schools* is a practical guide designed to help teachers avoid common patterns of sex-stereotyping and sex discrimination in their classrooms. The book will include a newly updated resource directory, a thorough compilation of organizations, materials and resources for achieving sex equity in education.

Organizations wishing to receive free copies of these valuable publications may do so by stating how they plan to use them effectively to support sex equity and how they will encourage others to purchase copies of the handbooks. For more information write: Carnegie Project for Sex Equity, School of Education, University of Massachusetts, Room 124 Furcolo Hall, Amherst, MA 01003.

FROM OTHER PUBLICATIONS

"1989 Annual AMS-MAA Survey (First Report)", Report on the 1989 Survey of New Doctorates by Edward A. Connors, *AMS Notices*, November 1989

Highlights

1. 904 doctorates in the mathematical sciences were awarded by U.S. institutions in the period July 1, 1988 through June 30, 1989. This is a 12% increase over last year and an 18% increase over the average of the fall counts for the last four years.

2. 411 U.S. citizens received doctorates in the mathematical sciences. This is only 46% of the total awarded by U.S. institutions, however.

3. 24% of the U.S. citizen doctorates were awarded to women. This is the largest percentage ever and a significant increase over the 20 to 21% awarded in the last six years.

4. Although women comprise 24% of the U.S. citizens receiving doctorates, only 16% of the new doctorate hires in the U.S. doctorate-granting departments were women.

5. 9 of the 411 U.S. citizen doctorates were black, 7 of whom were women. Black women account for 7% of the doctorates awarded to women U.S. citizens.

6. Median starting salary for new doctorates reporting teaching (or teaching and research) employment was \$30,500 (men) and \$31,000 (women).

Concluding Remarks

We view with guarded optimism the small increase in the number of U.S. citizens receiving doctorates in the mathematical sciences. It is encouraging to note the increase in the number of women among the new doctorates, but it remains to be seen if this gain can be sustained. Perhaps the proportionately large number of women new doctorates hired by the Group B departments, the wellspring of American mathematics, will result in larger numbers of women enrolling in graduate programs (35% of the new doctorates hired by Group B departments were women). [Ed. note: looking for the silver lining in the hiring-pattern cloud?]

"More Women Are Earning Doctorates in Mathematics, but Few Are Being Hired by Top Universities" by Judith Axler Turner, *The Chronicle of Higher Education*, December 6, 1989, pp. A13-A15

The report from the *Notices* quoted above was the taking-off point for this article in the *Chronicle*. 24 percent of the doctorates went to American women, but only 16 percent of the hires of new Ph.D.'s by Ph.D.-granting departments were women. "The discrepancy between women's achievement in mathematics and their recognition in academe comes as no news to women mathematicians and scientists."

Several familiar voices from AWM are quoted. Here are a few excerpts:

...Alice T. Schafer remembers that the principal of her high school wouldn't give her a recommendation for a scholarship in 1932 because mathematics was one of her preferences, and the principal believed that "girls don't do math."

Says Lida K. Barrett, president of the Mathematics Association of America and dean of the college of arts and sciences at Mississippi State University: "If you assume women can't do mathematics, the professors don't expect as much; they don't pay attention to the student in class; they don't encourage women to go on."

Ms. Barrett thinks the discrimination stems less from misogyny than from elitism. These institutions, she says, "tend to hire one another's graduate students," and produce very few women Ph.D.'s. "It's a self-perpetuating problem," she says.

Rhonda J. Hughes, chairman of the mathematics department at Bryn Mawr College, says that when a female student sees that women on the faculty don't get tenure, "it's a terrible message for young women."

"Mathematicians are decent types," says Bryn Mawr's Ms. Hughes, "but sadly, mathematics is still very much a man's world."

"Growth in Number of Woman Ph.D.'s Termed a 'Blip'," *The Chronicle of Higher Education*, December 6, 1989, p. A14

A long-time trend watcher calls the increase in the proportion of Ph.D.'s in mathematics awarded to women this year just a "blip" in the demographic records.

"Although the number of women in mathematics and sciences climbed very rapidly both numerically and in percentages for about a decade, between 1982 and 1986 it leveled off, and by 1987

it started to drop in every field," says Bette M. Vetter, executive director of the Commission on Professionals in Science and Technology. The commission collects and distributes data on the work force in scientific and technical fields.

Ms. Vetter, who is putting this year's figures into her annual publication, "Professional Women and Minorities: A Manpower Data Resource Service," says the latest [AMS/MAA report] statistics reflect the high numbers of women undergraduates in mathematics before 1987. The decline, she says, will not show up in graduate schools for at least two years.

... [The report is] available for \$85 from the Commission on Professionals in Science and Technology, 1500 Massachusetts Ave., NW, Suite 831, Washington, DC 20005.

"Mathematics Is Beautiful" by Rószta Péter, translated by Leon Harkleroad, and "Rószta Péter: Recursive Function Theory's Founding Mother" by Edie Morris and Leon Harkleroad, *The Mathematical Intelligencer*, Vol. 12, No. 1 ©1990, Springer-Verlag New York

Rószta Péter's "many contributions to mathematics deserve much greater recognition than they have received," to quote from the second of the two articles named above. The publication of these articles should help remedy that defect by bringing these contributions to the attention of a wide audience. The biographical article details Péter's many contributions to mathematical logic.

Péter's article is a translation of an address that she delivered to high school teachers and students in 1963 in Rostock, German Democratic Republic. She begins, "I am here to pass on my belief that mathematics is beautiful." She succeeds admirably. As any who have read *Playing with Infinity* will know, she is an excellent expositor and math educator. Her account of working on the greatest common divisor with a class of twelve-year-old girls is alone worth the price of the magazine.

MSEB ANNOUNCES 25 AWARDS FOR PLANNING STATE MATHEMATICS COALITIONS

On November 20, 1989, the Mathematical Sciences Education Board (MSEB) of the National Research Council announced awards of approximately \$10,000 each to 25 organizations for the planning of state mathematics coalitions. Funded by a major grant from the Exxon Education Foundation, and with additional support from the Carnegie Corporation of New York, these awards constitute the first phase of a project to establish mathematics coalitions in each state and the District of Columbia. Over the next decade, these coalitions will use national standards to guide state and local programs to improve mathematics education.

States in which planning grants have been awarded for 1989-90 are: Arizona, California, Colorado, Georgia, Idaho, Illinois, Kansas, Kentucky, Louisiana, Massachusetts, Missouri, Montana, Nebraska, New Hampshire, New Mexico, Ohio, Oregon, Rhode Island, South Carolina, Utah, Vermont, Washington, West Virginia, Wisconsin, and Wyoming.

The state grant directors met in Denver, Colorado, in February to hear reports of current activities in mathematics education reform and to examine the results of recent studies on how coalitions can guide change in education. The meeting was hosted jointly by the MSEB and the Education Commission of the States.

The formation of state mathematics coalitions to reinvigorate school mathematics nationwide is an MSEB priority. The coalitions are designed to promote state and local actions that will move curriculum, instruction, and assessment toward the goals proposed earlier this year in *Everybody Counts*, published by the National Research Council, and *Curriculum and Evaluation Standards for School Mathematics*, published by the National Council of Teachers of Mathematics.

In a joint statement issued in September, President Bush and the nation's governors emphasized the need for "clear, national performance goals" that reflect the views of all persons having a stake in education. The joint statement, which in pointing to the need for "a major state-by-state effort to restructure our education system," asserted that the first step toward such reform requires broad-based consensus on national goals. MSEB State Mathematics Coalitions Project Officer Robert J. Kansky says, "The 25 state mathematics coalitions to be initiated by these awards are a means for taking the 'first step' identified by the president and governors. They are designed to bring together educators,

business representatives, and developers of public policy for the purpose of 'thinking nationally but acting locally' in developing mathematics programs tailored to state and local needs."

State mathematics coalitions objectives include helping to communicate the specifics of proposed changes in mathematics education, stimulating development of state goals compatible with national ones, and promoting adoption of policies which foster long term improvement. Coalition participants represent three constituencies: education, the public policy arena, and the corporate sector.

The MSEB State Mathematics Coalitions Project began with four regional meetings held from May through July, 1989. At these meetings, 128 leaders from 45 states discussed the goals and structures of the proposed coalitions, identified key coalition activities, and outlined procedures for seeking grants through the MSEB. The Minnesota Mathematics Mobilization, the only state mathematics coalition in operation prior to the MSEB project, served as a model of a successful alliance.

Starting in 1990, the MSEB also hopes to offer funding for implementation grants to support first year activities of established State Mathematics Coalitions. These multi-year grants would provide diminishing MSEB support each year. The State Mathematics Coalitions eventually will be supported entirely by non-MSEB funding sources.

For more information about the MSEB State Mathematics Coalitions Project, contact Robert J. Kansky, Senior Project Officer, Mathematical Sciences Education Board, 818 Connecticut Ave., N.W., Suite 500, Washington, DC 20006.

OF POSSIBLE INTEREST

"Women and the Elements: The Role of Women in Element and Fission Discoveries" by Joseph Spradley of Wheaton College, IL, appears on pages 656-662 of the December, 1989 issue of *The Physics Teachers*.

Gender and History. Journals Marketing Manager, Basil Blackwell, Three Cambridge Center, Cambridge, MA 02142.

Thinking Gender, a new series. Routledge, an imprint of Routledge, Chapman and Hall, Inc., 29 W. 35th St., NY, NY 10001.

DEADLINES: Mar. 24 for May-June, May 24 for July-August, July 24 for September-October

AD DEADLINES: Apr. 5 for May-June, June 5 for July-August, August 5 for September-October

ADDRESSES: Send all Newsletter material except ads and book review material to Anne Leggett,

Dept. of Math. Sci., Loyola Univ., 6525 N. Sheridan Rd., Chicago, IL 60626.

email: cantor!borel!alm@gargoyle.uchicago.edu \$L\$MA24@LUCCPUA (bitnet) FAX: 312-508-2282

Send all material regarding book reviews to Cathy Kessel, 3141 Lewiston Ave., Berkeley, CA 94705.

Send everything else, including ads, to Tricia Cross, AWM, Box 178, Wellesley College,

Wellesley, MA 02181. email: PCROSS@LUCY.WELLESLEY.EDU

ADVERTISEMENTS

All institutions advertising in the AWM NEWSLETTER are **Affirmative Action/Equal Opportunity Employers**. Institutional members of AWM receive two free ads per year. Please see the statement of **Advertisement Guidelines** at the end of this listing. Ads must be prepaid by check or P.O. Institutions are listed in alphabetical order.

FACULTY POSITIONS

Antelope Valley College. F/T, 10-mo, tenure-track, Mathematics Instr. pos avail. Start Aug 23, 1990, Deadline Mar. 30, 1990. Salary \$26,572-\$38,241 dep on ed & exp. Master's req. Load 15 lecture-teach hrs or equiv. incld eve cls. Excellent fringe benefits. Contact Linda Millner, Office of Human Resources, Antelope Valley College, 3041 West Avenue K, Lancaster, CA 93536, 805/943-3241, ext. 255.

Bowling Green State University. The Dept. of Math and Statistics invites apps for a tenure-trk. Asst. Prof. pos. in Stats., beg. Aug. 15, 1990. PhD degree, promise of strong research and evidence of quality teaching background req'd. The duties of the successful app incl. teaching 2 courses/sem. and active participation in research and seminars. The pos. is supported by the Academic Challenge Grant to the stats. prog. Academ. yr. salary range is \$35,000-\$38,000 depending on exper. and quals. App deadline: Mar. 20, 1990 or until suitable candidate is found. Send credentials (vita, 3 letters of ref. and an official transcript) to Dr. H.S. Al-Amiri, Chair, Dept. of Mathematics and Statistics, Bowling Green State University, Bowling Green, OH 43403.

Case Western Reserve University. Dept. of Math and Stats. Tenure-trk., possilby sr., pos. anticipated to beg. Aug. 15, 1990. Outstanding research record and/or proven research potential and teaching excellence req'd. Pref'd areas: Stats. and Prob. The recently est'd CRWU Center for Stochastic and Chaotic Processes in Sci. and Tech. will provide and esp'ly friendly envir. for probabilists doing theoretical research motivated by serious apps. Interacting particle systems, stochastic control, pop. genetics, random media and infinite dimen'l stochastic processes (Malliavin calc. and stochastic PDE) are good examples here. The statisticians are expected to work within an autonomous Appl'd Stats. unit. Visiting pos. also possible. Send vita plus 3 letters of rec. to: Prof. W.A. Woyczynski, Chairman, Dept. of Mathematics and Statistics, Case Western Reserve University, Cleveland, OH 44106.

Central Washington University. Apps invited for 9/90 tenure-track asst/assoc professorship in Math Ed. Req'd: recent doctorate in math ed or math (candidates with substantial progress toward doctorate considered); demonstrated teaching strength; exper. as teacher or student in teacher prep. progs. Desired: elementary or secondary teaching exper.; exper. using computers in learning situations; acquaintance with trends in teacher ed and public school curric. Salary open. Send app letter, resume, grad coursework description, and names/addresses/telephone numbers of three profess'l refs to: W.F. Cutlip, Chairperson, Mathematics Dept., Central Washington University, Ellensburg, WA 98926. Screening starts Mar. 12.

Clark University. Four jr.-level pos, one to three yrs, non-tenure track. PhD in math or comp. sci., plus good research and teaching credentials desired. Ability to teach comp. sci. courses req'd for one of the 3-yr. pos. Pref'd research areas are those that fit in with departmental interests: Theoretical Comp. Sci., Artificial Intell., Group Representations, Algebraic number theory, Knot theory & Low Dimen. topology, Diff. equations, Topos Theory. Send vita and 3 letters of rec. to John F. Kennison, Clark University, Dept. of Math and Computer Science, Worcester, MA 01610. Apps rec'd by Mar. 20, 1990 are assured of full consideration.

College of St. Catherine. Full-time temp. pos. starting Fall 1990 with the possiblity of a future renewable 3-yr. term. Candidates must be able to teach all course in the comp. sci. minor and, possibly, some math courses. Masters degree in comp. sci. is pref'd; PhD/MS in math with exper. in teaching comp. sci. considered. Excellence in undergrad teaching is essential; scholarly activity is encouraged. Teaching load is 6 courses/yr. Rank and salary dependent upon quals. and exper. Send letter of app, resume, and transcripts and have 3 letters of rec. sent to Sister Adele Marie Rothan, Chair, Dept. of Mathematical Sciences, College of St. Catherine, St. Paul, MN 55105. Consideration of aps will begin 15 Feb. 1990.

DePaul University. Apps are invited for a tenure-track pos. at the asst. prof. level beginning in Sept., 1990. A PhD in Math is req'd. Strong candidates in any field of research will be considered. Strong commitment to teaching is essential. The official teaching load is 9 qtr. courses/yr., but a reduction to 7 qtr. courses/yr. for research is possible. App should send a vita and 3-4 letter of rec, at least one of which pertains to teaching, to Hiring Committee, Dept. of Mathematics, 2219 North Kenmore, Chicago, IL 60614.

Ferris State University. The Dept. of Mathematics has avail. one-yr. teaching pos., contingent on funding. Apps should have a Master's degree in Math or Math Ed with demonstrated excellence in college teaching. An Ed Master's degree with emphasis in developmental math is welcomed. Responsibilities incl. teaching in the area of the first 2 yrs. of undergrad

math. Send resume, transcripts, and 3 letters of ref. to: Dr. Robert Kosanovich, Dept. of Mathematics, Ferris State University, Big Rapids, MI 49307.

Florida Atlantic University. Sr. Pos. in Mathematics. Candidates should have an est'd research record and proven ability to attract external research support as well as interest in building a strong research group. Salary is competitive; teaching load does not exceed 2 courses/sem. Areas of research interest in the dept. incl. Algebra, Analysis, and Combinatorics. The dept. anticipates filling several jr. pos. in the next 3 yrs. The new sr. person of the dept. will be expected to play a major role in the new PhD prog. Apps from all fields are invited, but pref. will be given to those candidates whose interests would enhance and complement existing research strength. Apps will be accepted until Mar. 31. Send a letter of app and a vita with descr. of research interests, and arrange for at least 3 letter of rec. to be sent directly to: Senior Search Committee Chairman, Dept. of Mathematics, Florida Atlantic University, Boca Raton, FL 33431.

Florida Atlantic University. Apps are invited for 2 tenure-track pos. at the Asst. Prof. level beg. Aug. 1990. Candidates must possess a PhD, a strong commitment to research, and demonstrated teaching ability. Salary is competitive. Apps will be accepted until Mar. 31. Send a letter of app, a detailed resume with descr. of research, and ask 3 people to send letter of rec. to: Recruiting Committee Chairman, Dept. of Mathematics, Florida Atlantic University, Boca Raton, FL 33431.

Frostburg State University. Mathematics/Actuarial Science. F/T, Ten. trk., Asst./Assoc. Prof., Fall 1990. Teach 12 cr. undergrad math per sem., incl. upper level actuarial math. Give direction to new actuarial science majors. Master's degree & undergrad math teaching exper., exper. in actuarial sci., & at least 1 actuarial exam passed, req'd. Doctorate, Assoc. Actuary in CAS or SOA, pref'd. Rank & sal. commens. with credentials & exper. Teaching exper. & quality of teaching of prime concern. Pos. avail. pending final approval by the legislature of Maryland. Direct questions to: Dr. Richard Weimer, Dept. Chair, 301-689-4377. Send letter of interest, resume, transcripts & 3 letters of rec., by 3/31/90, to: Mr. C. Douglas Schmidt, Dir. of Personnel Servs., Frostburg, MD 21532.

Lehman College (City University of New York). Tenure-track pos. anticipated in math and comp. sci. Candidate must have an earned doctorate, a strong commitment to teaching and a demonstrated outstanding research potential. Rank and salary commensurate with quals. Send resume and names of 3 refs. to: Prof. Robert Feinerman, Chairman, Dept. of Mathematics and Computer Science, Lehman College, Bronx, NY 10468.

Lewis and Clark College. Portland, OR 97219. New tenure-track pos. beg. Sept. 1, 1990. Apps should have PhD in either math or CS and masters level competency in the other, exper. in teaching undergrads, strong commitment to the liberal arts, and interest in research. Individual hired will have major respon. for building a CS prog. within the Math Dept. This incl. course and curric. devel. and helping to hire at least one add'l tenure-track faculty. Candidates with PhD in CS and exper. in undergrad CS prog. devel. pref'd. Teaching load is 2 courses/qtr (10 hrs/wk). Send letter indicating goals and interests, resume, and 3 letters of rec. to: Roger B. Nelson before Feb. 12, 1990.

Mankato State University. Dept. of Mathematics, Astronomy, and Statistics, Mankato, MN 56002. One-yr. fixed-term pos. Rank/salary dependent upon quals. Master's degree req'd. This pos. involves coordinating and teaching foundation courses. Apps must have strong interest in teaching at freshman level and show evidence of successful teaching at secondary/post-secondary level. Teaching load at most 36 qtr. hrs./9-mon. academic yr. Successful candidate will teach courses in math, coordinate grad asst. teaching, assist with student advising, and serve on various departmental committees. App deadline is April 1 or until filled. Send app letter, vita, teaching interests, and 3 letters of ref. to F.T. Hannick, Chairperson, MSU Box 41.

Massachusetts Institute of Technology. C.L.E. Moore Pure Math Instructorships and Applied Math Instructorships. Open to mathematicians with doctorates who show definite promise in research. Teaching loads are 6 hrs/wk one semester, 3 hrs/wk the other, or other combinations totalling 9 hrs. Appts. are for 1 yr., renewable for 1 add'l yr. Please send (a) a vita; (b) a descr. of the research in your thesis; and (c) the research which you plan for next yr. to: Dept. of Math, MIT, Rm. 2-236, Cambridge, MA 02139.

Massachusetts Institute of Technology. The Dept. of Math may have several appts. at the Asst. Prof. level for 1990-91. These appts. will be for 3 yrs., and the teaching load will be 6 hrs/wk one semester and 3 hrs/wk the other, or other combination totalling 9 hrs. Open to mathematicians with doctorates who show definite promise in research. Apps please send (a) a vita; (b) descr. of your research; and (c) your research plans for next yr. to: Pure Mathematics Committee or Applied Mathematics Committee (depending), Rm. 2-236, Dept. of Mathematics, MIT, Cambridge, MA 02139.

Michigan Technological University. One tenure track and several visiting positions starting Sept. 1990. PhD req. May also have an instructorship; M.S. req. Send CV, 3 rec. letters to Recruitment Committee, Dept. of Math. Sciences, Michigan Technological University, Houghton, MI 49931.

Michigan Technological University. Dept. of Mathematical Sciences is seeking a director for the Fluids Research Oriented Group (F.R.O.G.). F.R.O.G. is an interdisciplinary group, involving Dept. of Math Sci, Mechanical Engineering,

and Chemical Engineering, engaged in an active program of research in Fluid Mechanics. This position will carry an appt. as Associate Prof. or Prof. Candidates should have an active research record in Fluid Mechanics or Computational Mathematics. A good funding record and experience with PhD students is required. The position starts September 1990. Send CV, 3 rec. letters to: Recruitment Committee, Dept. of Math Sci, Michigan Technological University, Houghton, MI 49931.

Michigan Technological University. Invites apps and nominations for the position of Dept. Head. Department offers B.S. and M.S. degrees and is developing a PhD program. We have a strong commitment to research, especially in Applied Mathematics, and to excel in undergrad ed. Seeking a distinguished senior mathematician to further develop and enhance our program. Send CV, 3 rec. letters to: Head Search Committee, Dept. of Math Sci, Michigan Technological University, Houghton, MI 49931.

Moorhead State University. Mathematics Dept. Moorhead, MN 56563. Tenure-track pos. at rank of asst. or assoc. prof. to begin Sept. 1990. A PhD in math, stats, or math ed is req'd. Candidates in all fields of math are encouraged to apply, however, pref. will be given to apps who are qualified through coursework or exper. to teach math content and methods courses for elem. and secondary ed. majors. Successful college teaching exper. is desirable. Duties incl. teaching undergrad courses in math and stats, advising students, univ. and dept. committee work and other profess'l activities as appropriate. First screening of apps on Feb. 15, 1990. Apps accepted until filled. Apply to Milton Legg, Chair, Mathematics Dept.

North Carolina State University. Dept. of Mathematics, Raleigh, NC 26695-8205. A pos. of lecturer is avail. beg. Aug. 1990. The primary duties will be to conduct honors problem sessions in calc. for selected freshman students. The pos. reqs. a creative indiv. whos is committed to excellence in instruction and is also able to motivate students. The quals. are nominally a PhD in math, however a highly qualified indiv. with a master's degree in math will receive serious consideration. Apps should submit a resume and arrange for 3 letter of ref. to be sent to Prof. E.E. Burniston. Completed apps rec'd by May 1 will receive full consideration.

Northeastern Illinois University. Tenure-track pos. at the Asst. Prof. level starting 9/1/90. PhD in math is req'd. An interest in the training of teachers of math is a plus. Must be an effective teacher, have excellent communication skills, exhibit scholarly achievement, and show a commitment to curric. devel. Salary competitive. Screening begins 3/5/90 and continues until pos. is filled. Send letter of app, vita, and names and addresses of 3 refs., at least one concerning teaching, to Dr. Richard Reichhardt, Dept. of Mathematics, Northeastern Illinois University, 5500 N. St. Louis Ave., Chicago, IL 60625.

Northern Michigan University. The Mathematics and Computer Science Dept. invites apps for an anticipated temp. pos. at the rank of Asst. Prof. All specialties welcome - math, math ed, stats, and comp. sci. A commitment to teaching is an essential req. for the pos. Scholarship and profess'l activity are both encouraged and supported. Apps should send a resume, transcripts, and 3 letters of ref. to Dr. Terrance Seethoff, Head; Dept. of Mathematics and Computer Science; Northern Michigan University; Marquette, MI 49855.

Rhode Island College. Two positions available: Mathematics Education tenure track position, specific qualifications available from the Rhode Island College Personnel Office. The second position is a 3-year term position in Mathematics/Computer Science, specific qualifications available from the Rhode Island College Personnel Office, Providence, RI 02908.

Russell Sage College. Fall '90 opening for an Assist. Prof. in Mathematics. The successful candidate will have an earned doctorate in math or math ed, excellent communications skills and dedicated to teaching in the undergraduate curriculum. Teaching experience and an interest in education of prospective teachers and computer science are highly desirable. Salary commensurate with experience. Applications received before 4/1/90 will be given precedence. The search will remain open until position is filled. Submit application materials to: John Hammer, Mathematics, Russell Sage College, Troy, NY 12180.

Santa Clara University. Dept. of Mathematics, Santa Clara, CA 95053. G.L. Alexanderson, Chair. One or more tenure-track openings in math. Asst./Assoc. Prof. level, beg. Sept. 1990. PhD req'd; area of specialization open. Dept. emphasizes excellent teaching and continuing research commitment from faculty. Undergrad teaching only; seven courses/yr. on the qtr. calendar.

Simon Fraser University. The Dept. of Mathematics and Statistics invites apps for a tenure-track pos. in math at the Asst. Prof. level starting Sept. 1, 1990 or as soon thereafter as feasible (this pos. is subject to final budgetary approval). Apps will be expected to have completed a PhD degree at the time of appt. and to have demonstrated a strong teaching and research potential. Apps should have research interests in the areas of Algebra and/or Discrete Math. Apps, incl. vita, should be sent to: Dr. A.R. Freedman, Chair, Dept. of Mathematics and Statistics, Simon Fraser University, Burnaby, BC V5A 1S6 CANADA. Please arrange for 3 letters of ref. to be sent directly from the referees. The deadline for app is April 30, 1990. This ad is directed in the 1st instance to Canadian citizens and permanent residents of Canada, however, other qualified persons are encouraged to apply.

State University of New York, Albany. Dept. of Mathematics and Statistics, Albany, NY 12222. Two tenure-track pos. to begin in the Fall of 1990 are anticipated. One will be at the jr. level, with the rank of the other pos. open. A PhD

in math or stats. and strong commitment to excellence in teaching and research are req'd. Apps should provide a vita and have at least 3 letters of rec. sent to Timothy Lance, Chair. Pos. are open until filled.

State University of New York, Binghamton. Dept. of Mathematical Sciences invites apps at all levels for an unexpected opening. Sr. apps must have an outstanding research record. Jr. apps must show great research promise. All areas, incl. stats. and mathematical comp. sci. will be considered. Vita and letters of rec. should be sent to: David L. Hanson, Chair, Dept. of Math. Sciences, SUNY-Binghamton, Binghamton, NY 13901. Screening of apps will begin Mar. 15, 1990.

State University of New York, Stony Brook. The Depts. of Mathematics and Applied Mathematics and Statistics are pleased to announce that they have a joint fellowship prog., for U.S. citizens and perm. residents, funded by the Dept. of Ed's GANN prog. These fellowships carry an academ. yr. stipend of \$12,000 plus tuition. In addition to the GANN Fellowships, both depts. have teaching and research assistantships and fellowships, w/academ. yr. stipend ranging fr. \$9,000 to \$11,000 plus tuition. Summer support is also avail. For further info., and/or app forms, call or write: Graduate Studies Dir., Dept. of Appl'd Math and Stats, SUNY Stony Brook, Stony Brook, NY 11794-3651. Telephone: (516) 632-8282.

University of California, Berkeley. Temp. Postdoctoral Pos. Dept. of Mathematics, University of California at Berkeley, Berkeley, CA 94720. Several temp. pos. beg. Fall 1990 are anticipated for new and recent PhD's of any age, in the areas of algebra, anal., appl'd math, foundations, or geom. and topol. The terms of these appts. may range from 1-3 yrs. Apps for NSF or other postdoctoral fellowships are encouraged to apply for these pos.; combined teaching/research appts. may be made for up to 3 yrs. Those whose research interests are close to those of reg. dept. members will be given some pref. Send by April 1, 1990 a resume, and reprints, preprints and/or dissertation abstract. Ask 3 people to send letters of rec. to Andrew J. Casson, Vice Chair for Faculty Affairs at the above address. (Apps for our earlier Jan. 15, 1990 deadline will automatically be considered for this deadline also.)

University of Tennessee, Chattanooga. Apps are invited for the pos. of Mathematics Dept. Head. PhD in math sci. w/previous admin. exper. desired. The Head should provide leadership in curric. devel. and support for teaching and scholarship. The faculty is expected to exhibit excellence in teaching while maintaining a strong commitment to research and public service. Send apps w/vita and 3 letter of ref. to: Dr. Paul L. Gaston, Dean, College of Arts and Sciences, 119 Holt Hall, UTC, Chattanooga, TN 37403. Those rec'd before Mar. 1, 1990 will be given pref.

University of Vermont. Pos. for appl'd mathematicians, tenure-track or visiting. Salary and rank commensurate w/ability and exper. Demonstrated excellence in research and teaching, interaction w/other scientists and engineers. Also, postdoctoral pos. in subjects of current dept. interest. Send vita, descr. of research, and 3 letters of ref. or names of refs. to Kenneth I. Gross, Personnel Committee, Dept. of Mathematics and Statistics, University of Vermont, Burlington, VT 05405

Ursinus College. Anticipated opening, Fall 1990. Tenure-track pos. at the Asst. Prof. level. PhD desired and req'd for tenure. Three courses/sem. teaching load, full range of courses in the math sciences. Salary open. Standard fringe benefits. Send app and 3 letters of rec. to Nancy Hagelgans, Chairperson, Dept. of Mathematics and Computer Science, Ursinus College, Collegeville, PA 19426. Good teaching refs. essential.

Wayne State University. Dept. of Mathematics, Detroit, MI 48202. Bertram M. Schreiber, Chair. Apps are invited for 2 tenure-track Asst. Prof. pos. Priority will be given to candidates whose research interests interact with our groups in algebra, anal., appl'd math, combinatorics, prob., topology, and stats. One tenure/tenure-track pos. in the area of stats. and/or prob. theory. Also possible visiting pos. Excellence in research and teaching expected. Apps should incl. a detailed vita, description of current research and 3 letters of rec.

York University, Glendon University College. Dept. of Math. Apps are invited for a tenure-tk. appt., at the Asst. or Assoc. Prof. level, beg. July 1, 1990. The candidate must be fluent in French and in English, and will be req'd to teach in both languages. The candidate should hold a PhD in Math w/research interests and publications in complex anal. and should have a strong teaching record in English and French. The pref'd candidate should also have exper. in the teaching of appl'd math courses (eg, oper. research, regression anal., etc.) Duties will incl. undergrad teaching and the possibility of grad teaching. Salary is determined in accordance w/the current collective agreement. Deadline: April 1, 1990. Send apps (incl. complete curric. vita) and arrange to have 3 letter of ref. sent to Prof. Jean-Claude Bouhenc, Chair, Mathematics Dept. Glendon University College, York University, 2275 Bayview Ave., Toronto, Ontario, M4N 3M6, CANADA. This ad is directed first to Canadian citizens and perm. residents.

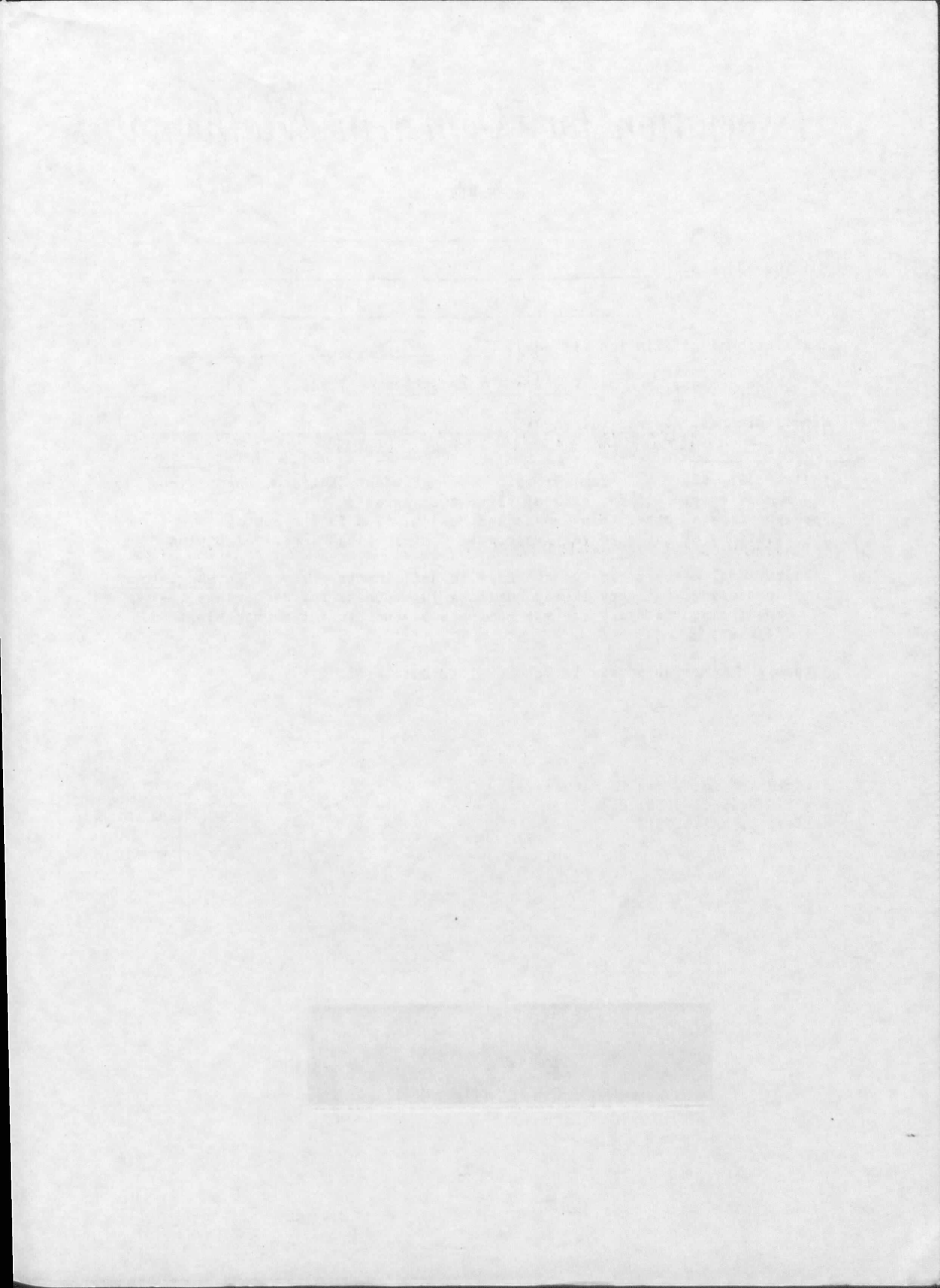
Position of Interest

Mankato State University. Apps are invited for the pos. of Dean of the College of Natural Sciences, Mathematics, and Home Economics. Persons in this pos. provide leadership to the College whose disciplines incl. the Biological Scis., Chem., Geology, Comp. Sci., Home Ec., Math, Astron., and Stats. Quals. incl. a doctoral degree in an approp. academ. field, proven effectiveness in teaching and research, and demonstrated admin. ability are req'd. Add'l qual. incl. active participation in curric. and profess'l issues and a commitment to provide leadership in the areas of scholarship, research, devel., external relations, and equal oppor. and affirm. action. This is a 12-month admin. pos. Salary is competitive and will be commen. w/qual. and exper. Apps must incl. a resume and the names and addresses of 3 current refs. Apps or noms. to: Dr. Richard A. Croftis, VP for Academic Affairs, Mankato State University, MSU Box 43, Mankato, MN 56002-8400. (507)389-1333. Review of apps will begin Feb. 19, 1990. Date of appt. will be as soon after July 1, 1990 as possible.

ADVERTISEMENT GUIDELINES

AWM will accept advertisements for the AWM 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.**

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