Association for Women in Mathematics

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> ## In Memoriam: Louise Hay
> ## 1935 - 1989

PRESIDENT'S REPORT

For those of you who have not yet heard, I am sad to report that Louise Hay died on October 28 after an extended illness. Louise was an active and dedicated member of the AWM. All of us who knew her and had the opportunity to work with her will miss her. Her article "How I became a mathematician," which was published in the September-October 1989 issue of this newsletter, seems, in retrospect, a farewell gift to us. Elsewhere in this newsletter you will find some reminiscences from those who knew her well. The 1990 Emmy Noether Lecture will be dedicated to Louise Hay's memory and delivered by Bhama Srinivasan, her colleague at Chicago Circle.

The AWM office has moved from one tiny room in the Simpson Infirmary at Wellesley College to a two-room suite in Waban House, one of the original properties of the college. Tricia Cross describes her new quarters as much more functional and spacious. She now has room for some office equipment and for her part-time assistants. Although we occupy our new space on a year-to-year basis, we did receive a letter from the President of Wellesley assuring us that the college is pleased to have AWM on campus and hopes to continue to provide us with office space.

We recently received a $2000 contribution from the MAA towards the endowment of the Alice T. Schafer prize. I would like to thank the MAA Board of Governors for helping us to encourage undergraduate women to continue their studies in mathematics. The first prize will be awarded in the Spring of 1990, and we are currently accepting nominations. I am also pleased to say that we have been awarded a one-year grant of $30,000 from EXXON to support the development of a resource center at the AWM office at Wellesley. The grant will be used to develop and upgrade the brochures we distribute from our office; to purchase software for desktop publishing, database management, and word processing; and to help with some of the start-up administrative costs. We are also hoping to get some funding to upgrade our hardware so that we can better manage our membership records and begin to collect and analyze data relevant to women in the mathematical sciences.

Judy Roitman has accepted our invitation to give an AWM-MAA invited address at the 1990 Joint Summer Meeting in Columbus, Ohio. The lecture is part of the celebration of the MAA's 75th anniversary. I am also working on a jointly sponsored (AWM-SIAM) panel for the 1990 SIAM National Meeting in Chicago.

I was contacted by the media a number of times last month and asked to comment on the poor showing by women in the recent Putnam competition. There was a brief note about this in *Science* which began, "Efforts to get more women into math have a long way to go, judging by the results of

the latest William Lowell Putnam college math contest. Of the 100 winners, only one is a woman."
While I agree that we have a long way to go, I challenge the Putnam exam as the correct measure of
success. Many successful mathematicians never took the Putnam, or did not finish in the top 100. I
don't have statistics, but I would wager that many top 100 hundred finishers do not go on to careers in
mathematics. I would be interested in hearing your views on the subject in the Letters to the Editor
section of the newsletter. Also, if you happened to see me quoted on the subject, I'd appreciate a copy
of the article.

Best wishes for the New Year.

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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.

ALICE T. SCHAFER MATHEMATICS PRIZE

In January 1989 the AWM established the Alice T. Schafer Mathematics Prize in the amount of $1000 to be
awarded annually, beginning in 1990, to an undergraduate woman for excellence in mathematics. All members of the
mathematical community are invited to submit nominations for the Prize, to be awarded in April 1990.

The nominee may be at any level in her undergraduate career. The letter of nomination should include, but not
be limited to, an evaluation of the nominee on the following criteria: quality of performance in mathematics, exhibition
of real interest in mathematics, ability for independent work, and performance in mathematical competitions at the local
or national level if any.

Supporting materials should be enclosed with the nominations. Nominations must be postmarked no later than
March 1, 1990 and sent to Patricia Cross, Executive Director, AWM, Box 178, Wellesley College, Wellesley, MA
02181.

NOTE FROM THE EDITOR: Due to a 9600-baud electronic marvel now sitting on my desk, it has
become almost as easy for me to download files from the mainframe as from the mini. So use
whichever of my email addresses is easier for you. Letters to the Editor, articles, etc., which are sent
via email do not have to be retyped by yours truly, so I encourage this mode of submission (and of
course it's much faster than regular mail).

LOUISE HAY: 1935 – 1989

by Robert I. Soare, University of Chicago, with comments
and corrections by John Baldwin and Richard Larson

Louise Hay, 54, Head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, died October 28, 1989, of cancer. She had been Head since 1980, becoming at that time the only female head of a major research-oriented university mathematics department in the United States. Under her leadership the department strengthened its international reputation and added a strong group in computer science to its prominent mathematics faculty. She had a world-wide reputation for her research in mathematical logic, particularly recursive function theory (i.e., the theory of computable functions), and in theoretical computer science.

Professor Hay was born in Metz, France in 1935 of Polish-Jewish parents, and spent part of World War II as a refugee in Switzerland, before immigrating to New York in 1946. As a high school senior she was inspired by Wolfe's book on non-Euclidean geometry to write a project for the Westinghouse Science Talent Search, in which she won third prize. This led to a scholarship at Swarthmore College, where she earned her B.A. in mathematics in 1956. After two years at Cornell she completed her Master's degree in mathematics under Barkley Rosser in 1959. Before leaving for the summer, Rosser had sketched out for her a program to prove a completeness theorem for a Lukasiewicz inspired infinite-valued predicate calculus. Hay proved a "weak completeness" result and found a counterexample to the main lemma proposed by Rosser. Her husband moved to join the faculty at Smith College, and she temporarily postponed her mathematical career to be with him, taking an instructorship at Mount Holyoke College. Soon her first child was born. After a couple of years she became inspired first by the mathematical beauty of Artin's book *Geometric Algebra* and second by the new career possibilities for women raised in Betty Friedan's book *The Feminine Mystique*. Hay was also influenced by discussions with Hanna Neumann about Neumann's own mathematical career and the challenges Neumann faced during World War II.

In 1963 Hay returned to Cornell to complete a Ph.D. degree in mathematics. A remarkably energetic and dedicated person, she stayed at Cornell for only fifteen months, during which time she took the required graduate courses and Ph.D. examinations, started and completed her dissertation (1965), and had twins in November, 1964. Her dissertation on co-simple isols, written under Anil Nerode in recursive function theory and published in the *Annals of Mathematics*, represented a substantial advance in the Dekker-Myhill-Nerode theory of recursive equivalence types (r.e.t.'s) and isols, since Hay considered the more effective setting of r.e.t's of sets whose complements are recursively enumerable (r.e.). She returned to Mount Holyoke College as an Assistant Professor for three years. After a divorce she moved to an Associate Professorship at the University of Illinois at Chicago in 1968, where she later married Richard Larson, a mathematician at the same institution, whom she described in her recent A.W.M. article as "a very supportive colleague who helped make it possible for me to continue to prove theorems."

During those next few years in Chicago she entered into one of the most productive and creative phases of her career. She rapidly wrote over a dozen papers in recursion theory, mostly dealing with index sets connected with r.e. sets and with differences of r.e. (d.r.e.) sets. She classified the index sets of finite classes of r.e. sets into a sequence of 1-degrees complete for (finite) Boolean combinations of r.e. sets and developed certain sequences of degrees related to the difference hierarchy on the r.e. sets. Similar work was done independently by Y. Ershov (Novosibirsk). Hay's work considerably influenced a number of Soviet mathematicians and earned her high respect in the Soviet Union as well as in the United States. She developed a notion of "weak jump" and proved a jump theorem analogous to the classical jump theorem of G.E. Sacks. Later R. Soare used this weak jump notion in his work on automorphisms of the lattice of r.e. sets and in his abstract computational complexity results on speedable sets. Hay proved analogues of the Rice and Rice-Shapiro theorems for index sets of d.r.e. sets and gave a complete classification for the index sets of open classes determined by finitely many finite sets. With D. Miller she later obtained index set results in descriptive set theory for suitable topological spaces.

With the rapid rise of computer science in the last decade, she turned her attention to problems in the theory of computational complexity theory. With various co-authors, she developed a hierarchy of sets reducible to a fixed set by bounding the number of questions that an oracle machine can make during the computation. With S. Buss she studied the class of predicates which are polynomially time bounded truth table (tt-) reducible to NP (nondeterministic polynomial time) and obtained a number of equivalent characterizations of this class, in particular the surprising result that polynomial time tt-

reductions to truth tables described by Boolean circuits are the same as those described by Boolean formulas.

In 1974 she suffered her first bout with cancer. After an operation she was forced to stay at home for a while, during which time her enormous energy could not be utilized, and she coined the marvelous word "underwhelmed" to describe her feelings. She soon recovered and became acting Head of her department in 1979. In 1980 she was appointed Head for a five-year term, and she began a remarkable career leading her department to distinction. She possessed not only outstanding organizational skills but also, perhaps more importantly, extraordinary interpersonal skills which enabled her to become both an effective and popular Head. She greatly democratized the department and decentralized power, establishing elected committees to deal with such touchy subjects as salary raises. A warm and caring person, she devoted both the time and patience to listen personally to all complaints or problems of her faculty. So effective was her leadership style that she was virtually unanimously elected in 1985 to a second five-year term, which was tragically cut short by a recurrence of cancer in 1988. During her term of office the name of her department changed from "Mathematics" to "Mathematics, Statistics, and Computer Science" reflecting the department's response to the rapid changes in this decade. She made a number of outstanding faculty appointments both in mathematics and in theoretical computer science.

Hay was a member of the Association for Symbolic Logic from 1959 to her death and served as its Secretary from 1977-82. She was keenly interested in encouraging women to enter mathematical careers, and greatly influenced her own graduate students Nancy Johnson and Jeanleah Mohrherr, as well as other mathematics graduate students, including Rhonda Hughes (currently Professor of Mathematics at Bryn Mawr). Her influence extended well beyond graduate students. Hay was a founding member of the Association for Women in Mathematics (A.W.M.) and served on its executive committee from 1980 to 1982. Her article "How I became a mathematician" in the September-October 1989 issue of the A.W.M. *Newsletter* describes the many challenges she had to face. None was more challenging, however, than her battles with her recurrences of cancer, which she fought with her characteristic courage and cheerful spirit.

FOND REMEMBRANCES OF LOUISE HAY

by Rhonda Hughes, Bryn Mawr College

When Louise Hay's article, "How I became a mathematician (or how it was in the bad old days)" appeared in the September-October '89 issue of the *Newsletter*, I promised myself I would write to her to tell her how moved I was by her recollections of a life I felt I already knew rather well from my years as a graduate student at Chicago Circle. Then, on October 30, the sad news came via e-mail from Bhama Srinivasan, "Louise died yesterday." [Note: Louise actually died on October 28.] This should have been that letter, which I shall always regret not writing; it is my attempt to come to terms with her death, at the age of 54, and to put into perspective just what it was about Louise that so profoundly affected me. I leave it to others to chronicle her mathematical contributions to recursion theory, and will focus instead on her role as friend and mentor to so many young women and men at Chicago Circle in the seventies.

I first remember becoming aware of Louise's existence when I was still an undergraduate at Circle. She was one of a few "women research mathematicians" on the faculty, and I remember being impressed, at a distance, by what I saw then as her unusual combination of youth, vivacity, and mathematical reputation. When I became a graduate student, I began to get to know her better. My fondest memories of her, at which she would no doubt be surprised, are associated with countless lunches shared with her and her ever-supportive husband and friend, Dick Larson. She and Dick were always there, while other faculty and graduate students came and went. I learned a good deal about food from them. Coming from the South Side of Chicago, I had rather narrow views and tastes at the time. Louise and Dick ate homemade yogurt and fresh vegetables for lunch; I had Italian beef sandwiches. They introduced me to exotic foods — brown rice, bulghur, tahini — things we didn't eat on the South Side. While I never lost my fondness for Italian beef, I considerably broadened my culinary horizons under their unknowing influence. But what I remember best about those lunches was the talk. Louise loved to converse — to listen as well as to hold forth. Politics, recipes,

childrearing, feminism, mathematics, laughter (there was always laughter if Louise was around). I soaked it all in, and without realizing it at the time, those lunches were a rite of passage for me. Most of the views I hold today were forged then, around that table. They have served me fairly well, and fueled me for the road ahead, which I often found somewhat less congenial than those Circle lunches.

What was it about Louise? She was liberated, confident, intelligent, kind, maternal, funny. Her mutually loving and respectful relationship with her husband was one we admired as a model of professional marriages so unlike the professor/wife paradigm we knew as the norm. I'd never met anyone like Louise before (or since). Shirley Bachrach, an old friend who was department secretary during those years, summed it up simply when she called after receiving news of Louise's death, "Louise was the first feminist I ever met." But her feminism alone could not account for the extraordinary influence she had on me. Her approach to life was very appealing to me; her views felt right, made sense. She enjoyed the company of young people; she was a friend, and because I felt accepted and valued as a person by someone I so respected and admired, the impression she made on me was all the more profound. While she never hesitated to speak out in support of her liberal convictions, against injustice, unfairness, or plain indifference to the needs of others, she had a very positive view of human nature. I never heard her speak ill of anyone, nor did I ever see her become angry (although I imagine she did both). She had enough confidence in her views that she could make her points with humor and grace, but she never compromised her stand to achieve her goals. She never tried to be "one of the boys" (even though she was fully accepted by them). The voice I eventually found, as a woman, a feminist, a teacher, mathematician, and mother, was very much influenced by her substance and style. I only regret that my version lacks some of the good humor of hers.

A quiet turning point in my relationship with Louise came one day during a rather difficult period in my own life. Louise appeared at my office and came in for a woman-to-woman talk. At first, I was a little taken aback. After all, she was a professor, I a graduate student. But from that day on, I felt there was a special bond between us.

To women graduate students, Louise always offered support and encouragement. Inspired by AWM's founding, Nancy Johnson (Louise's Ph.D. student) and I organized the women graduate students and faculty in the department for the general purpose of raising our own consciousness and that of the men around us. We had a huge crowd at our first meeting (those were heady days!), and one woman who had been on the faculty for many years expressed the hope that we wouldn't make waves. "And what's wrong with making waves?" Louise retorted. She always backed our efforts even though, in retrospect, there wasn't that much wrong with what was (and still is) a remarkably enlightened faculty. One day, I mentioned casually to Louise that a woman graduate student with small children was having difficulty arranging a schedule that was compatible with her responsibilities at home. By the next day, the schedule had been changed. When we protested the fact that there had not been a woman colloquium speaker in anyone's memory, Louise gave weight to our cause. Our efforts resulted in memorable visits by Mary Ellen Rudin and Alexandra Bellow. With Louise, we always knew we had a friend in a high place. The knowledge that someone with clout is on your side is all too often a luxury that not enough women graduate students experience. When I speak with young women who feel frustrated and discouraged in graduate school, I realize now why my experience was so much better than theirs.

Louise first became ill in 1974. I remember visiting her at home with some other graduate students, after her first operation. Her spirits were, as always, high, her infectious laugh intact, and she spoke of Dick's being by her side throughout. Her courage in the face of her relentless illness leaves me in complete awe of the depth of her character and her love of life. When I left Circle for Boston in 1975, Louise had Tony and me over for a lovely farewell dinner (Dick cooked a superb meal). With my parents in Chicago, we made frequent visits in the years following. By then, Louise had become department Head, an indication of the esteem her colleagues had for her. No matter how hectic her schedule, she always gave me the warmest of greetings and ushered me into her office for a good chat. "How's Tony, the kids, parents, work?" Louise had a fine sense of humor, and I always left feeling better than when I'd arrived. I remember well our first visit after I became a new mother. I was feeling somewhat overwhelmed and exhausted, and Louise gave me her tips on "European childrearing — my children always slept when I wanted them to sleep!" Somehow, I never quite mastered the American translation of her methods. Louise took great delight in motherhood, as readers of her article well know. She was the best kind of role model — totally natural, open, and honest. She did not try to paint pretty portraits of a smooth-running home life. I loved her description of the parade of sometimes less-than-ideal babysitters her sons so admirably survived.

Over the years, Louise's illness recurred several times. She always battled bravely and shrugged off inquiries about her health. She maintained, as far as I can tell, a full schedule and good spirits long after most would have given up. I last saw Louise in Atlanta in January, 1988, when I invited her to speak in the AWM panel discussion "Is the Climate for Women in Mathematics Changing?" As always, Louise was candid and forthright. Professional posturing was not her style. She always seemed to say things you wouldn't hear others say. I can't imagine anyone but Louise paraphrasing Virginia Woolf, " ... women will not achieve equality until they have earned the right to be hacks... not everyone is a genius." In Louise's eyes, there was room for a broad spectrum of mathematical achievement. Perhaps that is why many of us who were at Circle then have remained in mathematics long after good people from better places have gone on to other things.

In recent years, I occasionally called Louise for advice, both personal and professional, which she was always willing to give. In November, 1988, I had what would be my last communication with her. I e-mailed her in embarrassment after being quoted in the *New York Times* Careers column as saying, "Louise Hay was a voice in the wilderness." Taken out of context, it didn't sound like the compliment I had intended. She wrote back, "Never mind about the article. I found it. It's not too bad. Sometimes I do feel like a voice in the wilderness. Will you be in Phoenix?" (I was, but, sadly, she was not.)

Late in 1988, Louise had what would be the final recurrence of her illness. Last summer, in this *Newsletter*, she graciously gave us the moving and personal story of her life as a mathematician, wife, and mother. Through her own words, you have the opportunity to know briefly the woman who has had the most profound influence on my professional and personal development. I wish I'd told her that, but she had much greater rewards, I'm sure. I'm so grateful to have known Louise. She was the first feminist I met, and she was the best. I'll miss her clear voice, and her gentle laughter.

MEMORIAL FUNDS FOR LOUISE HAY

Donations may be made to two funds in memory of Louise Hay. Before her death, Louise established a scholarship fund at the Oak Park/River Forest High School. Awarded to high school women seniors who plan to major in mathematics in college, the scholarship may be used toward tuition for college or for one of the summer mathematics programs. Checks may be made out to O.P.R.F. Scholarship Fund and sent to Richard Deptuch, Mathematics Department, Oak Park/River Forest High School, 201 N. Scoville St., Oak Park, IL 60302. Also, donations may be made to the American Cancer Society, Oak Park/River Forest Unit, Suburban Trust & Savings Bank, 840 S. Oak Park Avenue, Oak Park, IL 60304.

AWM TRAVEL GRANTS AWARDED

The following women were selected in August and November 1989. Congratulations!

Ann M. Castelfranco, University of Minnesota, Workshop on Mathematical Physiology and Differential-Delay Equations, Minneapolis

Erica Flapan, Pomona College, Mathematical Approaches to DNA, Sante Fe, NM

Sylvia Hobart, University of Wyoming, Technische Universiteit, Eindhoven, the Netherlands

Sung-Ock Kim, Providence, RI, Joint Mathematics Meetings, Louisville

Urszula Ledzewicz-Kowalewska, Southern Illinois University at Edwardsville, Conference on Applied Mathematics, Fielpa, Poland

Mary E. Parrott, University of South Florida, The International Conference on Differential Equations and Applications in Biology and Population Dynamics, Claremont, CA

Tamar Schlick, New York University, The Second Biennial Workshop on Molecular Mechanics and Molecular Dynamics, Florida State University

Lori A. Thombs, University of South Carolina, IMS Joint Eastern Regional Meeting, Baltimore

Roselyn E. Williams, Florida A&M University, Joint Mathematics Meetings, Louisville

AWARDS AND HONORS

Ten UIC faculty members have been named 1989 University Scholars.

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Each University Scholar receives a stipend for three years to support his or her scholarly activities. The money can be used to travel, to hire graduate assistants, to purchase research equipment, or to otherwise further scholarship.

...

Vera Pless, *professor, department of mathematics*

Vera Pless is recognized as one of the world leaders in the theory of error-correcting codes. Such codes were used in the transmission of the recent Voyager pictures from Uranus. They also are used to provide the high-fidelity on compact disc players. She has played an important part in the development of mathematical computer science programs. Professor Pless is the first woman elected to the governing board of the Institute of Electrical and Electronics Engineers. She serves on the editorial boards of three major journals and on the board of the Mathematical Sciences Advisory Panel to the National Security Agency.

Congratulations to Susan Horwitz of the University of Wisconsin. She was awarded a Presidential Young Investigator (PYI) award for her work in programming environments. The awards fund research by faculty members near the beginning of their careers and are intended to help universities attract and retain outstanding young Ph.D. scientists who might otherwise pursue careers outside teaching. She may receive up to $100,000 per year for five years in a combination of federal and matching private funds. The NSF provides base funding of $25,000 and will match private sector funding of up to $37,500.

Congratulations to the following recipients of Mathematical Sciences Postdoctoral Research Fellowships. Institutions in parentheses are the 1988-89 institution; those outside are those at which the fellowship is held. The fellows are: Iris L. Anshel (Columbia University), Columbia University; Elise E. Cawley (University of California, Berkeley), City University of New York, Graduate Center; and Vallorie J. Peridier (Lehigh University), Temple University.

Congratulations also are due to NSF Graduate Fellows. Institutions in parentheses are the undergraduate schools, and those outside are the graduate schools. The fellows are: Meghan Anne Burke (Brown University), Oxford University; Tanya Julie Christiansen (Rice University), University of California, Berkeley; Bethel Ann Fetterman (Pennsylvania State University), University of North Carolina at Chapel Hill; Alyson Rose Gabbard (Rice University), Harvard University; Mary Horn (Pennsylvania State University), University of Virginia; Theresa Mary Hull (St. Olaf College), Cornell University; Nadine Kowalsky (Harvard University), Massachusetts Institute of Technology; Becky Stephens (Bryn Mawr College), Harvard University; Alice Mary Underwood (University of Texas, Austin), Princeton University; and Pamela Hatch Vance (Georgia Institute of Technology), Georgia Institute of Technology.

Next we congratulate the NSF Minority Graduate Fellows. They are Danielle Denise Carr (Beloit College), Duke University and Sonia Ester Marx (Johns Hopkins University), Stanford University.

Seven of the 1989-1990 National Science Foundation Visiting Professorships for Women were awarded to mathematical scientists. These recipients, their institutional affiliation, and the institutions they propose to visit are: Ingrid Daubechies, AT&T Bell Laboratories (NJ), University of Michigan; Ursula Hamenstadt, California Institute of Technology, University of Pennsylvania; Jenny Harrison, University of California, Berkeley, Yale University; Joan P. Hutchinson, Smith College, University of Washington; Linda Keen, CUNY H. L. Lehman College, Princeton University; Joyce R. McLaughlin, Rensselaer Polytechnical Institute, University of California, Berkeley; and Mei-Chi Shaw, University of Notre Dame, University of Wisconsin, Madison.

Congratulations to the principal investigators whose proposals received awards from the National Science Foundation calculus curriculum development program. The project descriptions below were supplied by NSF staff.

Calculus and Computers: Toward a Curriculum for the 1990's, Marcia Linn, University of California at Berkeley, One year, $42,898

This award was used to fund a conference held at U.C. Berkeley this past August. Faculty from a broad spectrum of institutions, including two-year colleges, learned about and exchanged ideas on how to use Mathematica in teaching calculus. The invited speakers and the PIs have been using Mathematica and other integrated symbol manipulation and graphics systems in their calculus courses and described exciting possibilities for their use.

Calculus Redux, Judith H. Morrel, Butler University, One year, $27,000

Students are finding more excitement and making better progress in calculus because of a revised curriculum that emphasizes problem solving, building intuition, and improving written mathematical expression. A data base is being created consisting of non-routine, open-ended, multi-step problems and discussion modules emphasizing concepts, experimentation, and widely varying applications.

Utilization of Technology in Non-traditional Calculus, Wanda Dixon, Meridian Junior College, One year, $25,000

The calculus curriculum is being revised to place more emphasis on learning the concepts, solving realistic problems, and improving estimation skills. Materials are being developed to utilize the HP-28S hand-held calculator.

Collaborative Learning in Calculus, Patricia R. Wilkinson, CUNY Borough Manhattan CC, Two years, $50,000

This collaborative learning project is providing students, especially those from minority groups, a better chance to achieve success in calculus. These students are working in informal study groups with the assistance of specially trained tutors.

BOOK REVIEW COLUMN

Uneasy Careers and Intimate Lives: Women in Science, 1789 – 1979, Pnina G. Abir-Am and Dorinda Outram, editors, foreword by Margaret Rossiter. Rutgers University Press, 1987. 365 pp. ISBN 0-8135-1256-5.
Reviewer: Judy Roitman, University of Kansas

This book is a collection of essays meant to illuminate the interplay between career and private life in the lives of women scientists. Unfortunately, there is very little illumination. Most of the papers in this book are at the bare-bones stage of telling us that yes, there were women in such and such a field, and these were the roles they played. We learn that it helps not to have to do housework, if you must marry, marry someone supportive, and if you don't marry, at least live with someone supportive. Embedded in each essay are the usual horror stories of institutional obstacles, and it is helpful for practicing scientists and mathematicians to be reminded of how the professionalization of our fields had, as an immediate effect, the further marginalization of the already marginalized (e.g., women and what few people of color had the opportunity to attempt science) by their exclusion on social grounds from higher education and from the professional societies that became necessary for serious scientific work in the middle of the 19th century.

But the theme of the book is not really developed. The usually excellent scholar Regina M. Morantz-Sanchez, for example, has a paper on women physicians which basically says that some were married and some were celibate and some had women lovers. So what else is new? She, as well as many other authors in this book, points out the importance of supportive women peers, more available in medicine than in many other fields. But I wanted her to say more, to say something unpredictable, and this neither she nor most of the authors here did.

My interest picked up when I came to the biographical studies of individual scientists. Maybe this is because reading *People* is one of my vices. In particular, Ann Hibner Koblitz's excellent study of Sofia Kovalevskaia was one of the few essays that discussed how any of the scientists actually felt about their children and the way they were being taken care of, and one of the few essays that didn't seem to be a string of platitudes. Pnina Abir-Am's essay on Dorothy Wrinch was also fascinating, not because of its relation to the theme of the book, but because it focused on a scientist who ultimately

failed from being too strongly attached to an idea which was pretty good for its time, but whose time was short. The history of science tends to talk too much about success and not enough about failure.

This was my spring airplane book, and I will admit that I found myself reading many an airline magazine instead. Had I not run out of alternate reading on a very long flight I probably still would not have finished it. Much of my reluctance came from a quasi-socialist bias — while the interplay of public and private is interesting and important, most of these women had many more resources to handle the ensuing conflicts than, say, their cooks and maids and children's nannies (*not* true of the two greatest scientists studied here, Curie and Kovalevskaia, who spent years in extreme poverty). Indeed, the greatest obstacle to many of these women was their acceptance of conventional social roles and internalized limitations. Saying this does not trivialize the issue — it remains one of the most serious barriers to full participation of women in scientific life. But it is a clash of *public* roles, and the underlying terminology of this book obscures the nature of the problem, making serious discussion nearly impossible, and condemning the authors to cataloguing life patterns, rather than clarifying the difficult issues at hand.

Symmetries of Culture: Theory and Practice of Plane Pattern Analysis by Dorothy K. Washburn and Donald W. Crowe. Seattle, WA & London, UK: University of Washington Press, 1988. 312 pp., illustrations, appendices, bibliography, index. ISBN 0-295-96586-X, LC 87-27924. $40.00 + $2.00 p/h. Toll-free ordering: 1-800-441-4115.
Reviewer: Claudia Zaslavsky, New York, NY

My first reaction to this beautiful production was, "Can this be a mathematics book?" True, it has flow charts and symbols, but the overwhelming impression is of hundreds of stunning photographs representing the cultures of many peoples, ranging from ancient Egyptian painted tomb ceilings to contemporary Pueblo pottery, and including such artists as Escher.

My second reaction also concerns the photographs — many of the objects depicted here were produced by women. Although gender is rarely mentioned in the text, and few artists are cited by name, we know that in many cultures it is the women who do pottery, basketry, beadwork, embroidery, quilting and weaving. These examples are particularly striking in that folk artists, both female and male, generally work without reference to sketches, layouts, or precise measurements.

The product of years of investigation by Washburn, an anthropologist, and Crowe, a mathematician, the book is addressed primarily to nonmathematicians, to researchers and to students in the humanities and social sciences. The focus is on "the presentation of a mathematically based classification system for nonrepresentational patterns in the plane" [p. 267]. These are the geometric patterns found in textiles, ceramics, basketry, tiling, stonework and wood carving, either as borders or as incidental or overall decorations.

The text explains how repeated patterns in the decorative arts of various cultures can be classified on the basis of mathematical principles, according to the symmetries which generate them. To enable even the mathematically unsophisticated to classify any pattern, the authors have developed a flow chart for each broad classification. The analyst need only answer each of a series of questions by stating "yes" or "no" to determine the correct category for a specific pattern.

The first chapter is a survey of the history and theory of plane pattern analysis. Historically, the subject begins with the creation of repeated patterns in the art of ancient Egypt. The Greeks developed the theory of regular polygons, but it was not until the nineteenth and twentieth centuries that crystallographers and mathematicians worked out a systematic analysis of repeated patterns. Edith Müller, a mathematician, first applied these tools to material culture in her 1944 study of the art of the Alhambra. Others followed in her wake, and the authors describe their contributions.

The late nineteenth century also witnessed an upsurge in interest in design. Machines could stamp and weave repeated patterns, and these had to be put into some kind of order. At the same time, the material culture of many peoples was filling museums and requiring classification. Unaware of the work in crystallography and mathematics, authors published books and encyclopedias in which they proposed various classification schemes, described briefly in this chapter.

In recent decades the disciplines have joined hands to bring a common system of classification and notation to the field. For example, a chemist and a craft expert collaborated to write two articles on traditional Hungarian needlework, published in the *Journal of Chemical Education* [Istvan Hargittai & Georgyi Lengyel, 1984 and 1985].

The principles of symmetry have proved to be a useful tool in anthropological research. In 1942 George Brainerd, an anthropologist, analyzed the pottery of the prehistoric Anasazi (U.S. Southwest)

and the Maya of the Yucatan (Mexico), showing that each culture has certain preferred symmetry types and that the same motif may be used in different ways by different peoples. A few years later the geologist Anna O. Shepard published a landmark monograph explaining the general method of symmetry analysis in anthropology, a work which received but little attention for almost thirty years. Meanwhile others in the field were discovering these principles on their own, each person engaging in a process similar to "reinventing the wheel." Hence the tremendous value of *Symmetries of Culture*. As the authors state, "the success of this more recent research has prompted us to present the method in a more uniform and complete handbook format so that others can avoid a lengthy process of discovery and self-instruction" [p. 14]. The authors are too modest. This "handbook" is itself a work of art!

After a brief discussion of the symmetries of the plane and of their combinations, we read about symmetry as a factor in perception. Although important advances have been made in the field of psychological research on the processing of visual information, most studies are flawed in two respects: they fail to "define symmetry, much less test for preference among the different symmetries of patterns in the plane" [p. 26], and they fail, further, to control for cultural differences. However, all studies show that the recognition of symmetry is a universal aspect of perception.

A review of the literature demonstrates that each cultural group shows a preference for certain categories of symmetries. Both California basket makers and Lao women weavers, for example, identified patterns that they considered correct on the basis of the arrangement of the elements. Patterns from other cultures that consisted of the same arrangements, but using different motifs, were also said to be appropriate, while those that employed different ordering systems were pronounced "bad" or "unknown." Over time, the preferences of any group may change to include other types of arrangements. These shifts can often be correlated with the introduction of new technology (e.g., the wide loom) or of new ideas from other cultures, thus providing clues to interactions with neighboring or distant peoples.

In sum, the "analysis of design structure by the symmetries which generate the pattern is a replicable, objective way of describing pattern arrangement. Since pattern arrangement appears to reflect culturally meaningful patterns of behavior, then a systematic way of describing and studying this arrangement should be the first order of business for the archaeologist or any other investigator studying design. This analytical tool not only isolates an attribute which has been shown to be culturally significant, but also measures it systematically [p. 34].

While the first chapter justifies the book as an aid to art historians, archaeologists, and anthropologists, the subsequent chapters deal with the mathematical analysis of symmetries, illustrated by flow charts, schematic drawings, and a wealth of photographs and drawings of objects in museums and elsewhere. Mathematical proofs are relegated to the appendices. The twelve-page bibliography seems to include almost every work on this subject worth mentioning.

Chapter two explains the mathematical principles and terminology necessary for the analysis of symmetry. All the figures under discussion are assumed to lie in the plane. A motif in the plane may be repeated by any one of four rigid motions (also called symmetries, isometries, or distance-preserving transformations): 1. reflection (in a line in the plane), 2. translation, 3. rotation (about a point in the plane), 4. glide reflection. Each of these motions is carefully explained and illustrated, both by diagrams and by examples in art. As the authors note, non-mathematical discussions of the subject of symmetry, such as those described in the first chapter, generally recognize only bilateral symmetry (reflection or mirror symmetry), the most popular type.

Additional terminology is introduced: finite vs. infinite; design and pattern; one- and two-dimensional patterns. When only one color is considered, there are exactly seven one-dimensional and seventeen two-dimensional classes of patterns. The authors wisely consider several cases that might cause confusion.

The next section explains the mathematical notation that identifies each design or pattern. This topic may be daunting to a non-mathematician, particularly since other authors have introduced different notations. Referring to the schematics of the seven one-color one-dimensional patterns, the four symbol notation pxyz is interpreted as follows: p: always the first letter for a translation; x: m (mirror) for a vertical reflection, 1 otherwise; y: m (mirror) for a horizontal reflection, a for a glide reflection, 1 otherwise; z: 2 for a half-turn (180° rotation), 1 otherwise. For example, pma2 identifies a pattern having a vertical reflection, a horizontal reflection, and a half-turn. The mirror lines and the centers of rotation are indicated on the diagrams. Notation and schematics for one-color, two-dimensional patterns complete the chapter.

In a similar fashion, chapter three discusses the seventeen two-color classes of one-dimensional patterns and the forty-six two-color classes of two-dimensional patterns.

Chapter four introduces flow charts for the one- and two-color patterns in one dimension, and chapter five does the same for two-dimensional patterns. To make it all perfectly clear, an example of each of the eighty-seven types is "keyed out" according to the relevant flow chart. Then follows an analysis of a varied and striking collection of additional examples — ancient Peruvian cloth, Kuba (Zaire) wood carvings, modern Pueblo bowls, Maori painted wood rafters, a Japanese coverlet, Persian tiling, eighteenth century French embroidery, to name just a few. Schematics and drawings, well marked with lines of symmetry, centers of rotation, and directions of translation, make it easy for the reader to follow the steps in the analysis.

Finite design is the subject of chapter six. Early in the book the authors define a finite *design* as one which has at least one type of symmetry, but admits no translations or glide reflections. A *pattern*, on the other hand, has translation symmetry, and theoretically, might extend infinitely in one or two dimensions. After working through the previous chapters, dealing with the analysis of patterns, the reader will have no difficulty with chapter six. Here we are concerned only with reflections and rotations and whether colors are preserved or reversed by each motion.

Chapter seven, aptly titled "Problems in Classification," contains some of the most exciting and varied examples. No wonder the analyst might have trouble in classifying them. Here is a woman's blouse from Guatemala, with a whole conglomerate of patterns. A nineteenth century Japanese silk brocade staggers the imagination, as does an elegant Peruvian burial mantle dating back over two thousand years.

The chapter concludes with a discussion of irregularities in the design, whether placed at regular intervals or in a more arbitrary fashion. Such irregularities are not mistakes, although they may seem so to us, accustomed as we are to machine-produced perfection. These irregularities may have religious, esthetic, or informational significance of which the outsider is unaware.

The book is timely. An interdisciplinary symposium on symmetry took place in August 1989 in Budapest, Hungary. Participants included mathematicians, artists, architects, anthropologists, musicians, crystallographers, brain researchers, practitioners in engineering and applied sciences, philosophers; in short, people in any field in which symmetry or asymmetry plays a role.

A genius must have done the layout for the book. On no occasion did I have to turn a page in order to correlate the text with the relevant illustration.

As prices go these days, the book is a great bargain. Whether it is used as a basis for an interdisciplinary course or just to decorate a friend's coffee table, this beautiful 8-1/2 × 11" book is well worth the cost. The authors are to be congratulated on their achievement.

Book Review Editor:

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EDUCATION COMMITTEE COLUMN

Sally I. Lipsey, chair
report by Regina Baron Brunner, Cedar Crest College, Allentown, PA

Are you making plans for Math Education Month and Math Awareness Week? Do these include special plans for encouraging women in mathematics? The following article describes a Math Awareness Day (MathConn) aimed at girls in grades 7 and 8, which took place in April, 1989. MathConn 89 will be used as a model for a similar program in April, 1990.

The purposes of Math Conn 89 (a Mathematics Awareness Day at Cedar Crest College) were to stimulate interest in math-related careers for girls in grades 7 and 8 and to help teachers of those grades enhance their teaching skills and deal with the current technology explosion. MathConn is a "grass-roots" effort to reach the girls and their teachers. It aims to increase the number of girls in local math classes at present and in math-related careers in the future. It also provides an opportunity for teachers to attend sessions on innovative teaching techniques and to interact with each other informally.

MathConn 89 consisted of two separate programs, one for students and one for teachers, held from 8:30 A.M. to 2:00 P.M. MathConn 90, scheduled for April 4, 1990, will be modeled on MathConn 89.

The schedule for students involved an introductory session, followed by a small group panel session and a problem discovery session. At the panel session, groups of 24-28 seventh and eighth grade girls met informally with two women in successful math-related careers. The jobs held by the eight panelists were the following: teacher, market research analyst, software engineer, district accountant, director of technical development, advisory systems engineer, independent computer consultant, and statistician. Thus the girls were exposed to a variety of math-related jobs.

At the Mary Ellen Rudin Problem Discovery Session, the girls were put in teams of four from different schools. Each team included both public and non-public school members and both seventh and eighth graders. The problems were put in five categories: computation, patterns (the theme for Mathematics Awareness Week activities), logic, geometry, and variable arithmetic. The problem instrument was developed and designed by local junior high and middle school math teachers. At the close of the day, awards were presented to the outstanding teams in each category.

All 214 seventh and eighth grades girls from 36 schools in Intermediate Units 20 and 21 (a five-county area in east central Pennsylvania) heard two world-renowned women mathematicians give keynote addresses. Dr. Linda R. Petzold, the Group Leader of the Numerical Mathematics Group at Lawrence Livermore National Laboratory, spoke on what a numerical analyst does. Then Dr. Lilian Shiao-Yen Wu, an operations research specialist at IBM T. J. Watson Research Center, gave two examples of modeling problems in population dynamics and in planning. Afterwards, in the early afternoon, the girls had lunch and participated in one of three activities: a statistics lesson using computers, a VCR demonstration of the future of computers, or a presentation of high-tech job opportunities conducted by Digital Equipment Corporation.

Concurrently, the sixty teachers had an informal break session after the introductory remarks. They then chose three sessions from the following: using spreadsheets in class; hands-on display of computer software; math in science, statistics, and computers; VCR tapes related to the National Mathematics Awareness Week theme of patterns; math motivators; problems in math education; and the keynote addresses for the students. Over lunch, the teachers heard a keynote address entitled "Pennsylvania's Future Mathematics Testing Program" by Dr. Richard L. Kohr, educational measurement and evaluation supervisor for the Pennsylvania Department of Education.

At the closing sessions, questionnaires were distributed and collected. There was a brief discussion about Mary Ellen Rudin and a discussion of solutions to problems solved in the morning sessions. Awards were given to five teams of four students from a mix of schools.

At dismissal time, every student, teacher, and speaker participant received a T-shirt with the MathConn 89 logo. Also, each student, teacher, and school received various gifts in kind from sponsors of the event.

MathConn 89 was a smashing success. Both the teachers and the students enjoyed the day. The evaluations were extremely encouraging. MathConn 89 will be used as an example by the Joint Policy Board for Mathematics to encourage similar events nationwide for Mathematics Awareness Week in 1990.

READER SURVEY: Please let us know how your institution is observing (or has observed) Math Awareness Week and/or Math Education Month, especially with regard to women students. Thank you. AWM Math Education Committee, c/o Sally Irene Lipsey, 70 East 10th St., #3A, New York, NY 10003.

BLACK WOMEN IN ACADEME: The Project on the Status and Education of Women, Association of American Colleges, 1818 R St., NW, Washington, DC 20009 has produced another interesting report. "This paper explores the climate for Black women students, faculty members, and administrators in both predominantly white colleges and universities as well as historically Black colleges and universities. It focuses on the subtle — and not so subtle — ways that race and gender stereotypes can combine to create double obstacles for Black women." It is available for $5 at the address above; bulk rates are available.

AAAS PRESIDENTIAL LECTURE: VOICES FROM THE PIPELINE (part 1 of 2)

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

The number of white males of college age, who have been the dominant participants in the fields of science and engineering, is predicted to drop significantly in the future. Rapid increases in the participation of women offer some hope of filling anticipated vacancies in the ranks of scientifically trained personnel, although this rapid growth has reached a plateau in many fields. Most studies show that women enter graduate school at about the same rate as men; the dropoff in women's participation occurs sometime before the attainment of the Ph.D. Recent surveys of graduate students indicate that men and women respond differently to the pressures of graduate school and often have a different image of themselves and of their advisers' perceptions of them as graduate students. Some clues from these results may show how the environment can be made more supportive for all students, and for women and minority students in particular.

As President of AAAS I have chosen the opportunity of the presidential lecture to discuss an issue in which I have been involved since the early 1970's — during a time of rapid increases in the number of women studying for scientific and technical careers. I have been actively involved in encouraging women to enter such careers and in helping to reshape the institutions in which these women find themselves. The issue of the full participation of women in science is at the very heart of the question of who will do science in the years ahead.

Demographic trends predict a future significant drop in the numbers of white males of college age, who have been the dominant participants in science and engineering. The likely effects of these trends on scientific and engineering personnel have been documented by the National Science Foundation and the Office of Technology Assessment (OTA) of the U.S. Congress. If current participation rates continue, the future pool of science and engineering baccalaureates is projected to show a significant drop [1-4]. We have now passed the peak of U.S. graduate students available from traditional pools and are headed down the slope to a 26% decrease in the pool by the late 1990's. What is hidden in these statistics is that the percentage of minority students in this age cohort will increase substantially. Since this group is currently underrepresented in science and engineering graduate programs, a projection based on the current participation of various groups would show even a more severe drop in the production of scientifically trained personnel at the Ph.D. level.

In addition, the percentage of B.S. degree holders in science and engineering who attain the Ph.D. degree has fallen from about 12 to 6% over the past 20 years [1]. In engineering, the number of Ph.D.'s obtained by U.S. citizens per year fell by more than 50% between 1970 and 1984 [5], and at present more than 50% of Ph.D.'s in engineering awarded each year go to foreign nationals [1]. In science, the actual number of Ph.D. degrees awarded to male U.S. citizens has continually tended downward since 1970 [1]. Increased competition between industries and universities for the reduced number of B.S. degree holders will likely occur. Indeed, this competition is evident already in engineering and is a major reason for the significant decrease in U.S. students attaining the Ph.D. in engineering.

These issues have provoked a number of responses from the scientific and education communities. The importance of precollege science and mathematics education for all children, with special emphasis on disadvantaged groups, has been stressed. The possibilities of influencing career choice at various decision points have been discussed. The climate for B.S. students in science and engineering has received much attention, as has the issue of discrimination in the workplace and its effect on career choice. Projecting future work force needs and availability is difficult, since slight changes in the participation rates can cause large swings in the data. Nonetheless, on the basis of current information, the composition of the graduate school population can be expected to change dramatically over the next two decades.

One of the most important offsetting trends in the projection of rapid decreases in scientifically trained personnel has been the rapid increase in the participation of women across all fields of science and engineering [2]. This trend offers some hope of filling anticipated vacancies in the ranks of

scientifically trained personnel, although this rapid growth began to plateau in many fields after 1985. There has also been a correspondingly rapid increase in the percentage of women in law, medical, and graduate business schools: women now make up 40% of the students in law school and 34% of the students in medical schools, and they receive 31% of M.B.A. degrees [2].

An OTA report [6] presented the pipeline issues for women students in the natural sciences and engineering relative to that of men in a dramatic way. The report described an initial cohort of 2000 male and 2000 female students at the ninth grade level. Of that original cohort, only 1000 of each group will have sufficient mathematics at the ninth grade level to remain in the pipeline. When the two groups are followed to the end of high school, 280 men and 220 women will have completed sufficient mathematics to pursue a technical career. A major drop in women students occurs with career choice upon entering college, with 140 men and 44 women choosing scientific careers. After a career choice is made, a larger percentage of women than men actually complete their intended degree in science and engineering: at the B.S. level, 46 men and 20 women receive degrees. Data show that women enter graduate school in the same proportion relative to their percentage of B.S. degrees as do men in the various technical specialties [7]. (The number actually entering graduate school from each cohort is estimated from their current presence in graduate schools since entry data are not available.) However, some combination of attrition and stopping at the M.S. level rather than going on for the Ph.D. creates another major drop for the women students in the pipeline. Of the original 2000 students in each group, five men and one woman will receive the Ph.D. degree in some field of the natural sciences or engineering.

These results suggest that two points of concentration on the career aspirations of women students would be fruitful: at the initial career choice and during the graduate school years. Many studies and projects have been carried out on the point of early career choice; much less has been documented about the environment in graduate school and its effect on degree completion rates.

Beyond the issue of the health of the scientific enterprise and the necessity to make full use of the intellectual talents of all of our population, there is the issue of equality of opportunity for these talented individuals. In addition, we should concern ourselves with the issue of future public support for science on the part of groups who perceive that they have been excluded from full participation in the scientific enterprise. The years ahead may be troublesome for the support of science, and the image of science as a community accessible to all will be important to maintain public support.

Graduate Student Surveys

Several recent surveys of male and female graduate students preparing for scientific and technical careers were carried out at Stanford University [8] and at the Massachusetts Institute of Technology (MIT) [9, 10]. In addition to quantitative detail about differential attitudes, expectations, and experiences of their students, the wealth of comments from students provides considerable insight about the process of graduate education as seen from the student's perspective.

In the Stanford study, graduate students in medicine, science, and engineering were surveyed, with a 54% return rate for a total number of 627 students. The results were presented only for the combined group. The major conclusions of this work were that the women were indistinguishable from the men in objective measures of preparation, career aspirations, and performance in graduate school. They differed significantly in their perceptions of their preparation for graduate study, in the pressures and roadblocks that they experienced, and in the strategies that they developed for coping with these pressures.

Graduate students at MIT were surveyed both by the Graduate School Council [9] and by the presidentially appointed Committee on Women Students Interests [10]. Both surveys covered all of the departments in the institute. More than 1600 questionnaires institute-wide were returned in the first survey. Within the School of Science, 476 student questionnaires were returned in the second survey. The MIT surveys reinforced the conclusions of the Stanford survey. In addition, in both of the MIT surveys, the results differed widely across departments, including responses to questions focused on the academic environment for women students. Whether these distinctions are due to differences in fields, the different percentage of women students in the various departments, the personality of the departments, or specific policies and practices that a department uses to provide information and academic guidance to the students is not clear. However, the survey results indicate that for departments with a poor environment for women students, a few specific measures might lead to considerable improvement for all students.

Nationally, women enter graduate school at about the same rate as men relative to their presence in the B.S. pool [2]. The career aspirations of women in the Stanford survey were the same as those of the men. Objective measures of their academic achievements and potential indicate that the entering women students were as qualified for graduate work as the men. Men in the Stanford survey scored slightly higher on the math section of the Graduate Record Examination, whereas women scored higher on both the verbal and the analytical portions of the exam and had a higher undergraduate grade point average. The grade point averages of the male and female students as graduate students were essentially the same [8]. As a group representative of only a fractional percentage of the cohort of females of their age, statistics of large groups or preconceived ideas about their specific interests, attitudes, aptitudes, or commitments cannot be applied.

The drop-off in women's participation in scientific careers after the B.S. degree seems to coincide with the lower rates of attainment of the Ph.D. I have been unable to identify comprehensive studies of attrition from graduate school in science and engineering, but available data suggest that women often stop at the M.S. degree rather than continuing to the Ph.D. and that many more women report serious consideration of dropping out of graduate programs. Anecdotal information suggests that they do drop out at a higher rate than the men. Also, data indicate that a larger percentage of women students is to some extent self-supporting [2]. Within a given field, there is a direct correlation between male-female differentials in self-support and differentials in the time required to attain the Ph.D. degree. (The disparity in self-support is even greater for blacks [5].)

Graduate Education and Research

Education can be seen as a continuum, a progression from the development of career-related skills in a preset curriculum to the achievement of autonomous professional capabilities. However, it is at the graduate level that the student begins to function as an independent scientist — indeed, that is the purpose of graduate education. Ideally, graduate education should proceed from an explicit set of tasks — acquiring advanced skills through courses, preparing for and passing a set of qualifying exams to demonstrate mastery of one's field, and carrying out technical work under the close supervision of a faculty advisor — to the development of independence in the student. During this process the faculty gradually begins to remove the props supporting the student and to place more responsibility on the student for problem formulation, evaluation, execution, and defense. Ideally, as the process occurs, the student has access to a variety of structured professional experiences designed to enhance self-confidence and build independence. These experiences include opportunities to present and defend research results in regular and productive group meetings, to evaluate and criticize the work of peers, to formulate and carry out research tasks of increasing importance, to participate in dialogues and debates about scientific and technical issues, and to discuss future career plans as they relate to current interests and activities.

Faculty members often do not make these latter parts of the educational process explicit to the student. Much of the stress of graduate education results from a lack of student understanding of this hidden agenda. Students who duck such professional experiences because of a lack of self-confidence or because they find them painful are deprived of an important component of the graduate experience. Although they may be successful in achieving a Ph.D., they may not be equipped to take full advantage of the next set of career possibilities, and they are unlikely to be recommended by their mentors for important opportunities in their profession. Attention to how women and minorities are affected by and respond to this hidden agenda will be valuable in developing strategies to allow them to achieve their full potential.

To be successful, the graduate student must run both an academic and a financial support gauntlet. The academic gauntlet is the most explicit. Successful passing of graduate-level courses and various exams by specified deadlines are usually clearly laid out as requirements for the students. Less clear is the issue of financial support, the desirability of various forms, and the leverage that certain modes of financial support give to the success of thesis research and adviser interaction. The task for the student is to find a spot in a functioning research group, work on a topic central to the interests of the group with sufficient financial resources to carry out the research, and work with a faculty adviser who will both supervise the research and guide the educational and future career development of the student. The level of support required for this task is well beyond what is needed to support the student's living expenses.

A fellowship, while providing some flexibility in the beginning of a graduate program, may actually delay the acceptance of the student as a member of a research group. A teaching assistantship,

while providing financial support and interaction with younger students, can also delay acceptance into a research group and offer less time for carrying out independent research. The research assistantship (RA) will facilitate the student's acceptance into a research group, provide a research topic central to the group, and allow access to resources such as equipment and computer time. The fact that a smaller percentage of women graduate students than men in all fields of science are supported as RA's [2] has serious implications for the quality of their graduate education.

Whatever goals the student had when the initial decision to attend graduate school was made, the process itself will continually act to reformulate these goals. The continual testing and trial of one's academic and personal characteristics, the ongoing interaction with peers and supervisors, and the signals picked up about one's relative potential within the research group will reshape the career goals and affect the research productivity and career aspirations of the students. The research opportunities presented by the faculty and the quality of interaction and support will strongly determine the quality of graduate education and the preparation for further career advancement. A reasonable objective for the education of women and minority students is that they have a fair chance to succeed in graduate school; that the feedback loop of lowered expectations based on sex or race, leading to lowered self-image and finally to lower performance, be broken by conscious action by faculty and students; and that the students be aware of the future consequences of career-related decisions.

Because the Ph.D. thesis is primarily an apprenticeship in research, the success of the graduate experience depends on the quality of interaction with the adviser. The adviser is the primary gatekeeper for the professional self-esteem of the student, the rate of progress toward the degree, and access to future opportunities. Problems with the adviser-student relationship are apt to go unreported by the student out of fear of professional reprisals. There are few checks and balances in the system, and the rest of the department faculty can do little to redirect an impaired relationship. Changing advisers after investing several years in research is a traumatic experience for the student, and it is likely to delay receipt of the degree considerably.

Our current method of financing scientific research and graduate education puts considerable stress on both faculty and students. The graduate students are the first in line to be affected by pass-through stress from their research supervisors. The continued search for research funds and the continued high level of professional activity required to remain at the forefront of research make faculty less accessible to students. The graduate education process is labor-intensive, requiring large amounts of faculty time. Students are often aware only of breakdowns in the system: the neglect of the faculty, their inaccessibility, their failure to appear at oral exams, and their occasional unprepared lectures. The current system of support of graduate education makes it impossible for a faculty member to make a commitment of support to the student for the length of a typical graduate program. Gaps in funding are common, and students are often faced with the choice of dropping out or taking on a debt burden to complete their degree.

These familiar facts of life of graduate education are at the heart of much of the stress felt by all graduate students. However, the white male students benefit from the self-reinforcing confidence that "they belong." The self-identification with the predominantly white male faculty reassures them that graduate school is a step on the way to a productive career in science, and that many others with whom they can identify have done it before them. For women students, minority students, and many foreign students, the environment is not as reinforcing. Their acceptance by the system is not automatic. Results from the Stanford survey [8] indicate that 35% of the men compared to 24% of the women were confident of "making it" in their chosen field; 62% of the men, but only 51% of the women, anticipated an academic career.

- (to be continued) -

CONFERENCE AND GRANT OPPORTUNITIES

East-West Scientific Exchanges

The National Academy of Sciences (NAS) invites applications from American scientists who wish to make visits to the U.S.S.R., Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania, and Yugoslavia. A new program of two-week project development visits begins in April 1990. Also, one- to twelve-month research visits during 1991 will be supported. Special emphasis on young investigators is included in each program.

Applicants must be U.S. citizens and have doctoral degrees or their equivalent by June 1990 in physics; chemistry; mathematics and computer sciences; earth, atmospheric, and oceanographic sciences; agricultural, forestry, fishery, and plant sciences; biological sciences; environmental sciences; engineering; archaeology and anthropology; geography; psychology; science and technology policy; and the history and philosophy of science. Projects in the economic and social sciences that involve development of new analytical methodologies will be considered on a case-by-case basis. Necessary expenses will be met by the NAS and the foreign academy, including reimbursement for long-term visitors for salary lost up to a predetermined maximum and expenses for accompanying family members for visits exceeding five months.

Requests for applications should reach the National Academy of Sciences not later than February 15, 1990. Applications must be postmarked by February 28, 1990. Address application requests to: National Academy of Sciences, Office of International Affairs, Soviet and East European Affairs (HA-166), 2101 Constitution Avenue, NW, Washington, DC 20418. (202) 334-2644.

NSF Workshop: Mathematicians and Education Reform Network

An NSF workshop for the Mathematicians and Education Reform Network will be held at the Ohio State University, Columbus, Ohio, March 1-4, 1990. Workshop highlights include: a program to facilitate greater involvement of mathematicians in precollege education projects; focus on planning, development and evaluation for implementing change successfully; presentation of exemplary projects (identifying and educating mathematically talented students, increasing involvement and achievement of minorities and women, integration of math and science, prognostic testing, teacher enhancement); discussions on building faculty and institutional support for educational projects, planning a proposal, issues in math education, and effective collaboration between school teachers and university faculty; and opportunities for establishing networking contacts.

For more information, contact Naomi D. Fisher, Associate Director, MER Network, The University of Illinois at Chicago, Office of Mathematics and Computer Education (M/C 249), Box 4348, Chicago, IL 60680, (312) 996-2439, Bitnet U357158@UICVM.

Call for proposals: 1991 NSF-CBMS Regional Research Conferences

To stimulate interest and activity in mathematical research, the National Science Foundation each year supports eight to ten NSF-CBMS regional research conferences. A panel chosen by the Conference Board of the Mathematical Sciences makes the selections from among the submitted proposals. In the twenty-one year history of this series, a total of 207 such conferences have been supported.

Each five-day conference features a distinguished lecturer who delivers ten lectures on a topic of important current research in one sharply focussed area of the mathematical sciences. The lecturer subsequently prepares an expository monograph based upon these lectures, which is normally published as a part of a regional conference series. Depending on the conference topic, the monograph is published by the American Mathematical Society or the Society for Industrial and Applied Mathematics, or jointly by the American Statistical Association and the Institute of Mathematical Statistics.

Support is provided for about 30 participants at each conference and the conference organizer invites both established researchers and interested newcomers, including graduate students, to attend.

College or universities with at least some research competence in the field of the proposal are eligible to apply, and institutions that are interested in upgrading or improving their research efforts are especially encouraged to apply.

Closing date for proposals is April 2, 1990. For more information, write: Conference Board of the Mathematical Sciences, 1529 Eighteenth St., Washington, DC 20036, (202) 293-1170.

AAUW Grants

Research & Projects Grants offer women the opportunity to work for societal change and self-development through projects, research, or study. R&P Grants are intended to fund new efforts, and as such, may not provide full funding or operational costs for a proposed activity.

Women who hold a baccalaureate degree are eligible to apply for an R&P Grant. Preference for awards is given to AAUW members. Members of the boards, standing committees, panels, task

forces, and staff of the AAUW, AAUW Educational Foundation, and AAUW Legal Advocacy Fund are ineligible to apply for R&P Grants; former AAUW employees are eligible after one year from their last date of employment.

Project RENEW (Career Development) Grants, Public Service Grants, Issue Focus Grants, and Short-Term Project Grants are awarded in this program. The deadline for Project RENEW Grants has passed; for Public Service and Issue Focus Grants, the deadline is February 1; for Short-Term Project Grants, the deadline is September 1. An individual may apply for a grant in at most one of these categories per year.

For more information and application materials, write: Research & Projects Grants, AAUW Educational Foundation, 2401 Virginia Ave., NW, Washington, DC 20037.

OF POSSIBLE INTEREST

Women's Studies:

The Feminist Press, at the City University of New York, 311 East 94 St., New York, NY 10128

University of Illinois Press, 54 E. Gregory Dr., Champaign, IL 61820

Southern Illinois University Press, P.O. Box 3697, Carbondale, IL 62902

Scarecrow Press, 52 Liberty St./P.O. Box 4167, Metuchen, NJ 08840

d/b/a South End Press, 116 Saint Botolph St., Boston, MA 02115

Rutgers University Press, 109 Church St., New Brunswick, NJ 08901

Gordon and Breach Science Publishers, STBS, P.O. Box 786, Cooper Station, New York, NY 10276

Psychology of Women Quarterly, Cambridge University Press, 40 West 20th St., New York, NY 10011

DEADLINES: Jan. 24 for Mar.-Apr., Mar. 24 for May-June, May 24 for July-August
AD DEADLINES: Feb. 5 for Mar.-Apr., Apr. 5 for May-June, June 5 for July-August
ADDRESSES: Send all Newsletter material except ads and book review material to Anne Leggett, Dept. of Math. Sci., Loyola Univ., 6525 N. Sheridan Rd., Chicago, IL 60626.
email: cantor!borel!alm@gargoyle.uchicago.edu or LMA24@LUCCPUA (bitnet)
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

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FACULTY POSITIONS

Albion College. Tenure-track pos. at the Asst. Prof. level in Math Dept. Starts Aug., 1990. Salary competitive; excellent fringe benfits. PhD in math or stats with strong emphasis in appl'd stats. Evidence of excellence in teaching req'd. Direct inquiries to R.C. Fryxell, Chairman, Mathematics Dept. Albion College, Albion, MI 49224, (517) 629-0287. (BITnet address: RFRYXELL@ALBION)

Allegheny College. Mathematics Dept. Meadville, PA 16335. Receiving apps for a tenure-track pos. beg. Sept. 1990. Apps should have a PhD in math, strong commitment to the teaching of undergrad students and to continued profess'l devel. Rank and salary are competitive and commensurate with quals. and exper. Fringe benefits incl. TIAA-CREF, health and life insurance, full tuition benefits for family, and personal computers in faculty offices. Screening of apps will beg. Jan. 4 and continue until the pos. is filled. Send app, vita, grad transcripts, and 3 letters of rec. to Dr. Ronald Harrell, Search Committee Chairman. Early apps should also indicate whether they plan to attend the Joint Math Mtg. in Louisville, KY.

Alma College. Math & Comp. Sci. Dept. Tenure-track pos. beg. Fall, 1990. Candidates should enjoy teaching a variety of undergrad math courses in a liberal arts envir. and working with students on independent projects. PhD in Math is req'd, excellence in teaching is paramount, and the ability to teach some comp. sci. is pref'd. Normal teaching load is 6 courses/yr.; faculty development is encouraged. Salaries are competitive and fringe benefits are excellent. Please send a cover letter addressing scholarly interests, resume, grad transcript, and 3 letters of rec. incl. eval. of teaching ability to: John Putz, Dept. of Mathematics and Computer Science, Alma College, Alma, MI 48801 by Feb. 2, 1990.

American University. Faculty vacancies in Mathematics and Statistics. Two anticipated Asst. Prof. pos. avail. for 1990-91. 1) One tenure-track pos. in math. PhD in math and evidence of strong scholarship req'd. 2) Tenure-track pos. in stats. with pref'd areas being experimental design or stat. computing. PhD in stats. with evidence of strong scholarship and an interest in appl'd stats. req'd. Responsibilities: undergrad and grad teaching, advising scholarship and Univ. services. Competitive salary, commensurate with quals. and exper. Pos . subject to final budgetary approval. Send CV and names of 3 refs. Pref. given to apps rec'd by March 1, 1990. Prof. Basil P. Korin, Dept. of Mathematics and Statistics, The American University, 4400 Massachusetts Ave., NW, Washington, DC 20016.

Arizona State University. West Campus is seeking qualified candidates for the following pos.: Assoc./Asst. Earned doctorate in Ed. with spec. in Math Ed. Interested candidates should send a letter of app, vita, and names, phone numbers, and addresses of 3 refs. to: Dr. David Moore, Chair, Arizona State University West Campus, PO Box 37100, Phoenix, AZ 85069-7100. App deadline is Dec. 1, 1989 or the 1st of each month thereafter until pos. is filled. Interested individuals may write or phone (602) 543-6300 for more info.

Bowling Green State University. Dept. of Math and Stats. announces 2 anticipated pos. Asst. Prof. tenure-track pos. in Math Ed. PhD in Math Ed.; successful writing of grant proposals for external funding desirable; teaching exper. at the elementary or secondary level, or in curric. devel. Responsibilities inc. teaching 2 math courses/sem.; involvement in research in math ed. leading to publication of articles and prep. of proposals for funding from external agencies; participation in seminar activities. The salary range is $30,000-$37,000 for the academic yr. Possibility of summer employment. Starting date: 8/15/90. Assoc./Full Prof. tenure-track pos. in Algebra. PhD in Math, exper. in advising PhD students in algebra pref'd, overlapping interest with the interests of the active algebraists group in the Dept. Responsibilities incl. teaching 2 courses/sem.; involement in research, seminars and directing theses at the PhD level. The salary range is $40,000-$60,000 for the academic yr. Possibility of summer employment. Starting date: 8/15/90. Send credentials (vita, 3 letters of ref., official copy of transcript) to: Dr. H.S. Al-Amiri, Chair, Dept. of Mathematics and Statistics. Bowling Green State University, Bowling Green, OH 43403. Deadline for apps is March 20, 1990 or until a qualified candidate is found.

California State Polytechnic University, Pomona. Two tenure-track teaching pos.: one in Math Ed., salary dependent upon quals., Doctorate in Math Ed. or Math; one in Applied Math at the Asst. Prof. level, salary dependent upon quals., Doctorate in Applied Math or Math. Evidence of potential for excellent teaching and scholarly research req'd. App, resume, copy of transcripts and 3 ref. to be postmarked by 2/16/90. For add'l info. or to apply, contact: Search Committee, Mathematics Dept. California State Polytechnic University, 3801 W. Temple Ave., Pomona, CA 91768-4033. (714) 869-3467.

California State University, Chico. One tenure-track pos. and one or more f/t temp. one-yr. pos. PhD in Math or Stats. and evidence of teaching excellence req'd. Candidates in math stats. are esp. encouraged to apply but candidates in all fields will be considered. Teach 12 units of undergrad math/sem., be actively engaged in scholarly activities, incl. research, contribute to governance. Tenure-track pos. at Asst. Prof. level, $28,884-$39,924 per academ. yr. Temp. pos. $28,884-$55,452 per a.y. Submit resume, grad transcripts, supporting documents, and at least 3 letters of rec. by Feb. 1, 1990 to: Thomas A. McCready, Chair, Dept. of Math. and Stats., Calif. State University, Chico, CA 95929-0525.

California State University, Sacramento. Three tenure-track pos. for Fall 1990, at a step appropriate to the app's exper. Must have PhD in Math or Stats by Sept. 1990. Salary range begins at $31,668. Apps should be committed to excellence in teaching (12 units/sem). The Dept. has a diverse curric. currently experiencing growth in its undergrad and grad degree and teacher prep programs. Send vita, transcript, and 3 letters of rec. (at least one commenting on teaching ability), by 2/1/90, to: Hiring Committee, Math and Stats. Dept. California State University, Sacramento, CA 95819-2694.

California State University, San Bernardino. Dept. of Math. Apps are being accepted for the pos. of Asst. Prof. or Assoc. Prof. (tenure-track); a PhD in Math or Math Ed. with at least a bachelor's degree in Math is req'd. Successful candidates will be expected to teach 12 hrs./wk., participate in scholarly activities, and help implement a new MAT prog. Current salarly range is $28,884-$50,472 dependent upon quals. and exper. Apps should submit a letter of app, vita, 3 letters of rec. and all transcripts. Apps received after Feb. 1, 1990, cannot be guaranteed consideration. Materials should be sent to: Dr. John Sarli, Chair, Dept. of Mathematics, California State University, 5500 University Parkway, San Bernardino, CA 92407.

Central Missouri State University. Dept. of Math and Comp. Sci. Apps are invited for several tenure-track pos. beg. Aug. 1990. The Dept. seeks to fill the following: Two pos. in comp. sci. A PhD in comp. sci. is pref'd. One pos. in math ed. A PhD or EdD in math ed. with the equivalent of a masters degree in math is pref'd. A possible pos. in stats./actuarial science. A PhD in math, stats., or comp. sci. is pref'd. An Assoc. or Fellow in the Society of Actuaries will be considered. Some training in stats. and an interest in actuarial science is req'd. Salary is competitive and negotiable. A resume, transcripts, and 3 refs. should be sent to Dr. Ed Davenport, Dept. of Mathematics and Computer Science, Central Missouri State University, Warrensburg, MO 64093. App deadline is Jan. 15, 1990, or until pos. are filled.

College of Charleston. Math Dept. At least 2 tenure-track pos. at the Asst. Prof. level avail. Fall, 1990. Quals.: PhD in one of the math scis., commitment to undergrad teaching and potential for continuing research. Teaching: 9 hrs/wk normal load for those engaged in research. Salary is competitive. Send resume and have 3 letters of rec. sent to W. L. Golightly, Chair, Math Dept. College of Charleston, Charleston, SC 29424.

Chatam College. Apps are being accepted for a full-time Asst. Prof. or Instructor in the Dept. of Math effective Sept. 1990. The PhD is pref'd; ABD's with approp. exper. will be considered. The individual will be expected to teach a variety of courses in math incl. linear algebra, intermediate anal., elementary stats., calc. with applications in business and econ., and precalc. In addition the individual will be expected to advise students, supervise student research projects, and have and ability and willingness to participate in the liberal arts interdisciplinary core curric. of the College. Send letter of app and vita to DR. William Beck, Chair, Dept. of Mathematics, Chatam College, Woodland Road, Pittsburgh, PA 15232 by 2/15/90.

Claremont Graduate School. Dept. of Mathematics, 143 E. 10th Street, Claremont CA 91711-3988. Asst./Assoc. Prof. to begin 9/90. Duties: research and teaching, directing Math Clinic projects solving industrial probs. Exper. with the application of stats. to eng. probs. would be valuable. Send vita and 3 letters of rec. to Robert Williamson, Chair.

Cleveland State University. Apps are invited for anticipated openings of tenure-track Asst. Prof. starting Sept. 1990 and of Visiting Asst./Assoc. Prof. for Spring Quarter 1990. Candidates should have a strong research record and a commitment to excellent teaching. Research areas compatible with those in the Dept. are pref'd esp. for the visiting pos. Send vita, reprints/preprints and 3 letters of rec. to John Chao, Dept. of Mathematics, Cleveland State University, Cleveland, OH 44115.

Colorado College. One or more openings for a temp. pos. expected, to beg. Aug. 29, 1990. Usually this pos. is at the Instr. or Asst. Prof. level, but people also interested in a visiting pos. are encouraged to apply. Candidates should send a letter of app describing both your commitment to teaching and your math interests, a vita, a complete set of transcripts, and arrange to have sent 3 letters of rec. (at least one must address teaching) to: John J. Watkins, Dept. of Mathematics, The Colorado College, Colorado Springs, CO 80903.

Dartmouth College. Senior position in Mathematics. Associate or Full Professor position avail. beginning 1990- 1991. Candidates should have established and recognized research program, proven ability to attract external research support, and interest in building and leading a strong research group. Appointee will participate in recruitment for several junior positions. Proven record of excellence in teaching at both undergrad and grad levels and commitment to professional interaction with faculty and Ph.D. students req. Apps welcome in all fields of math. Dept. has special interest in algebra, combinatorics,

geometry/topology, and prob/stat. Dartmouth provides grants to new faculty members for research related expenses, a generous sabbatical program, and moderate teaching loads. Review of apps begins 1/1/90. Send letter of app, CV, names of 4 people who have agreed to write letters of recommendation, and a description of research interests to: Mathematics Senior Search Committee Chair, Dept. of Mathematics and Computer Science, Bradley Hall, Dartmouth College, Hanover, NH 03755.

Dartmouth College. John Wesley Young Research Instuctorship, 2-yrs., new or recent PhD's whose research overlaps Dept. member's. Teach 4 ten-week courses spread over two or three quarters. $31,000; $6,889 summer research stipend. Send app letter, resume, research/thesis description, grad transcript, and 3 (prefer 4) refs. (1 discussing teaching) to: Mathematics Recruiting, Dept. of Math and CS, Dartmouth College, Hanover, NH, 03755. Files complete Jan. 15 considered first.

Denison University. Three pos. preferably at the Asst. Prof. level, in the Dept. of Math Sciences. The first pos. is non-tenurable and starts in Jan. 1990. A Master's degree in math or comp. sci. is req'd; pref. will be given to those having a background in comp. sci. or holding the PhD. Apps for this pos. can (if they choose) simultaneously be candidates for one of the tenurable pos. The second pos. is in comp. sci. and is tenurable with a starting date of Fall, 1990. It requires a PhD (in hand or to be attained shortly following employment) in comp. sci. or in a related field. The third pos., also tenurable, is in math (any specialty) and requires a PhD (in hand or to be attained shortly following employment) in math. It also starts in the Fall of 1990. Teaching loads are 5 and 6 courses/yr. for comp. sci. and math respectively. The primary resp. of both pos. is teaching; a commitment to quality instruction is essential. Some research is expected of those in tenurable pos. Send resume and transcripts of grad work to Prof. Zaven A. Karian, Chairman, Dept. of Mathematical Sciences, Denison University, Granville, OH 43023. Also ask 3 persons who know you will to send ref. letters in support of your app (at least one letter should address your teaching). For the non-tenurable pos., apps will be reviewed as they are received. Apps for the tenurable pos. should be made by Feb. 5, 1990; apps beyond this date will be considered until the pos. are filled.

Eastern Michigan University. Apps being accepted for asst/assoc prof in Dept. of mathematics, avail Fall 1990. Responsibilities inc. teaching undergrad and grad mathematics courses, advising majors and minors, and conducting research. Qualifications: PhD in mathematics and demonstrated achievement and potential in college-level teaching and research. Candidates for the assoc rank must have at least 4 years exp at the asst level. For consideration, send letter of interest, vita, latest transcript, and 3 letters of ref by Jan 31, 1990 to the address below. Inquiries to Dr. Don Lick at (313) 487-1444. Position FAAA89065, 310 King Hall, Eastern Michigan University, Ypsilanti, MI 48197.

Emory University. Invites apps for a tenure-track asst. professorship position in Computer Science commencing fall 1990. Apps should have a PhD in Computer Science or related area and be committed to quality research and teaching. Apps in all areas of Computer Science will be considered but we are particularly interested in candidates with research qualifications in one or more of the following areas: operating systems, computer networks, distributed computing, parallel processing, and software engineering. Teaching load is 6hrs./wk, including grad and undergrad courses. Please send vita and names of 3 references to : Emory University, Dept. of Mathematics and Computer Science, Atlanta, GA 30322 and have references forwarded. Screening apps will begin Feb 1, 1990.

Fairfield University. Tenure-track pos. in Math. An entry level Asst. Prof. is sought to start in Sept. 1990 who must have a PhD in math and evidence of teaching ability. Normal teaching load is 3 courses/sem. plus research. Salary is competitive and full consideration is given to dossiers completed by Feb. 1, 1990. Please send a resume and 3 letters of ref. to: Joseph B. Dennin, Chair, Dept. of Math and CS, Fairfield University, Fairfield, CT 06430-7524.

Florida State University. Apps are invited for 2 anticipated asst. Prof. pos. with research spec. in computational and appl'd math, geom. (esp. diff'l geom.), or topology. The app deadline is Feb. 9, 1990, and appt. would begin Aug. 1990. Candidates should have potential for excellence in research and teaching. Please send resume, and arrange for 3 letter of rec. to be sent to Ralph McWilliams, Chair, Dept. of Mathematics, Florida State University, Tallahassee, FL 32306.

Foothill - De Anza Community College District. Math instructors: Instructs community coll. courses ranging from arithmetic and beg. algebra to elemen. stats., calc., linear algebra and diff. equations. Serves on a min. of 2 college committees per yr.; curric. devel./textbook selection. MA in math or appl'd math or BA in either and MA in stats. physics or math ed., or equivalent. $28,758-$46,585.60 annually plus benefits. Complete app package consists of: District app and questionnaire, current resume, and 3 letters of profess'l ref. App and complete job description may be obtained from: Employment Services, Foothill-De Anza Community College District, 12345 El Monte Road, Los Altos Hills, CA 94022. (415) 949-6217. A resume or vita may not be submitted for a completed app. Deadline 2/26/90.

Fort Lewis College. The Math Dept. anticipates a tenure-track pos. for 1990-1991. Terminal degree or near completion is req'd. 12 hrs. of undergrad teaching, CS and/or Math. Send a letter of app, resume, statement of profess'l intent, transcripts, 3 current letters of rec, incl. one that clearly addresses teaching to: H.C. Rosenberg, Math Dept. Fort Lewis College, Durango, CO 81301. Deadline is Feb. 5, 1990.

Georgia Southern College. Apps are sought from all areas of math and comp. sci. to fill 3 tenure-track pos. avail. Sept. 1, 1990. And advanced degree in a math sci. or comp. sci. is req'd and a doctorate is pref'd. Salary and rank (inst. or asst. Prof. pref'd; assoc. Prof. considered) commensurate with quals. Send letter of app, evidence of, or document potential for, outstanding teaching, along with vita and 3 letters of ref. or placement file to Dr. Rick Hathaway, Landrum Box 8093, Georgia Southern College, Statesboro, BA 30460. Deadline: Feb. 1, 1990.

Georgia State University. Dept. of Math & Comp. Sci., Univ. Plaza, Atlanta, GA 30303-3083. (1) Tenure-track Asst. Prof. pos. 9/1990. Rank & salary commensurate with quals. & exper. Quals.: PhD in math with strong res. potential & commitment to teaching. Pref. is for anal. Duties: teaching, research, & service to support BA & MS degrees in Comp. Sci. (2) Tenure-track pos. 9/1990. Rank & salary commensurate with quals. & exper. Quals.: PhD with strong res. potential in & commitment to teaching in Comp. Sci. Pref. apps in all areas of comp. sci. but esp. in theoretical comp. sci., artif. intell., operator systems, software eng., data comm., networking & anal. of algorithms. Duties: teaching, res. & service to support BS & MS degrees in math & comp. sci. Send letter of app, vita without birthdate but with citizenship status, 3 letters of ref. & transcipts of all undergrad and grad work and postmarked by 1/31/90 to Chmn. at above address.

Governors State University. Apps are invited for 3 full-time tenure-track pos. in comp. sci. to contribute to an established BS degree prog. and to implement a newly authorized MS in comp. sci. Apps. with a PhD in comp. sci. or closely related area are pref'd. A PhD is req'd. for eventual tenure. Outstanding apps with an MS in comp. sci. will also be considered. The University seeks faculty with strong teaching and research capabilities in data comm., networking, operating systems, software eng., graphics, art. intell., and database devel. Duties incl. teaching, research, and service. Salaries are competitive. Starting date: Negotiable 1/1/90 - 9/1/90. Please send a vita which includes iden. of the teaching/research specialties and the names, addresses and phone numbers of 3 refs. to: Jane Wells, Chairperson, Computer Science Search Committee, Governors State University, University Park, IL 60466.

Grand Valley State University. Mathematics and Computer Science Dept. Allendale, MI 49401. Asst. Prof. (tenure-track). Pref. PhD with emphasis in math ed. or stats. At GVSU, emphasis is placed on efffective teaching and profess'l devel., with reduced teaching loads and/or grants avail. for research and profess'l devel. Interviews will continue until pos. is filled. Send app with resume to: Chair, Math Search Committee.

Hobart and William Smith Colleges. Asst. Prof., tenure-track pos. starting in Sept. 1990. Salary is competitive. Apps should have a PhD in comp. sci. or a PhD in math and exper. in comp. sci. Duties incl. teaching undergrad comp. sci., teaching some math (depending on interest and quals.), and participating in the Colleges' Interdisciplinary General Curric. A strong commitment to teaching and promise of continued scholarly activity req'd. Teacing load: 2 courses/trimester. Send detailed resume, 3 letters of rec. (at least in incl. comments on teaching), and undergrad and grad transcripts (photo copies acceptable) to: Prof. David Eck, Dept. of Mathematics and Computer Science, Hobart and William Smith Colleges, Geneva, NY 14456. Eval. of apps will begin Jan. 15, 1990 and will continue until the pos. is filled.

Holy Cross College. Apps are invited for 2 tenure-track pos. in math beg. Sept. 1990. One pos. has some pref. for an appl'd math area. The other reqs. a strong interest and background in comp. sci. at least at the masters level. Both req. the PhD in either math or comp. sci. Excellence in teaching and an active research prog. is expected. Competitive salary, fringe benefits, and esp. generous sabbatical and faculty fellowship progs. Send apps including resume, undergrad and grad transcripts and 3 letters of rec. to: Melvin C. Tews, Chair, Dept. of Mathematics, Holy Cross College, Worchester, MA 01610.

Hood College. Dept. of Mathematics and Computer Science, Frederick, MD 21701. One or two tenure-track pos. Rank and salary dependent on quals. Req. commitment to quality teaching, terminal degree in comp. sci. or PhD in math or related field plus substantial grad study or exper. in CS. Teach undergrad and grad courses, advise students, and participate in curric. devel. for existing bachelor's and master's progs. Pos. begins Aug., 1990. Send resume, letter of app and 3 letters of rec. to Dr. E.B. Chang, Chair.

Humboldt State University. Apps are invited for two tenure-track asst. or assoc. Prof. pos. for Fall 1990. Candidates must have a doctorate in a math science or in math ed. All qualified apps with a commitment to teaching excellence and scholarly activities will be considered. Pref. will be given to apps who can help meet prog. needs in math ed., stats., or general undergrad math. Apps should sned vita and the names of 3 refs. to: Search Committee, Dept. of Mathematics, Humboldt State University, Arcata, CA 95521 by Feb. 15 for full consideration.

Iowa State University of Science and Technology. The Dept. seeks qualified apps for tenure-track positions at the Asst. Prof. level in Discrete Math and in Mathematical Bio. and for a tenure-track pos. at the Assoc. or Full Prof. level in Comp. Math or Numerical Anal. starting Aug. 21, 1990. The successful app for the sr. pos. will be expected to seek outside funding for his or her research and to interact scientifically with colleagues in other campus depts. There will be start up funds avail for the successful app for each of the 3 pos. We will begin the interview process Jan. 15, 1990. However, we shall continue to accept apps after that date until the pos. are filled. A number of visiting pos. in diverse areas are expected to be

avail. also and apps for them are also encouraged. Apps should be sent to: Howard A. Levine, Chair, Dept. of Mathematics, Iowa State University, Ames, IA 50011.

Johns Hopkins University. The Mathematical Sciences Dept. invites apps for the 1990-91 ELIEZER NADDOR POSTDOCTORAL FELLOWSHIP. The fellow is to be an outstanding graduating doctoral student in math, stats., or operations research, who plans an academic research career. The fellowship provides a $29,000 stipend plus fringe benefits, to fully support 12 months of postdoctoral study at the Dept. in an area of interest to some Dept. faculty member, free from teaching and admin. duties. Apps should provide a current vita, a letter describing career aspirations and a research plan for the fellowship yr., and transcripts, and should arrange for 3 letters of rec. to be sent, by Feb. 28, 1990, to: Prof. John C. Wierman, Chairman, Mathematical Sciences Dept. 220 Maryland Hall, The Johns Hopkins University, Baltimore, MD 21218.

Johns Hopkins University. Apps are invited for a jr. pos. in stats., to beg. Fall 1990. Selection is based on demonstration and promise of excellence in research, teaching, and innovative app. Apps are asked to furnish a vita, transcripts, a letter describing profess'l interests and aspirations, and arrange for 3 letters of rec. to be sent to: Prof. John C. Wierman, Chairman, Mathematical Sciences Dept. The Johns Hopkins University, Baltimore, MD 21218.

Kalamazoo College. The Dept. of Math and Comp. Sci. invites apps for a tenure-track pos. as an Asst. Prof. of Math to commence Fall 1990. Apps must have a PhD in Math or Stats. and a wide range of math interests. The teaching load is 2 courses/ten-wk. term, 3 terms per yr. Competitive salary, good benefits. Apps should send resume and 3 refs. to: Prof. J.B. Fink, Dept. of Mathematics and Computer Science, Kalamazoo College, Kalamazoo, MI 49007. (616) 383-8514. e-mail: fink@heyl.kzoo.edu. Apps rec'd until pos. is filled.

Kansas State University. Dept. of Math. Subject to budgetary approval, apps are invited for several tenure-track and visiting pos. beg. Aug. 18, 1990; rank and salary commensurate with quals. All fields will be considered, but pref. will be given to candidates in low dimen. topology, geometric topology, and algebraic topology. Apps must have strong research credentials and a commitment to excellence in teaching. A PhD in math or a PhD dissertation accepted with only formalities to be completed is req'd. Letter of app, current vita, description of research, and 3 letters of rec. should be sent to: Louis Pigno, Dept. of Mathematics, Cardwell Hall 137, Kansas State University, Manhattan, KS 66506. Deadline: Feb. 1, 1990.

Kent State University. Apps are invited for a faculty pos. at the Assoc. or Full Prof. level beg. Fall 1990. The ideal candidate would have a strong training in classical appl'd math and some exper. with large-scale sci. comp. He or she would be expected to have a solid record or research, publication, and external funding, as well as a commitment to quality teaching. The appointed faculty member would be expected to enhance the Dept.'s outreach and interdisciplinary research efforts, supervise grad students, and contribute to curric. planning and devel. A competitive salary is avail. This new pos. is intended to complement existing strenghts in appl'd anal. (esp. numerical anal. and approx. theory) and comp. sci. (esp. symbolic comp., expert systems, and parallel computing). App deadline is Feb. 24, 1990. If qualified individuals do not apply by Feb. 24, the deadline will be extended until the pos. is filled or until Aug. 18, 1990, whichever occurs first. Apps should submit a resume and arrange to have 3 letters of rec. sent to: Chuck Gartland, Chair of the Applied Mathematics Search Committee, Dept. of Mathematical Sciences, Kent State University, Kent, OH 44242.

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.

Loyola University. The Dept. of Mathematical Sciences anticipates at least one tenure-track pos. and some visiting pos. beg. Aug. 1990. Reqs. are the PhD, an active research prog. in any area, and a commitment to quality teaching. Interviews will beg. in Jan. and continue until all pos. are filled. Send detailed CV and 3 letters of rec. to: Prof. R.J. Lucas, Dept. of Mathematical Sciences, Loyola University of Chicago, Chicago, IL 60626.

Mount Holyoke College. Tenure-track position in computer science at the assistant professor level with a three year initial appointment. Necessary qualities are: excellence in teaching at all levels; ability to provide leadership for a strong computer science program in a liberal arts setting; interest in involving undergraduates in high-quality research projects. Ph.D. in computer science required. The Five College environment offers excellent opportunities for professional development. Mount Holyoke, a liberal arts college for women, is committed firmly to fostering multicultural diversity and awareness in its

faculty, staff, and student body. Send statement of interest, a resume, and three letters of recommendation to Dr. Robert Weaver, Chair of Computer Science, Department of Mathematics, Statistics, and Computation, Mount Holyoke College, South Hadley, MA 01075. by 2/20/90.

Massachusetts Institute of Technology. C.L.E. Moore Pure Math Instructorhips 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 semeseter 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.

Memphis State Unversity. The Dept. of Mathematical Sciences invites apps for anticipated tenure-track pos. for 1990. Our library and comp. facilities, teaching load, and travel opportunities contribute to a very favorable research environ. Pref'd. research areas in comp. sci. incl. software eng., algorithms, parallel and distrib. processing, art. intell./cognitive sci., network design and anal., data comm., and theory. Pref'd. research areas in stats. include appl'd stats., biostats., sochastic models, and time series. Pref'd. research areas in math incl. approx. theory & numer. anal., diff. equations & non-linear anal., dynam. systems & ergodic theory, graph theory & combinators, funct. anal. & operator theory, math ed., and number theory. Apps must have a PhD by Sept. 1, 1990, and a strong potential for excellence in teaching and research. Selection will beg. Jan. 31, 1990. apps will continue to be accepted until all pos. are filled. Apps should submit a resume and direct 3 letters of ref. to: Ralph Faudree, Chair, Dept. of Mathematical Sciences, Memphis State University, Memphis, TN 38152.

Michigan State University. Dept. of Mathematics. There will be several open tenure-track pos. at the Asst., Assoc. and possibly the Full Prof. levels in all fields. Excellence in research and teaching essential. Please send a resume and arrange to have 3 letters of rec. sent to: Prof. Kyung Whan Kwun, Chairperson, Dept. of Mathematics, Michigan State University, East Lansing, MI 48824-1027. Apps received by Jan. 2, 1990 will be given more attention.

Michigan State University. Dept. of Mathematics. One or more Postdoctoral fellowships in Math. The appt. is for 2 yrs. Duties incl. teaching one course/term with the expectation that the fellow will devote remaining time to research. These fellowships are normally offered to persons (regardless of age) who have had their doctorate less than 2 yrs. There will be some instructor pos. avail. also. Please send resume and arrange to have 3 letters of rec. sent to: Prof. Kyung Whan Kwun, Chairperson, Dept. of Mathematics, Michigan State University, East Lansing, MI 48824-1027. apps received before Jan. 2, 1990 will be given more attention.

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.

Mills College. The Dept. is seeking outstanding candidates for a tenure-track position as Asst. Prof. of Comp. Sci. beg. Fall 1990. Candidates must submit evidence of superior teaching and research abilities, and demonstrate a commitment to become involved in a highly innovative and energetic Dept. Salary will depend on exper. and quals. The initial contract will be for 3 yrs., subject to final admin. approval. Send vita and direct 3 letters of ref. to: Prof. Barbara Li Santi, Chair of the Computer Science Search Committee, Mills College, Oakland, CA 94613. Deadline: Jan. 20, 1990.

Moorhead State University. Mathematics Dept. Moorhead, MN 56560. Tenure-track pos. at rank of Asst. Prof. to begin Sept. 1990. A PhD in math or stats. is req'd. Candidates must be qualified to teach courses in math stats. and/or appl'd math. Pref. given to candidates with successful college teaching exper. Duties incl. teaching undergrad courses in

math and stats., advising sutdents, univ. and Dept. committee work and other profess'l activities as approp. First screening of apps on Feb. 1, 1990. Apps accepted until filled. Apply to Milton Legg, Chair, Mathematics Dept.

New Mexico State University. The Dept. invites apps for several visiting and tenure-track pos. for Fall Semester, 1990. Tenure-track pos. are primarily at the Asst. Prof. level, but under very special circumstances, appts. at a higher rank may be possible. Strong commitment to research and teaching req'd. Pref. given to apps whose research interests are related to strengths in the Dept. Apps are kept on file through hiring period and pos. filled as openings occur. Arrange for vita, short research description, and at least 3 ref. letters to be sent to: Hiring Commitee, Dept. of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003.

Northwestern University. Mathematics Dept. 2033 Sheridan Road, Evanston, IL 60208-2730. The Math Dept. will sponsor and emphasis yr. in Dynam. Systems during the yr. 1990-91. The Dept. expects to fill one or two 2-yr. Asst. Prof. pos. starting Sept. 1990 with priority given to mathematicians with research interests in Dynam. Systems. There is a further possibility for more sr. mathematicians of visiting pos. for part or all of the academic yr. Apps. should be sent to Prof. Clark Robinson at the Dept. address and incl. a vita and 3 letters of rec. In order to ensure full consideration, an app must be rec'd by Feb. 28.

Northwestern University. Mathematics Dept. 2033 Sheridan Road, Evanston, IL 60208-2730. The Math Dept. invites apps for a tenure-track pos. at the level of Asst. Prof. from mathematicians with strong research interests. Pref. will be given to those areas which complement the present Dept. strengths. Apps should incl. a vita (incl. a list of publications) and the app should have 3 ref. letters sent to the Chairman, Personnel Committee, Dept. of Math.

Occidental College. Dept. of Math, Los Angeles, CA 90041. Regular appt. open to rank beginning Sept. 1990. PhD and expertise in stats. req'd. Candidates expected to interact with social science students and faculty on curric. matters of mutual interest. Excellence in teaching and quality research is expected. Two courses (8 hrs/wk) per quarter of teaching except during the first yr. of appt. when only five courses are taught. Interviews will be held at the Jan. AMS meeting. Send resume and 3 letters of rec. (one about teaching) to Statistics Search Committee, Dept. of Mathematics by Feb. 15, 1990.

Ohio Northern University. Tenure-track pos. avail. beg. Fall 1990. We are seeking a candidate with teaching exper. and a PhD in Math or CS. We have a pref. for expertise in stats., comp. sci., or possibly anal. Candidates must have a strong commitment to undergrad teaching. Rank and salary open. Teaching load is 12 hrs/quarter. Send resume and 3 letters of ref. to: Dr. Robert Hovis, Chair, Dept. of Math/CS, Ohio Northern University, Ada, OH 45810. Deadline is Feb. 15 for full consideration.

Ohio Wesleyan University. Comp. Sci./Math: Tenure-track pos. beg. Fall 1990. Teaching load of 3 courses/sem., at least two in comp. sci. PhD in comp. sci. or in a closely related area. Seek person interested in planning a devel. of a modern curric. in comp. sci. Scholarly activity expected. Apps close Feb. 28, 1990. Send cover letter, resume, official grad transcript, and 3 letters of ref. to: Prof. Jeffrey Nunemacher, Dept. of Mathematical Sciences, Ohio Wesleyan University, Delaware, OH 43015.

Pacific Lutheran University. Dept. of Math and Comp. Sci., Tacoma, WA 98447. Tenure-track pos. beg. Sept., 1990. PhD in math, math stats. or equivalent req'd. Must have commitment to quality teaching and scholarship. Send vita, college transcripts, 3 letters of rec. (with at least one commenting on teaching ability), and if possible, student teaching evals. by Jan. 26, 1990 to James Brink, Chair.

Pomona College. Apps are invited for a tenure-track Asst. Prof. pos. in the math scis. beg. Fall 1990. The PhD and demonstrated excellence in teaching and research req. Must have a strong commitment to high quality teaching in a variety of undergrad courses and contributing to the math life of our Dept. Pref will be given to strong candidates in stats., and appl'd maths. Apps who will attend the AMS Jan. Mtg. in Louisville should so indicate in their app letter prior to Jan. 3. Submit apps, including resume, transcripts and letters evaluating teaching and research capabilities by Jan. 31, 1990, to: The Search Committee, Dept. of Mathematics, Millikan Lab., Pomona College, Claremont, CA 91711-6348.

Purdue University. Dept. of Mathematics, West Lafayette, IN 47907. L. D. Berkovitz, Acting Head. Several regular or research assistant professorships beg. August 1990. Exceptional research promise and excellence in teaching required. Send resume and 3 letters of recommendation.

Purdue University. Dept of Mathematics, West Layfayette, IN 47907. L. D. Berkovitz, Acting Head. Possible position at the Associate Professor/Professor level beg. August 1990. Excellent research credentials required. Send resume and 3 letters of recommendation.

Rensselaer Polytechnic Institute. Dept. of Mathematical Sciences, Troy, NY 12180 J. G. Ecker, Chair. Seek extremely high quality apps for expected tenure-track openings at all levels in areas of applied math, including math programming, starting Sept. 1990 or earlier. PhD and very strong research potential required for junior-level appts. and demonstrated outstanding record for senior-level appts. Also anticipate one or two Visiting and Postdoc appts.

Rhonde 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.

Rollins College. One tenure track position, pref. at Asst. Prof. level, avail. September 1990, pending approval. The area of specialization is open but Doctorate (or ABD with degree nearing completion), strong commitment to teaching undergrads and cont. prof development is required. Seek vertatile, broadly educated mathematician who can work collegially in 10-person Dept. in liberal arts setting. Dept. offers majors in math and CS, currently engaged in calculus renewal project (funded by NSF) and is well-equipped with MAC II computers. Teaching load is 8-10 hours/week. To ensure full consideration, apps must be completed by 15 Feb. 1990. Send resume, transcripts, and 3 letters of rec. (at least one of which must comment on teaching) to: David Kurtz, Chair, Rollins College, Dept. of Mathematical Sciences, Winter Park, FL 32789.

Rollins College. At least one perhaps two visiting positions avail. Sept. 1990. The approved position is a 2-year appt. with renewal possible and the other is a 1-year sabbatical replacement. Area of specialization open. Doctorate or ABD preferred, but a master's with teaching exp. will be considered. Strong commitment to teaching undergrads required. Dept. offers majors in math and CS, is currently engaged in calculus renewal project (funded by NSF) and is well-equipped with Mac II computers. Teaching load is 8-10 hours/week. To ensure full consideration, apps must be completed by 15 Feb. 1990. Send resume, transcripts, and 3 letters of rec. (at least one of which must comment on teaching) to: David Kurtz, Chair, Rollins College, Dept. of Mathematical Sciences, Winter Park, FL 32789.

College of St. Catherine. Full-time temp. pos. starting Fall 1990 with the possiblilty 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.

Saint Mary's College of California. Mathematical Sciences. One tenure-track asst. professorship, beginning fall 1990. A PhD and a commitment to both liberal arts ed. and continued research are expected of candidate to join a young, growing Dept. Computer Science expertise is desirable. Current salary range is $28,786-$34,259. Send resume and 3 letter of rec., at least 1 of which discusses teaching ability, to Charles Hamaker, Chair, Dept. of Mathematical Sciences, PO Box 3517, St. Mary's College, Moraga, CA 94575. Eval. of candidates will begin Feb. 12, 1990, and continue until the pos. is filled. Interviews will be held at the AMS meeting in Louisville, KY, Jan. 1990.

Saint Olaf College. One 2-yr. postdoctoral pos., partially funded by the Fund for the Improvement of Post-Secondary Education. This pos. is half time teaching (3 courses/yr.) and half time research. Unlike most postdoctoral pos., there will be a strong emphasis upon developing the teaching aspect of an academic career through a mentored internship. This pos. is allotted generous research and profess'l travel budgets. Salary: $31,500. For new or recent PhD's only. Write to: Prof. Paul D. Humke, Mathematics Dept. Saint Olaf College, Northfield, MN 55057.

Saint Xavier College. Mathematics Faculty. Tenure-track, beg. Sept. 1, 1990. Will teach a wide range of Math courses, direct sr. projects, advise students, and contribute to curric. revision. Doctorate in Math or Math Ed. pref'd, ABD considered. Colleg teaching exper. pref'd. Apps accepted until pos. filled; review of apps will begin Dec. 4, 1989. Send letter of app, resume, transcripts, and 3 letters of rec. to Dr. Susan Beal, Chair, Dept. of Mathematics & Computer Science, Saint Xavier College, 3700 W. 103rd. St., Chicago, IL 60655.

Saint Xavier College. Computer Scient Faculty. Tenure-track. Two pos. (Asst. & Assoc. Prof.). Begins Sept. 1, 1990. Will teach a wide range of undergrad courses in Comp. Sci., direct sr. projects, and contribute to curric. revision. Master's degree in Comp. Sci. req'd, Doctorate in Comp. Sci. or Mathematics, and teaching exper. pref'd. Apps accepted until pos. are filled. Review of apps. will begin Dec. 4, 1989. Send letter of app, resume, transcripts, and 3 letters of rec. to Dr. Susan Beal, Chair, Dept. of Mathematics & Computer Science, Saint Xavier College, 3700 W. 103rd. St., Chicago, IL 60655.

State University of New York, Fredonia. The Dept. of Mathematics and Computer Science invites apps for a one-yr. pos. in math. Duties: Teach undergrad courses in math and possilby first-yr. courses in comp. sci. The teaching load will consist of 3 or 4 courses (9-12 hrs.) per sem. Scholarly work is encouraged and supported. Quals: A PhD in math is pref'd. Starting date: Sept. 1, 1990. Apps should arrrange to have a resume and 3 letters of ref. sent to: Albert D. Polimeni, Dept. of Mathematics and Computer Science, SUNY College at Fredonia, Fredonia, NY 14063. The deadline for apps is May 15, 1990.

State University of New York, Plattesburgh. Apps are invited for a tenure-track pos. in the Dept. of Math beg. Fall 1990. Appt. at level of Asst. Prof. Quals.: PhD in Math, Math Ed., or Stats. Individual with an understanding of and

sensitivity to minority and gender concerns are encouraged to apply. Closing is Jan. 2, 1990, however apps will be accepted until the pos. is filled. Send letter of app, current resume, and 3 current letters of rec. to: Chair, Search Committee, c/o Office of Personnnel/Affirmative Action, SUNY Plattesburgh, Box 1640-178, Plattesburgh, NY 12901.

Southern Connecticut State University. Mathematics Department, 501 Crescent St., New Haven, CT 06515. Tenure track position at asst/assoc rank beginning 8/27/90 to teach undergrad/grad math and math ed, supervise secondary student teachers (12 hours). Qualifications: doctorate in math, or math ed. evidence of quality teaching, exp in teacher ed programs, potential for scholarly growth. Send app, vita, transcripts, references to: Dr. Helen Bass, Chair. Full consideration given to apps received by 1/31/90.

Southern Connecticut State University. Mathematics Department, 501 Crescent St., New Haven, CT 06515. Tenure track position at asst/assoc rank beginning 8/27/90 to teach undergrad/grad math including stat. and appl. math (12 hours). Qualifications: doctorate in math, evidence of quality teaching, expertise in stat. or appl. math, potential for scholarly growth. Send app, vita, transcripts, references to: Dr. Helen Bass, Chair. Full consideration given to apps received by 1/31/90.

Stony Brook Institute for Mathematical Sciences: SUNY , Ctr. at Stony Brook, NY 11794-3660. Apps are invited for temp. membership (usually 1 or 2 yrs.) at post-doctoral and sr. level in newly formed Institute beginning Sept. 1990. All areas of math will be considered: we are particulary interested in dynam. systems, the topic around which the current progs. of the Institute are built. Apps for joint appt. with the Dept. of Math encouraged.

Syracuse University. Anticipate there will be positions available at the asst. and assoc. Prof. level beginning Fall 1990. Candidates should have outstanding research ability and evidence of excellence in teaching. Applications area invited in any area of mathematics and in mathematics education and stat. Send a letter of application and vita with a list of publications, and have three letters of reference sent to Daniel Waterman, Chair, Syracuse University, Dept. of Mathematics, Box 1, Syracuse, New York 13244-1150.

Trenton State College. Anticipated Faculty Vacancies for Fall, 1990. Asst. Prof of Math. Tenure-track. Req'd: PhD (or within one yr. of completion); demonstrated commitment to quality teaching; strong research potential. Both pure and appl'd mathematicians will be considered. Asst. Prof. of Stats. Tenure-rack. Req'd: PhD in Stats. (or within one yr. of completion); demonstrated commitment to quality teaching; strong research potential. Both theoretical and appl'd statisticians will be considered. Asst. Prof. of Math Ed. Tenure-track. Req'd: PhD or EdD in Math Ed. (or within one yr. of completion); demonstrated commitment to quality teaching, ability to teach both undergrad and grad math courses, as well as supervise field experiences; strong research potential. Send vita and 3 letters of rec. to: Dr. Aigli Papantonopoulou, Chair, Search Committee, Dept. of Mathematics and Statistics, Trenton State College, Hillwood Lakes, CN 4700, Trenton, NJ 08650-4700. App deadline is March 1, 1990, or until pos. are filled.

Trinity College. The Dept. of Math invites apps for one tenure-track pos. and for one or more visiting pos., which will beg. in the academic yr. 1990-91. The normal teaching load is 5 sem. courses/yr. (3/2). Rank and salary are open, and dependent on quals. Spec. is also open. Reqs. for the pos.: PhD in math, evidence of teaching excellence at the undergrad level, and (for the tenure-track jobs) indications of promise in research. Apps should send a CV, 3 letters of ref. (at least one of which speaks directly to teaching exper.), and a statement of teaching and research interests to: Search Committee Chair, Dept. of Mathematics, Trinity College, Hartford, CT 06106, by Feb. 1, 1990. Representatives of the Dept. will attend the Employment Register at the joint Annual Mtgs. in Louisville in Jan., 1990. Apps will be considered for both the tenure-track and visiting pos. unless they specify otherwise.

United States Military Academy. Dept. of Mathematics has a rotating position of Visiting Prof. (VP) for which it is soliciting interested experience educators at the PhD level. The VP serves for one academic year, enhancing and bringing a civilian perspective to the military faculty. Individuals interested in consideration should have a strong interest in teaching, the desire to become involved in curric. development, and research interests which complement those in the Dept of Mathematics for this on-going annual position. Transportation costs to and from West Point are usually paid. Housing is available for rent on post. Send CV to Professor and Head, Dept. of Mathematics, USMA, West Point, NY 10996-1786.

University of Alabama in Huntsville. Apps are invited for a tenure-track asst. or assoc. Prof. pos. beg. Sept. 1990. Rank and salary will depend on the credentials of the appointee. A PhD in appl'd math, math, stats., or related field with emphasis on stats. or appl'd math, evidence of good teaching skills, and excellent research ability are essential. Pref'd spec. areas incl. stats, numer. anal., diff. equations, math modeling, fluid dynamics, discrete math, and prob. Send letter of app, vita, and 3 letters of ref. to Peter M. Gibson, Chairman, Mathematical Sciences Dept. University of Alabama in Huntsville, Huntsville, AL 35899. Review of apps will begin Feb. 12, 1990, and continue until the pos. is filled.

University of Alabama. The Dept. expects to fill from 2 to 5 tenure-track pos. at the rank of Asst. Prof. or possibly at a higher rank beg. Aug. 16, 1990. Areas of special interest are: algebra, anal., fluid mechs., comp'l math, diff'l equations, diff'l geometry, optimization, stochastic modeling, and topology. Applicants for Asst. Prof. should have or reasonably expect to have by Aug. 16, 1990 a PhD or the equivalent. Excellence in both teaching and research is req'd. An established

record of research and leadership in one of the areas described above is expected of apps for a senior pos. We also invite apps for visiting pos. Send a vitae, reprints and/or preprints, and at least 3 letters of rec. to: Search Committee, Dept. of Mathematics, The University of Alabama, Box 870350, Tuscaloosa, AL 35487-0350.

University of Arizona. The Math Dept. is happy to announce several pos. which will be avail. beg. Fall 1990. Tenure-track pos. Excellent research record or potential, strong commitment to teaching req'd. Fields should complement but not duplicate existing Dept. research strengths in algebra, computational sci., diff. equations, dynam. systems, fluid mechs., geom., math physics, nonlinear anal., nonlinear optics, number theory, prob. and stats. Postdoctoral fellowships (Research Assoc.). Apps with areas of strength in appl'd math, compuational sci. and nonlinear optics may qualify for Special Center of Excellence Awards. Only candidates with outstanding research records or potential should apply. The Math Dept. will also have several visiting pos. for next yr. We encourage early app. Deadline date will be Feb. 1, 1990 or whenever pos. are filled. Send apps (please incl. Social Security # if possible) to: Dept. Head, Dept. of Mathematics, University of Arizona, Tuscon, AZ 85721.

University of California, Berkeley. Dept. of Statistics. Pending final budgetary approval, apps are invited for a faculty pos. at any tenured or tenure-track rank, to begin July 1, 1990. Will consider strong candidates in any area of theoretical and appl'd stats., prob. and appl'd prob. theory. Interdisc. interests are encouraged and joint appts. are a possibility. Send inquiries and apps incl. a resume and 3 refs. by Jan. 30, 1990 to: David R. Brillinger, Personnel Committee, Dept. of Statistics, University of California, Berkeley, CA 94720. (Apps rec'd for our earlier Nov. 30, 1989 deadline will automatically be considered for this deadline also.)

University of California, Santa Cruz. The Math Dept. is recruiting for a pos. in nonlinear anal./diff. geom, at either the Asst. (tenure-track), Assoc. or Full Prof. (tenured) level. Salary will be in the range of $33,900-$36,600 (Asst. Prof.), $40,400-$45,200 (Assoc. Prof.), $48,500-$69,400 (Full Prof.), effective July 1, 1990. The teaching load is 4 1-qtr. courses/yr. Min. qual. is a PhD or equivalent in Math. Candidates at the tenure level are expected to have an exceptionally strong research record as well as a solid teaching record. Candidates at the untenured level should demonstrate the potential for such. Apps should send vita, incl. teaching and research record (indicating at which level you wish to be considered), and 4 letters of rec. to.: Recruitment Committee, Mathematics Dept. University of California, Santa Cruz, CA 95064. Closing date: Feb. 1, 1990. Please refer to #36-856 in your reply.

University of California, Santa Cruz. The Math Dept. is recruiting for a pos. in algebra or number theory, at either the Asst. (tenure-track) or Assoc. Prof. (tenured) level. Salary will be in the range of $33,900-$36,600 (Asst. Prof.) or $40,400-$45,200 (Assoc. Prof.), effective July 1, 1990. The teaching load is 4 1-qtr. courses/yr. Min. qual. is a PhD or equivalent in math. Candidates at the tenure level are expected to have an exceptionally strong research record as well as a solid teaching record. Candidates at the untenured level should demonstrate the potential for such. Apps should send vita, incl. teaching and research record (indicating at which level you wish to be considered), and 4 letters of rec. to: Recruitment Committee, Mathematics Dept. University of California, Santa Cruz, CA 95064. Closing date: Feb. 1, 1990. Please refer to #190-890 in your reply.

University of California, Santa Cruz. The Math Dept. expects to have several visiting pos. avail. during the academic yr. 1989-1990 and invites apps from qualified mathematicians in all fields. Appts. will be made as Visiting Asst., Assoc. or Full Prof. as approp. Visitors will be expected to teach, pursue their research, and perform some Dept. or univ. service. Such pos. are avail. for periods ranging from one quarter to the full academic yr., with a possible extension to a second yr. There is also a possibility that visitor will be able to stay on to do summer school teaching following the academic yr. Pref. will be given to those who can teach for the entire academic yr. Apps must hold the PhD in Math. Univ. teaching exper. desired. Apps should send vita, 3 letter of ref. speaking to the app's teaching and research exper. to: Recruiting Committee, Mathematics Dept. University of California, Santa Cruz, CA 95064. Closing date: Feb. 1, 1989. Please refer to #T89-14 in your reply.

University of Connecticut. Asst. Prof., Dept. of Mathematics. Apps and noms. arer invited for an anticipated permanent pos. effective Fall 1990. Candidates must have a PhD in Math and have strong research and teaching capabilities. Duties will incl. the guidance and performance of research and teaching at both the undergrad and grad levels. Rank and salary will be commensurate with exper. Pref. will be give to those working in the areas of number, anal., geom. and topol., of combinatorics; strong candidates in all areas of math are encouraged to apply. Apps should send a resume and have 3 letters of rec. sent to: Prof. William Abikoff, Chair, Mathematics Search Committee, Box U-9, University of Connecticut, 196 Auditorium Road, Storrs, CT 06269-3009. Preliminary processing will begin on Nov. 15, 1989. Apps will be accepted until the pos. is filled.

University of Hawaii. Apps are invited for some anticipated pos. beg. Fall, 1990, one tenure-track and some temp. (1-yr.). Rank open. Duties incl. mathematical research and teaching 6 credit hrs/sem. Min. quals. incl. a PhD, commitment to research and teaching, and achievement approp. to rank. Research interests complementing those of the Dept. are desirable.

Normal salary range as of 7/90 is from $30,240 (min. for Asst. Prof.) to $68,928 (max. for Full Prof.). To apply, write to: Prof. L. Thomas Ramsey, Chairman, Dept. of Mathematics, 2565 The Mall, Keller 401A, Honolulu, HI 96822. Have 3 refs. send confidential letters directly to the chairman. Deadline for app: 1/22/90.

University of Illinois, Chicago. Dept. of Mathematics, Statistics, and Computer Science, Box 4348, Chicago, IL 60680. Apps are invited for pos. beg. Sept. 1, 1990, in pure and appl'd math, prob. and stats., theoretica comp. sci., and math ed. Outstanding research record req'd; jr. candidates with post-doctoral exper. pref'd. Apps are also invited for visiting pos of one or more quarters. Send vita and direct 3 letters of ref. to: John Baldwin, Chairman, Search Committee (address above). To ensure full consideration materials must be rec'd by Jan. 15, 1990.

University of Louisville. The Dept. of Mathematics in the College of Arts & Sciences is seeking an Asst. Profs. for tenure-track pos. Candidates must have active research prog. in app'd math, prob. or stats. Primary teaching responsibilities will inc. courses in app'd math or prob./stats. as well as intro undergrad courses. A Doctorate in the Mathematical Scis. is req'd, as is evidence of scholarly achievement. Teaching exper. is desirable. Interested candidates should send a letter of app., vitae and at least 3 letters of rec. by Jan. 29, 1990 to: Dr. Robert B. McFadden, Chair, Dept. of Mathematics, College of Arts and Sciences, University of Louisville, Louisville, KY 40292.

University of Michigan, Dearborn. The U of M-Dbn plans to fill a tenure-track position staring Sept. 1990. It is at the Asst. or Assoc. level and requires a PhD in Math or Stats. A research interest in an appl'd area of math or in stats is preferred. Teaching capability in an appl'd area of math or in stats is a requirement for this position. The teaching load is 9 credit hrs/term. To apply, send resume and have 3 letters of rec. sent to: Ronald P. Morash, Chairman, Dept. of Math and Stat., Univ. of Michigan, Dearborn, MI 48128-1491.

University of Minnesota, Duluth. Dept. of Math & Stat. Appl'd/Computational Math. Tenure-track Asst. Prof. and tenure-track/tenured Assoc. Prof. starts 9/1/90. Teach 2 courses/qt. at grad/undergrad level; assist in master's prog. in appl'd and computational math; do research; Dept. and college responsibilities. Demonstrated evidence of effective teaching and communication skills approp. to a faculty pos. is req'd. Min qual.: PhD in app'd math or related field by 9/1/90 and research in appl'd anal., math modeling./control, or numer. methods/sci. computation. Des. qual.: 5 yrs. profess'l exper., demonstrated excellence in teaching and advising, publications, extensive industrial or gov'tal exper. in computational math. Send app letter, resume, 3 letters of rec., and transcript (if degree rec'd in the past 5 yrs.) to Harlan Stech, Math & Statistics, UMD, 108 Heller Hall, 10 University Dr., Duluth, MN 55812-2496, by 1/15/90.

University of Missouri-Columbia. Dept. of Mathematics, Columbia, MO 65211. Apps are invited for one or two regular pos. beginning Aug. 1990. Appts. will be made at a rank and salary commensurate with quals. The pos. req. a PhD, quality teaching, and a commitment to a distinguished research career. Selections for each pos. will be based primarily on demonstrated research achievement in a field of interest to the Dept. Send a letter of app, a vita, and arrange for 3 letters of rec. to be sent to Prof. L.J. Lange, Chair, at the address above. The app deadline is Jan. 1, 1990, or until the pos. are filled thereafter. Apps rec'd after March 1, 1990 cannot be guaranteed consideration.

University of Nebraska-Lincoln. Computer Science and Engineering Dept. Seek apps and noms. to chair dynamic Dept. Research progs. are in algorithms, theoretica comp. sci., communication and information theory and networks, info. retrieval, fault tolerant computing, and human factors. Req. Doctorate in Comp. Sci. or related field and evidence of strong leadership for research and academic progs. Admin. exper. is desirable. Qualified apps should send resumes and names of 3 refs. postmarked by Feb. 1, 1990 (or until suitable candidates apply thereafter) to: Samuel B. Treves, Assoc. Dean, College of Arts and Sciences, 1223 Oldfather Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0312.

University of New Haven. One full-time tenure-track pos. at the Asst. or Assoc. Prof. level, starting Sept. 1, 1990. This pos. reqs. that the selected individual teach the majority of his/her course-load at the U. of New Haven branch campus located in Groton, CT. Quals. incl. a PhD in Math with spec. in Appl'd Math pref'd; demonstrated excellence in teaching and potential for research. Teahcing load is 24 credit hrs./yr. This pos. offers opportunities to participate in the devel. of courses, progs. and research. Salary and rank commensurate with quals. Apps should send a resume, arrange for transcripts and 3 letters of ref. to be sent to: Prof. Donald Fridshal, Chairman, Dept. of Mathematics, The University of New Haven, 300 Orange Ave., West Haven, CT 06516. Apps rec'd by March 1, 1990 will receive full consideration. LAter apps will be considered until pos. is filled.

University of North Carolina, Chapel Hill. Apps are invited for one appt. at the tenured Assoc. or Full Prof. level, effective Fall, 1990. A PhD and demonstrated excellence in research and teaching are req'd. Apps will be accepted until the pos. is filled; however apps rec'd by Feb. 15, 1990, are assured full consideration. Send 4 letters of rec., vita, and abstract of current research prog. to Search Committee, c/o Deborah Reives, Mathematics Dept. CB #3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599-3250.

University of North Carolina, Greensboro. Apps are invited for 2 tenure-track pos. (Asst. Prof. level), beg. Aug., 1990. One reqs. a PhD in Comp. Sci.; the other, a PhD in Comp. Sci. or Math with a strong interest in computational

math. Initial appt.: 4 yrs./9 months per yr. Salaries are competitive and negotiable. Evaluation of apps starts Jan. 30, 1990, but will continue until the pos. are filled. Send vita, transcripts and 3 letters of ref. to: S.M. Lea, Math Dept. UNCG, Greensboro, NC 27412. E-mail: LEASUE@UNCG.BITNET.

University of Northern Iowa. The Dept. of Math and Computer Science is seeking a Dept. head to facilitate the devel. of leadership in: math, comp. sci., & math ed; teaching and scholarly activity by all faculty; profess'l activity; and curric. devel. Responsibilities incl. budgeting and faculty assignment, eval., & devel. Appt. effective Aug., 1990. Salary is competitive and commensurate with exper. and quals. Closing date is Feb. 16, 1990. Contact: Philip East, Chair, Head Search Committee, Mathematics and Computer Science, UNI, Cedar Falls, IA 50614. (319) 273-2631.

University of Northern Iowa. The Math and Comp. Sci. Dept. invites apps for a new tenure-track pos. at the Asst. or Assoc. Prof. level from individuals with a strong commitment to undergrad teaching. Quals. incl. a doctorate in an area of stats., demonstrated success in collegiate teaching, and scholarly performance or promise. To be assured of full consideration, apps must be rec'd by Feb. 9. For complete announcement, contact: Dr. David Duncan, Head, Dept. of Mathematics and Computer Science, University of Northern Iowa, Cedar Falls, IA 50614. Immigration status of non-US citizens must be stated in apps.

University of Pittsburgh, Bradford. Two Asst. Prof. level pos. avail., starting Sept. 1990. (1) PhD req'd, and apps should have teaching interests in prob., stats., descrete math, and calc. (2) PhD pref'd, but MS with exper. considered, and apps should have teaching interests in algebra and precalc. Please specify which pos. you are applying for (or both) in your letter of app, and send a copy of your vita with 3 letters of ref. by Feb. 1, 1990, to: Dr. Richard F. Melka, Chairman, Mathematics Search Committee, University of Pittsburgh at Bradford, Bradford, PA 16701-2898.

University of Pittsburgh. Department of Mathematics and Statistics. The following positions are expected, subject to funding approval: 1. Specialist in applied mathematics, with emphasis on scientific computing 2. A position in pure mathematics. We are interested particularly in algebraic topology, algebra, and analysis, but outstanding applicants in any field will be considered. The rank is open on each position. Requirements include outstanding research accomplishment or potential. Excellence in teaching is also essential. Junior applicants should send a resume and arrange to have at least three letters of recommendation sent to: Stuart Hastings, Department of Mathematics and Statistics, University of Pittsburgh, Pittsburgh, PA 15260. Senior applicants should write directly to the same address.

University of San Diego. Math Dept. San Diego, CA 92110. One tenure-track pos. and two full-time sabbatical replacement pos. are anticipated beg. Sept. 1, 1990. Apps for the tenure-track pos. must have a PhD and a strong commitment to teaching undergrads in a small, independent, Catholic, liberal arts setting. Send vita and 3 letters of ref. to Dr. Stan Gurak, Chair, Mathematics and Comp. Sci. Apps will be accepted until Feb. 15, 1990, or until the pos. are filled.

University of Tennessee, Knoxville. Noms. and apps are invited for the pos. of Dept. head in Math. Candidates must possess an earned doctorate, a substantial record of research achieve., a commitment to excellence in research and teaching, a demonst'd capacity for leadership and admin., and an understanding of and commitment to equal empl. opportunity and affirmative action. Apps will be reviewed beg. Jan. 1, 1990; the desired starting date is Aug. 1990. Salary will be commensurate with quals. Candidates should provide a vita and 4 letter of rec. Inquiries, apps, and letters of rec. should be sent to: Prof. Kenneth Stephenson, Secretary, Mathematics Search Committee, 121 Ayres Hall, University of Tennessee, Knoxville, TN 37996-1300. (615) 974-2461.

University of Tennessee, Knoxville. Possible pos. for visitors, 1990-91, all levels, one or two sems., in areas related to current prog.: algebra, anal., math ecology, numerical anal., ordinary and partial diff. equations, prob., topology, stats. Contact: G.S. Jordan, Acting Dept. Head, Dept. of Mathematics, University of Tennessee, Knoxville, TN 36996-1300.

University of Texas, Arlington. We expect to fill several pos. beg. Fall 1990 (5 tenure-track pos. were filled in 1988 and 1989). Salary and rank are commensurate with quals. The selected candidates must have excellent credentials in research and teaching. The desired areas of expertise are: diff. or algbraic geom., comp. geom., partial diff. equations, fuctional anal., stats. and appl'd math. A resume with 3 letters of rec. should be sent to: C. Corduneanu, Dept. of Mathematics, UTA Box 19408, Arlington, TX 76109.

University of Wisconsin, Eau Claire. Dept. of Mathematics. Eau Claire, WI 54702-4004. Marshall E. Wick, Chair. One or mroe tenure-track pos. All specialties considered, with some pref. to those in classical geom. or math ed., esp. those with interest and exper. in teaching uppper level undergrad courses in geom. Doctorate strongly pref'd; tenure without the doctorate is unlikely. Load: 12 hrs., with 2 preps. Apps must present evidence of potential for excellence in teaching. One- or two-yr. initial appt. Closing date is Feb. 15, 1990, or until pos. are filled. Send letter of app, resume, grad and undergrad transcripts, and 3 letters of rec. to the Dept. Chair at the above address.

Washington State University. The Dept. of Pure and Applied Mathematics has a perm, tenure-track pos. avail. beg. Fall 1990. Rank and salary are commensurate with quals. Apps must have a demonstrated research ability in Math Modeling. Pref. will be given to candidates whose research prog. complements and supports basic research in the molec.

sciences, a broad-based campus-wide research initiative. Apps are esp. invited from individuals expert in dynam. systems or reaction-diffusion. A PhD is req'd, with competence to teach relevant grad and undergrad courses. Apps should send a vitae, a statement of current research and long-term research interests, and 3 letters of ref. by Jan. 15, to: Prof. Michael Moody, Math Modeling Search Committee, Dept. of Pure and Applied Math, Washington State University, Pullman, WA 99164-2930.

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.

Wellesley College. Dept. of Math. Three-yr. pos. at the Asst. Prof. level beginning Fall 1990. Reqs. include PhD in math (completed, or expected by June 1990), excellence in and commitment to math research and undergrad teaching in a liberal-arts environment. Apps should send a vita and arrange for at least 3 letters of rec. that address both teaching and research. Contact Chair, Dept. of Mathematics, Wellesley College, Wellesley, MA 02181.

Western Illinois University. Apps and nominations for the position of chairperson with assoc. or full Prof. faculty rank are invited. Doctorate in math, stat, or math ed required. Evidence of excellence in undergrad and grad teaching, a record of substantial research/scholarly achievement, and demonstration of appropriate administrative ability is expected. Selection process will begin 11/1/89 and continue until the position is filled. Send application, vita, photocopies of transcripts, and at least 3 letters of reference to: Chairperson Search Committee, Dept. of Mathematics, Western Illinois University, Macomb, IL 61455.

Western Michigan University. Three tenure-track pos. are anticipated beg. late Aug. 1990 in stats. (Asst. Prof.), comp'l math or com'l stats. (Asst. Prof.), and Combinatorics/Graph theory. PhD req'd. Candidates should also demonstrate achiev. and potential in both teaching and research. Letter of app, vita, transcripts and 3 letter of rec. should be sent to: Dr. Yousef Alavi, Chair, Dept. of Mathematics and Statistics, Western Michigan University, Kalamazoo, MI 49008-5152. Deadline for apps is Feb. 1, 1990. Late apps will be considered until pos. are filled.

Western Washington University. Tenure-track and visiting pos. to begin Fall 1990. PhD in math req'd. Candidates esp. sought in: (1) Dynam. systems, optimization, graph theory. (2) Math ed., esp. secondary ed – elementary/secondary teaching exper. pref'd. Rank and salary open, but substantial research record req'd for appts. above Asst. Prof. level. Pos. subject to continuing avail. of funds. Apps should send vita, transcripts, and 3 letters of rec. to: Dr. Thomas T. Read, Chairman, Dept. of Mathematics, Western Washington University, Bellingham, WA 98225. App deadlin: Feb. 1, 1990, apps will be accepted until pos. are filled.

Wichita State University. The Dept. of Math and Stats. invites apps for a tenure-eligible Asst. or Assoc. Prof. pos. starting Aug. 1990. Spec. in Functional Anal. or Numerical Anal. will be give special consideration. All areas of Appl'd Math will be considered, esp. those consonant with the research interests of the members of the present Dept. A PhD is req'd. Asst. Prof. candidates are expected to have demonstrated potential for and promise in research. Assoc. Prof. candidates should be active in research with est'd research and publication records. All candidates should have a strong interest in teacing and the ability to participate in our doctoral prog. in Appl'd Math. Salarly competitive. Send app letter, detailed resume, and arrange to have 3 ref. letters sent to: Wichita State University, Prof. Stephen W. Brady, Search Committee Chair, Dept. of Mathematics and Statistics, Wichita, KS 67208. Deadline Jan. 20, 1990, then monthly until pos. is filled.

William Patterson College. Tenure-track pos. in Math avail. beg. Sept. 1, 1990. Apps must possess the PhD. A strong commitment to undergrad teaching and establishment of and active research prog. are expected. Current research interests in the Dept. incl. discrete math, stats., diff. geom., and topology. Salary and rank are based on background and exper. Submit a letter of app, current vita, and 3 letters of ref. concerning teaching and research abilities by Jan. 30, 1990 to E. Phadia, Chairperson, Dept. of Mathematics, William Patterson College, Wayne, NJ 07470.

Williams College. Dept. of Mathematics, Williamstown, MA 01267. Three anticipated pos., prob. at the rank of asst. Prof., for Fall 1990. Strong commitment to both teaching and scholarship is essential. Please have a vita and 3 letters of rec. on teaching and research sent to Frank Morgan, Chair. Eval. of apps. will continue until pos. are filled.

Winona State University. Apps are invited for 3 probable tenure-track (rank and salary dependent on quals.) pos. – one each in stats., math, and math ed. to begin Sept., 1990. Min. req. is ABD (PhD must be completed by 1993). We also anticipate 3 temp. 1-yr. pos. because of sabbaticals and a leave. Min. req. is a master's degree. All pos. (both tenure-track and temp.) req. and average teaching load of 3 courses (12 credits) per qtr. and may incl. off-campus teaching assignments. Send cover letter (indicating which pos. applying for), resume, transcripts, and 3 letters of ref. to: Dept. of Mathematics & Statistics Searches, c/o Office of Human Resources, Winona State University, Winona, MN 55987. All pos. are open until filled.

Xavier University. Apps are invited for tenure-track pos. in math/comp. sci. beg. Sept. 1990. Candidates must have and earned doctorate and a commitment to teaching a variety of undergrad math and CS courses within the framework of a Jesuit liberal arts institution. The pos. also reqs. advising majors and assisting in course and curric. revision while continuing a prog. of scholarly devel. Apps will be reviewed as they are rec'd and will be accepted until the pos. are filled. Send resume, transcripts and 3 letters of ref. to: D.C. Trunnell, Chair, Mathematics and Computer Science, Xavier University, 3800 Victory Pkwy., Cincinnati, OH.

POSITION OF INTEREST

University of Maryland, College Park. Applications and nominations are invited for the position of Dean of the College of Computer, Mathematical, and Physical Sciences at the University of Maryland, College Park campus. The dean of the College provides both academic and administrative leadership for the College and reports directly to the Vice Chancellor for Academic Affairs and Provost. The College of Computer, Mathematical, and Physical Sciences consists of the departments of Computer Science, Geology, Mathematics, Meteorology, and Physics and Astronomy, as well as the Applied Mathematics Program, the Center for Automation Research, the Chemical Physics Program, the Institute for Physical Science and Technology, the Institute for Advanced Computer Studies, and (jointly with Engineering) the Laboratory for Plasma Research. The College employs 472 faculty members and approximately 800 support personnel. Presently about 2300 undergraduate students and 800 graduate students are enrolled in degree programs within the College. In 1988-89, researchers in the College were awarded approximately $34,000,000 in external grants and contracts. The state-supported budget for the College for this period was about $28,000,000, and is expected to increase.

A candidate should have an earned doctorate and be eligible for appointment as a faculty member in a department of the College at the rank of Professor with tenure. He or she should have successful experience as a teacher at the undergraduate and graduate levels and a distinguished record of scholarly research. Candidates should also have demonstrated leadership ability and management skills.

Applications or nominations for the position are invited. Applications should include a complete resume or curriculum vitae and the names and addresses of at least four references. For best consideration, all applications and nominations should be submitted before March 1, 1990 to: Patrick F. CunniffC.M.P.S. Dean Search Committee Office of Graduate Studies & Research 2125 Lee Building University of Maryland College Park, Maryland 20742

PROGRAMS OF INTEREST

The American University. The Department of Mathematics and Statistics offers masters degrees in mathematics, statistics, and statistical computing; and doctoral degrees in mathematics education and statistics. The size of the department, twenty faculty and approximately forty grad students, allows a diversity of academic opportunity while retaining an intimate and supportive environment. Admission to the PhD program in mathematics education requires a master's degree in either education or the mathematical sciences. While the program stresses mathematics content and mathematics education at the secondary and college level, the curriculum permits considerable flexibility. For all grad programs enrollment is possible on both a full-time and part-time basis. Over the past ten years forty percent of the department's doctorates have been earned by women. For additional information write to: Basil Korin, Chair, Dept. of Mathematics & Statistics, The American University, Washington, DC 20016.

Rutgers University. Graduate study in mathematics at Rutgers University. The Graduate Program in Mathematics at Rutgers University is eager to attract applications from well-qualified women. We are fortunate to have on our faculty a number of the best women mathematicians in the country. We hope that our environment is supportive of all graduate students, especially women. We have an unusual faculty-student ratio: a faculty of more than 95 with an entering class (in recent years) numbering between 20 and 25. Almost all of our students are admitted directly to our doctoral program, and almost all our students have some sort of support. Support ranges from academic year teaching assistantships, paying approx. $8,800 plus tuition remission and full health benefits, to calendar year fellowships, with a stipend of $15,000 plus tuition remission. Some areas in which we have exceptional activity include combinatorics/discrete mathematics, mathematical physics (especially stat mechanics), systems control theory, non- linear functional analysis, Lie theory (both analytic and algebraic aspects), mathematical logic, finite group theory, and number theory. We would be happy to supply further details. Write to: Graduate Program in Mathematics, Dept. of Mathematics, Rutgers University, New Brunswick, NJ 08903.

University of Washington. One of the major research universities in the United States, offers a strong, demanding program of study in mathematics: approximately 60 faculty members and 90 graduate students with research interests in virtually every area of mathematics, an outstanding mathematics research library with more than 33,000 volumes and 550 serials, a recently installed network of VAX workstations, terminals and servers.
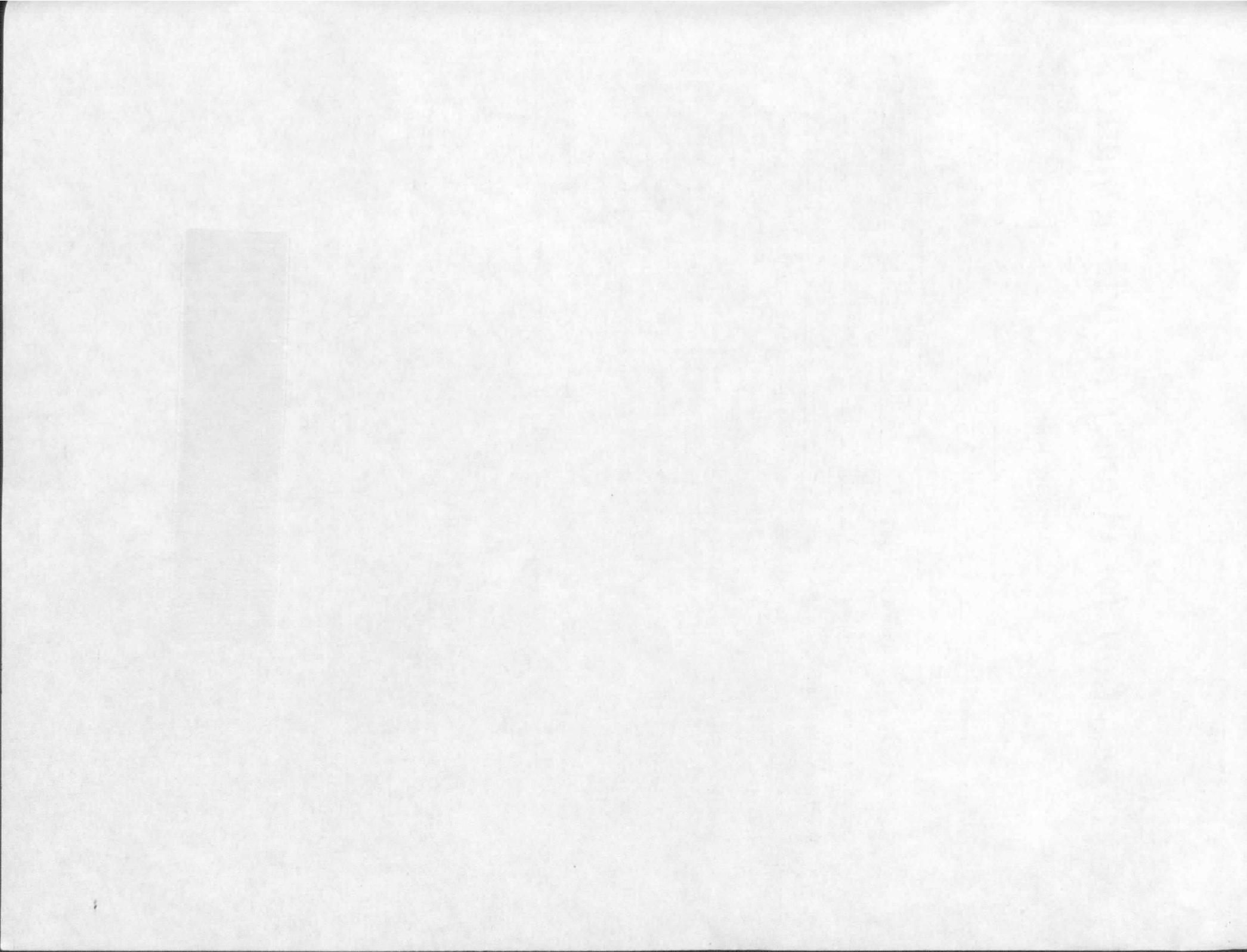
The following scholarships and fellowships will be available to qualified entering graduate students: 10 Fellowships, approximately $11,000, partially funded by the U.S.Dept. of Education; 1 Teaching Fellowship, $12,500; 8 Eleven- month TA positions, $10,022;16 Nine-month TA positions, $7,974. We expect to award a number of fellowships to members of ethnic minority groups and to women.

For additional information please write to: Ms Sheila Farr, Graduate admissions, Department of Mathematics GN-50, University of Washington, Seattle, WA 98195.

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.

Institutional members of AWM receive two free ads per year. All other ads are $20 each for the first eight lines of type. Ads longer than eight lines will be an additional $15 for each eight lines or fraction thereof (i.e., $35 for 9-16 lines, $50 for 17-24 lines, etc.)

Association for Women in Mathematics

MEMBERSHIP FORM

Name: _____ ___

Mailing address: _____

_____

Institutional affiliation (if any): _____

Telephone numbers: Home: (___)_____ Office: (___)_____

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Renewal_____ New Member_____ (check one) Address change?_____

Individual: $20   Family: $25   Student, Retired, Unemployed: $5
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Institutional members receive two free advertisements per year in Newsletter
    Sponsoring, Category I (may nominate 10 students for membership): $100
    Sponsoring, Category II (may nominate 5 students for membership): $75
    Regular: $50

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

Association for Women in Mathematics
Box 178 Wellesley College
Wellesley, MA 02181

JANUARY - FEBRUARY

Marie A. Vitulli
Dept. of Mathematics
University of Oregon
Eugene   OR 97403