

Association for Women in Mathematics

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NEWSLETTER

January-February 1989

PRESIDENT'S REPORT

It gives me great pleasure to pass on the AWM Presidency (and the silver bowl from the AMS) to Jill Mesirov, an able and experienced mathematician who brings to the position considerable knowledge of the worlds of academe, administration, and industry. Currently Senior Scientist at Thinking Machines in Cambridge, MA, Jill is widely known in the mathematics community and has long been active in AWM. Best wishes, Jill, for a productive and enjoyable term.

Exxon Grant and Kovalevsky Days. A few days before this report was due, Tricia Cross called with some wonderful news. We have received a grant of \$10,000 from the Exxon Education Foundation for the general support of our program and activities. This grant is particularly gratifying, for it was essentially unsolicited: our activities drew the attention of Exxon, and Tricia helped us put our best foot forward.

Because so many of you have expressed interest in organizing Sonia Kovalevsky High School Days, the Executive Committee has agreed to commit up to \$5,000 to support five such days this spring or summer. If you are planning a SKHS Day in your area and wish to apply for support, please send Tricia Cross a detailed description of your project, together with a budget, by *March 15, 1989*. We anticipate making five awards of up to \$1,000 each.

The remaining \$5,000 will be used at the discretion of our new President and her Executive Committee.

China trip. The generosity of our membership is truly gratifying! We have already received over \$15,000 in contributions from members who wish to support others unable to afford the full cost of the trip. Please let Alice Schafer know if you wish to be considered for support.

NSF-AWM Travel Grants. We had a strong response to our request for proposals, and a distinguished panel has selected the following women for funding:

Esther Beneish, Northwestern University (conference on ring theory in honor of S. Amitsur, Israel)

Kathryn P. Hess, MIT (Algebraic Models of Homotopy Types, Blaubeuren, West Germany)

Inessa Levi, University of Louisville (AMS-MAA Joint Meetings, Phoenix – algebraic semigroup theory)

Joan M. Lucas, Rutgers University (conference in theoretical computer science)

Katherine Murphy, University of North Carolina (IFAC Symposium on Control of Distributed Parameter Systems, Perpignan, France)

Katherine Porter, Ball State University (Annual Spring Topology Conference, Knoxville)

Judith Roitman, University of Kansas (Symposium on General Topology and Applications, Oxford, England)

Nancy E. Zumoff, Kennesaw College (Workshop in combinatorial group theory, MSRI, Berkeley).

Please continue to send us your proposals — the next deadline is February 1.

Nominating Committee. The Nominating Committee for the 1989 election consists of Bhama Srinivasan (Chair), Linda Keen, and Vivienne Malone-Mayes. Please contact them with suggestions for President-Elect and Members-at-Large (three to be elected).

Congratulations. Mary E. Brewster, assistant professor at Rensselaer Polytechnic Institute, was the first recipient of the DiPrima Prize awarded at the SIAM meeting last summer. Brewster received the award for her dissertation in applied mathematics.

Final Word. I really have enjoyed my term as President of AWM. I've met so many fine people, women and men committed to the support and encouragement of women at all levels of mathematical endeavor, that I am now somewhat spoiled. I take it for granted that wherever I go, I will find friends of AWM. Unfortunately, this is not always the case, and there is work to be done. There are still departments where AWM is virtually unknown, and situations in which women still feel isolated and out of place. We have yet to address seriously the attrition of women from graduate programs in mathematics. It is no surprise that, as Sheila Widnall observes in her excellent article "Voices from the Pipeline" in *Science* (30 Sept. 88), women exhibit low self-esteem in graduate school. What are women supposed to think, when their professors tell them, albeit indirectly, that there is not a single woman mathematician worthy of tenure and promotion in their department?

Although I have found the mathematical establishment intransigent and elitist at times, there are so many good people out there that I step down feeling optimistic about the future. Perhaps it has taken the sobering reality that we have collectively lost our ability to attract young people to our profession, to finally stir some serious action — but action there is. The research and education factions are working together in a way unprecedented in my mathematical lifetime. Those who years ago dedicated themselves to teaching, not a popular choice a decade ago — the Deborah Hughes Halletts and the Uri Treismans — are now justifiably perceived as those who can lead us out of this crisis. The AWM membership has always represented the best of both worlds — teaching and research — and so is in a unique position to lend leadership to the revitalization of our profession, and to insure that women thrive in the process. In Bhama Srinivasan's words, "... may our tribe increase."

Finally, thanks to all of you who have given me advice, support, and encouragement:

to Bettye Anne Case, Anne Leggett, and Alice Schafer, who really keep AWM going, and helped me in countless ways;

to my distinguished predecessor Linda and successor Jill, who helped guide me into and out of the forest;

to our conscientious and hard-working Treasurers, Lynnell and Jenny;

to Mary Beth Ruskai, Carol Wood, Tony Hughes, Ann and Neal Koblitz, Lee Lorch, Judy Roitman, Pat Kenschaft, Mary Gray, Karen Uhlenbeck, Deborah Haimo, Lida Barrett, Louise Hay and many more, for valuable suggestions;

to our wonderful friends of the AMS staff: Hope Daley, Janet Balletto, Penny Pena, and Betty Verducci, who treat us like royalty;

to my great kids, Sarah and Jeremy, who went to all those meetings, and didn't make *too* much noise;

and to the AWM members. It has been an honor to serve you.

Rhonda Hughes
Department of Mathematics
Bryn Mawr College
Bryn Mawr, PA 19010
BITNET: RHONDAJ@BRYNMAWR

UHLENBECK NAMED ONE OF AMERICA'S 100 MOST IMPORTANT WOMEN: The editors of *Ladies' Home Journal* in the November 1988 issue have named their choices for America's 100 most important women, "a fascinating, sometimes surprising group that reflects the multifaceted, still-evolving role of women on the eve of the 1990s". Their list includes Karen Uhlenbeck, professor, The University of Texas at Austin. Her quote: "Math is never boring; it's always challenging. I hope that one of my virtues as a teacher is communicating this to my students, especially my female ones."

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.

WHO INVENTED COBOL?

by Claudia Zaslavsky, New York, NY

Grace Murray Hopper is generally considered the "mother of COBOL [Common Business Oriented Language]" [AWM *Newsletter* 17,1: page 7]. It would be more accurate to call her the "grandmother of COBOL." This article will describe the work of the group of women who participated directly in the creation of COBOL.

During a recent conversation about women in mathematics and computers, I remarked that Grace Hopper had invented the computer language COBOL. "That's not true," said my friend, a retired computer expert. "COBOL was actually developed by a team, and Grace Hopper was not directly involved. I know the person who played a prominent role in the development of COBOL, also a woman. Her name is Jean Sammet."

One should give credit where credit is due. I wrote to Jean Sammet at IBM, explaining my interest in her work and my desire to write an article for the AWM *Newsletter* to correct the record. Shortly thereafter I received a letter and a 45-page article, both written by Jean Sammet. In her letter she emphasized that, although she had chaired two significant subcommittees, COBOL was truly a committee effort.

The following history is based on Jean Sammet's paper, "The Early History of COBOL" [Richard L. Wexelblat, ed. *History of Programming Languages*. Academic Press, 1981: 199-243]. A draft of her article had been reviewed by Grace Hopper, among others. Jean Sammet has read and approved the article you are now reading.

Why should Grace Hopper be called the grandmother of COBOL? Mainly because she had directed the development at Remington-Rand Univac of the language FLOW-MATIC, which subsequently became a major input in the deliberations that resulted in COBOL. FLOW-MATIC was the first computer language that used full English words as commands and full data-names rather than short symbolic names. A program written in FLOW-MATIC was fairly readable in ordinary English. Another feature was the separation of data descriptions from instructions, a conceptual breakthrough in the mid-1950s. Most important, it worked and was in use by 1957, before the effort that was to produce COBOL had been organized.

That effort was initiated in April 1959 by a group of computer people, including Grace Hopper, as a result of a request by Mary Hawes (Burroughs) to arrange "a formal meeting... where plans could be prepared to develop the specifications for a common business language for automatic digital computers" [page 200]. The Department of Defense was asked to sponsor this meeting, and it took place at the Pentagon the following month. Hopper attended as a representative of Remington-Rand Univac, while Sammet was the senior of two representatives from Sylvania Electric. The goal was to come up with a common business language that would be easy to use; many in the group favored the use of simple English to the maximum degree possible.

Hopper was not directly involved in the subsequent work, except as an adviser to the Executive Committee overseeing the project. Two committees were established, a Short-Range group and an Intermediate-Range group. The task of the Short-Range Committee, of which Sammet was a member, was to explore existing languages (FLOW-MATIC and others) and to recommend an interim language, in the expectation that this common language would supplant ("nip in the bud") those under development by individual manufacturers. The Intermediate-Range Committee would develop the language to be used in the future.

As it turned out, the language developed by the Short-Range Committee in the following months is still in use today! Sammet writes:

It was definitely felt that the Intermediate-Range Committee would have the time and the resources to develop a really good and long-lasting business data processing language. I am certainly convinced in my own mind that had the Short-Range Committee realized at the outset that the language it created (i.e., COBOL) was going to be in use for such a long period of time, it would have gone about the task quite differently and produced a rather different result. But I believe that most of us viewed our work as a stopgap measure — a very important stopgap indeed, but not something intended for longevity. [page 203]

An important factor that influenced the early adoption of this language was "the pressure from the Department of Defense which essentially insisted that computer manufacturers provide COBOL compilers" [page 236]. After all, he who pays the piper calls the tune!

I will not relate the many fascinating details of the creative process that resulted in COBOL, except to describe the remarkable input of the women who were involved. Of the twenty-eight people who participated in the work of the Short-Range Committee at any time, only seven were women. But of these seven, five played major roles.

The two main subcommittees of the Short-Range Committee were: the task group on data descriptions, chaired by Mary Hawes (Burroughs), and the task group on procedural statements, chaired by Jean Sammet (Sylvania).

By October 1959 it was clear that the Short-Range Committee as a whole was too large and unwieldy for efficient work. A six-member team was chosen, or semi-volunteered, to develop the specifications. In this group were two women — Sammet and Gertrude Tierney (IBM). After two weeks of work, including some round-the-clock sessions, they sent their results to the full committee. Then an editing committee (the same six-member group) was appointed, with Sammet as chair. Two women assisted unofficially in the editing task — Betty Holberton and Nora Taylor, both from the Department of the Navy.

In January 1960 the final product was submitted to the Executive Committee. The report was accepted, and a two-member editorial board was set up. However, due to certain circumstances, Frances E. (Betty) Holberton did all the editing herself.

And so, in a few short months, this remarkable project was successfully concluded.

The Government Printing Office published the final COBOL 60 GPO report, with the name of the requesting department, Department of Defense, printed in large letters on the cover. In accordance with an Executive Committee decision, the names of the people who had participated in the work of the Short-Range Committee were completely eliminated.

What was the fate of the Intermediate-Range Committee? It spawned work under its auspices on decision tables and on a more theoretical approach to business data processing known as Information Algebra. However, once the Short-Range Committee had produced a usable language which the manufacturers were practically forced to adopt if they wanted to sell to the Pentagon, there was no need for further work on a different language. In the ensuing years, COBOL itself went through many revisions, with input from European countries and Japan, as well as from American users. It became an American and international standard, with several upgrades of each.

No one woman can be called the "the mother of COBOL," but we can honor the women who participated in the birth of this long-lived language.

The story of Jean Sammet's life and work deserves an article by itself. What follows is a brief summary of the highlights. She graduated from Mt. Holyoke College with a major in mathematics. After receiving an M.A. in mathematics from the University of Illinois and doing other graduate work in mathematics, she started her work with computers. From 1955 to 1958 she organized and supervised the first scientific programming group for Sperry Gyroscope Company. After working with software for three years at Sylvania, she started her long-standing association with IBM in 1961. For her work in directing the development of FORMAC (FORMula MANipulation Computer), she received an IBM Outstanding Contribution Award. (FORMAC was the first widely used general language and system for doing symbolic computation.) Since 1978 she has been heavily involved in activities with

Ada, the Department of Defense's advanced programming language named after Ada Byron Lovelace (1815-1852), often called the "first computer programmer." Sammet has been very active in the Association for Computing Machinery (ACM) and has served it in numerous positions. She was the first woman President (1974-1976) and for eight years was the Editor-in-Chief of the ACM journals for reviewing and citing computer literature. For her numerous contributions to the field she received the ACM Distinguished Service Award. She also received an honorary Sc.D. from Mount Holyoke. In 1969 Prentice-Hall published her 785-page book *PROGRAMMING LANGUAGES: History and Fundamentals*, considered by many as "the standard work on programming languages." Her update of this classic is underway.

EDUCATION COMMITTEE SURVEY RESPONSES

AWM Education Committee; Sally Lipsey, Chair

We thank all those who responded to our survey, "Women and Computer Education." Each letter was interesting, helpful, and welcome. Suda Kunyosying (Shepherd College, West Virginia) organized and summarized the responses from the survey and found representatives from both groups: those who feel that the computer is predominantly a male machine and those who do not.

Among the first group, Anna Gade, a junior math major at Swarthmore, wrote that "with every class I must 'psych up' to be the only woman ... again" and conjectured that the problem began at the junior high level, where many boys already have advanced backgrounds. She suggested that female support groups be formed and that female educators should do more to encourage female students and should be more open in discussing women's math/science experiences with them. At Baker University, Dr. Elizabeth Applebaum (of Shawnee Mission, Kansas) found that "all the computer professors were men. Of the dozen or so science faculty, all except me were men. In the higher level computer courses the majority of the students were men." Dr. Applebaum supported affirmative action programs in colleges and maintained that criteria for accreditation of math/science departments should include participation by women and minorities.

From the second group, Dr. Ellen Cunningham of Saint Mary-of-the-Woods College, Indiana, a women's college, listed several successful actions at her college that have helped to promote the use of computers among women: a curriculum grant which encouraged faculty of all disciplines to incorporate computer use into courses, workshops to familiarize faculty with computers and software, and a "girls only" computer camp. St. Mary-of-the-Woods College has a required computer literacy course, a major in computer information systems, and a well-equipped computing center. Dr. Cunningham suggested that steps should be taken to highlight successes of female computer professionals and to protest sexism in computer marketing. A statistician, Meredith Warshaw (of Brookline, Massachusetts) works with a group of statisticians, most of whom are female who "use the computer constantly." She attributes her own positive outlook to a professor who integrated the computer into a psychology statistics course. "He didn't condescend to the class, but was very clear and organized..."

Also in response to our survey, Caroline Eastman (University of South Carolina) sent information on the Association for Women in Computing, which has a major interest in educational issues. For an address list of local chapters, write to AWM Education Committee, c/o Sally I. Lipsey, 70 E. 10th St., #3A, New York, NY 10003.

INVITATION TO JOIN THE AWM MATH EDUCATION COMMITTEE

To: All those interested in the work of the committee (current members and all interested in joining)
From: Sally I. Lipsey, Chair, 70 E. 10th St., #3A, New York, NY 10003 (212) 260-8221

This is a good time for the AWM Education Committee to make plans for 1989. We hope that you will be able to join us in the preparation of material for publication in the *Newsletter* or in other activities as they develop. Please help us to plan ahead by completing the form on the next page and returning it to the address above as soon as possible. Thank you.

EDUCATION COMMITTEE QUESTIONNAIRE

Name with preferred title:

Position:

Best address to use:

Best telephone(s) to use with preferred time(s):

Please rank the following with respect to your interest in being responsible for an article on that topic. Use 1 for your first choice.

Pedagogy:

- Math anxiety _____
- Textbooks _____
- Minorities and math _____
- Returning adults _____
- Applications _____
- Math literacy _____
- Teacher preparation _____
- Problem-solving _____
- Other (specify) _____
- _____
- _____

Curriculum:

- The "new" calculus _____
- New NCTM standards _____
- Applications _____
- Other (specify) _____
- _____

Programs:

- Math Awareness Week _____
- Math Ed Month _____
- Math Science Network _____
- Summer projects _____
- Other (specify) _____
- _____

Reports:

- Latest statistical data on women and math _____
- Historical data _____
- Recent news _____
- International comparisons _____
- Unusual experiences _____

- School/community news _____
- State activities _____
- Interviews _____
- Other (specify) _____
- _____

If you do not wish to be responsible for the writing of an article, would you be willing to contribute research only?

We are also seeking teams with opposing views to write Point-Counterpoint articles. Do you have a potential partner with whom to prepare such an article?

UNDERGRADUATE INSTRUMENTATION AWARDS

Congratulations to the following, who have received awards from the NSF Instrumentation and Laboratory Improvement program. The principal investigators and their institutions are: Betty L. Acord, Connors State College; Jean B. Chan, Sonoma State University; Gloria L. Drapac, Mount Mercy College; Leslie V. Foster, San Jose State University; Marilyn L. Livingston, Southern Illinois University, Edwardsville; Christine E. McLaren, Moorhead State University; Alice A. Saylor, Bloomfield College; and Patricia A. Wenner, Bucknell University.

The awards are made to non-doctoral institutions offering degree programs in one or more of the NSF-supported fields of science, engineering and mathematics. This year was the first time two-year and community colleges were included in the program. In addition to fostering the development of curricula and laboratories, this program is designed to benefit undergraduate student research programs, projects for nonscience majors, and projects that improve the training of precollege teachers of science and mathematics.

BOOK REVIEW COLUMN

Math Games for the Young Child by Agnes Azzolino, Mathematical Concepts Inc., 85 First Street, Keyport, NJ 07735-1053, \$10.
Reviewed by Mary Flahive, University of Lowell.

The possible audience for this book can be divided into two groups: mathematically oriented adults who want to be more comfortable in playing with children, and adults who want to be more comfortable with mathematics in order to play with children. Some individuals in the first class may get a pep talk from reading the introduction and scanning the book. I think that the pedantic tone of the book may stifle creativity in individuals of the second type. In addition, the author is a bit too conservative, giving too many admonitions about relative difficulty of questions.

The author considers the book to be "a textbook of games for ages of two through seven." She groups the games into seven categories: counting and counting games, travel games, card games, board games, games and activities with other things. Each game is classified according to level of difficulty and is related to other games in this book.

Discarded Minds by Lisa Syron, for the Full Access and Rights to Education Coalition and The Center for Public Advocacy Research. 12 West 37th Street, New York, NY 10018, (212) 564-9220, 91 pp., \$6.00.
Reviewed by Carolyn Dean, University of Chicago.

This report examines the effect of gender, racial and socioeconomic bias on the mathematical and scientific education of young women in the New York City public schools. It's sobering stuff, which ought to concern us all.

The statistics tell a powerful story. For example, only 25.6% of the senior girls in the study have completed three or more years of high school math. At predominantly minority low income schools, this figure drops to a shocking 6.3%. Ms. Syron points to evidence that a single year of high school math is worth \$3000 to a new graduate's starting salary, yet only 39.8% of the low income minority young women have completed this course.

Ms. Syron is at her best analyzing the causes of this situation. Overcrowded classes, inadequate teachers, sexism in the classroom — to be sure, some of the problems are all too familiar. But this report also points to the tracking system and the growing reliance on standardized achievement exams as trends which have a disproportionately adverse effect on female students.

Perhaps most importantly for AWM, Ms. Syron documents the powerful impact that encouraging teachers and attractive role models can have on the decisions made by high school (and college) students. For a girls who simply hasn't thought of furthering her mathematical education, this kind of attention can literally be the gateway to a better life. Anyone for the Speakers' Bureau?

Myths of Gender: Biological Theories About Women and Men by Ann Fausto-Sterling, Basic Books, Inc., 1985, PL 5185, \$9.95, ISBN 0-465-04791-2.
Reviewed by Linda Keen, Herbert H. Lehman College, CUNY.

In this refreshing book Anne Fausto-Sterling, a professor of biology and medicine at Brown University, takes a good look at many current theories of biologically-based sex differences. In extremely readable prose, she outlines various contemporary work on gender differences including work on genetic and hormonal studies. She also addresses the questions of whether men are really smarter and/or more aggressive than women. She finds that almost all the work she surveys is not only flawed because it reaches contradictory and absurd conclusions, but more importantly, it is flawed in its concept and methodology.

The issue here is not only what is good science and what is bad science, but also that "conventional good science" is not an absolute. As a scientist and feminist Fausto-Sterling examines mainstream scientific investigations of gender and, with this viewpoint, she sees things about the research methods and interpretations that many others have missed. Finally, she points out that all evaluations made by scientists are always influenced by philosophical and political beliefs.

I highly recommend this book to readers of this newsletter. We cannot avoid the issues raised in it — they are brought to our attention whether we like it or not. The discussion in this book is as articulate, intelligent and convincing as any I've seen.

FEMMES ET MATHEMATIQUES: Y A-T-IL UNE INTERSECTION? (part 2 of 2)

a presentation by Leone Burton to the Conference, Femmes et mathématiques, Québec, Canada, June 6, 1986

French version published in *Femmes et Mathématiques*, Louise Lafortune, ed. Les Editions du remue-ménage, Montréal, 1986.

Professor Burton would be happy to receive feedback about the article. Write her at School of Social and Environmental Education, Avery Hill Campus, Thames Polytechnic, Bexley Road, London SE9 2PQ, UK.

Thanks to Beth Ruskai for bringing this to our attention.

Three common themes are encountered in areas where girls are confident and successful. One is the role of language, another their preference for small group collaboration, and a third the desirability of personal choice. They are not independent, the third depending for its implementation on the validation of the first two. I shall look at them, however, in turn.

The use of language dominates areas of the curriculum at which girls succeed. In Britain, the figures for girls' entry into public examinations at 16 plus in English, history, social studies, etc., are an inversion of the figures for mathematics and the sciences. If we read the developmental psychologists we find that girls develop linguistically in advance of boys, and if we look at pupils experiencing difficulties in the reading/writing/spelling areas they are predominantly male. I am not asking why this might be so, but taking it as an empirical reality and, as such, wishing to apply it to the learning of mathematics.

So frequently we hear it asserted that mathematics *is* a language, but what does this mean for our pupils? It seems to me that they meet mathematics, if at all, as a foreign language at an age when they are still struggling for mastery of their natural language. Furthermore, they meet this foreign language in a written form, i.e., in symbols, before they have had the opportunity to "speak" it, a practice which has never been found productive in the teaching of English or French. In order to encourage young children to embrace their own language, to use it creatively, to experiment with it, we speak it, we tell stories, we sing nursery rhymes, we do as many and varied things with the language as we can. Is that how children encounter mathematics? If not, why not? The language of pattern, of shape, of relationships can be spoken, played, observed in order to encourage an equal facility and interest. But also, children's developing expertise in their natural language can be used to build confidence in mathematical representations. An area of performance in which girls feel familiar and confident would then be available in a subject where presently they appear to experience increasing alienation.

There is a counter-argument to this which states that girls' difficulties in mathematics only begin in the secondary years and that they are good performers in the primary school. Recent evidence in the U.K. contradicts this view and, indeed, raises extreme concerns over pre-school experiences which socialize girls into behaviors which are mathematically unproductive. For example, in a small study in London, teachers embarked upon action research in their own classrooms with nursery and infant children aged 3-6 years. In particular, they not only watched these children in constructional activities but also observed closely what happened during the activities. First they found that girls embarked upon traditional female permission-seeking behavior when they wanted to join a group which was already playing with construction equipment such as Lego. They would say "Can I play" to which the answer would be "No." Boys on the other hand would just join in and be accepted by the group. Once a group of boys was playing together they most frequently built dynamic models which they slotted into a story line. So, for example, they made lorries or cars, and then they would have them running down streets, racing, crashing — the kind of thing most parents and teachers of young children recognize. Inevitably, they were building linguistic representations of their spatial play and using language to explore the mathematical aspects of that play. The girls, on the other hand, built static objects, houses for example, and while they were building they were talking, but not about what they were doing. In other words, their brains were engaged but with different matter than what was engaging their hands. They were using their opportunity for exploring the social context of their learning while, at the same time, missing the opportunities for mathematically related discussion. In a recent publication, I pointed out that:

the caring parent discusses with the pre-school child while physically engaged in doing a number of tasks, but the tasks rarely form the basis for adult/child talk. More frequently, that talk is carried on despite the task. So by their very versatility in coping with a wide range of tasks and responsibilities simultaneously, caring parents, usually mothers, seem to be presenting a non-task-focussed model to their children, a model which the girls are more likely to use than the boys. [Burton, *Girls Into Maths Can Go*, Holt, Rinehart & Winston, 1985, p. 11]

Task-focussed speech is important to the learning process for many reasons. It provides a perceptual input in addition to sight, hearing and touch. It requires children to build linguistic representations of their actions and try these out on others. It encourages the growth of conversation about learning, first with others, ultimately with oneself. In a recent book on self-organized learning, Thomas and Harn-Augstein wrote:

conversation implies that whilst meaning is shared, each participant remains free to accept, reject and/or reconstruct the shared meaning. They can invent new meanings. All these are added to the potential for conversation. [Thomas & Harn-Augstein, *Self-organised learning*, Routledge & Kegan Paul, 1985]

Although the development of conversation with oneself is necessary to learning, in the early years it is important to provide the opportunity for such conversations to grow out of conversations with others. So the importance of being able to speak about learning is inseparable from the importance of working with others. We know from many experiments that have been conducted that girls prefer to work with others than to work alone. They certainly prefer to interact closely than to be required to respond at long distance, for example to a question from the teacher at the front of the room. In a conventional teacher/pupil dialogue where the teacher is asking questions and expecting pupils to supply answers, girls are reticent. This is not just a question of confidence but also a preference for a style of interaction which is not confrontational or competitive. Small-group work avoids such interactions, validating private rather than public talk. It also helps to undermine the dominance by boys of the mixed-sex classroom, a feature which has been underlined in many studies.

The availability of personal choice of a mathematical enquiry which is challenging provides the context in which pupils can work together, discussing what they are doing and why, arguing through their alternative interpretations and making mathematics come alive. The kind of discussion which takes place under these conditions has a very different quality from teacher/pupil dialogue. It is task focussed and responsive to the needs of the enquiry and those engaged upon it. It requires a minimum of two pupils for whom the task is a meaningful challenge and the responses to that challenge conjectural and possibly conflicting. The process of working through the conflicts is the means by which the pupil tests the conjectures, searches for falsifying and validating evidence, and establishes the new understanding in a personally robust manner. The process and the outcome are substantially different from the formal classroom in which the outcome is more likely to be the pupils' accommodation to impersonal knowledge "owned" by the text or teacher. In my book *Thinking Things Through* I describe the effects of offering some 12-year-old pupils the following task presented as shown:

O stands for any odd number.
E stands for any even number.
Write down what you get in the following addition sums.

$O + O =$
 $E + E =$
 $E + O =$
 $O + O + O =$
 $O + O + O + O =$
 $O + O + E + O =$
 $O + O + O + O + O =$

Describe in words what you will get if you add together
any number of odd numbers.

or simply saying, "What happens when you add together odd and even numbers?" The second style of presentation evoked much emotion as well as considerable work, as there was no boundary on what was expected. More interesting, however, was the reaction of two pupils who had been asked the simple question but then subsequently shown the first presentation. One said, with great disappointment, "Oh, it's all there" and then when asked if the first presentation would have been preferable said, "No, absolutely not. I don't like doing other people's questions. It is much more interesting to make the question your own." The other pupil described the two different presentations in this way: "You start out looking through a small opening. With the first presentation, it is as if the furthest you can see is a wall. With the second presentation, you can go on looking further and further into the distance." [Burton, *Thinking Things Through*, Basil Blackwell, 1984, p.3] These pupils seem to me to be conforming with the descriptions of Kline, Thom, Hodgkin and the other mathematicians whom I have quoted, of creating and using mathematics.

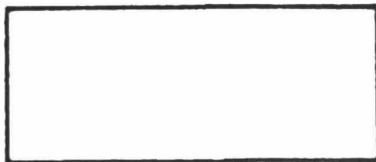
Another starting point I have given to pupils offers them the possibility of testing conjectures and, at the same time, validating their own knowledge of area and perimeter. It has been used with pupils of 10-15 years, of differing abilities:

In a class which had been working on area and circumference of rectangles, six children announced the following:

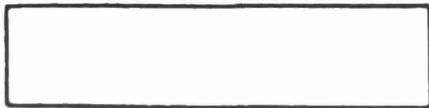
- David: Two rectangles with the same circumference have the same area.
- Susan: Two rectangles with the same area have the same circumference.
- Guy: Enlarging the circumference of a rectangle always makes the area increase also.
- Serge: Enlarging the area of a rectangle always makes the circumference larger.
- Brigid: Every rectangle with an area of 36 cm^2 has a circumference of not less than 24 cm .
- Louise: For any rectangle there is another one of equal area but with a larger circumference.

Do you agree or disagree with these children? Explain why.

Figure 4 demonstrates how Debbie, aged 15, found some counter-examples to disprove David's and Susan's statements:

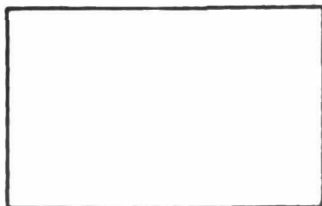


The circumference is 20 cm
and the area is 21 cm^2



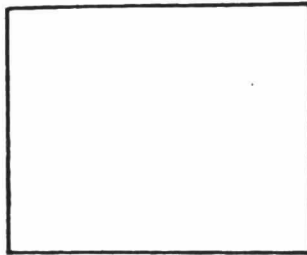
The circumference is 20 cm
and the area is 16 cm^2

Figure 4

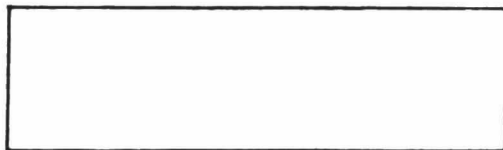


The circumference is 20 cm
and the area is 24 cm^2

I disagree with David because the 3 diagrams above all have a circumference of 20 cm but the area of all of them vary.



The area is 30 cm^2
The circumference is 22 cm



The area is 30 cm^2
The circumference is 26 cm

I disagree with Susan because both of the diagrams I have drawn had an ^{area} circumference of 30 but different circumferences



Most of her class agreed with Guy. Dionne, also aged 15, put it like this:

What Guy has to say about enlarging the circumference ~~and~~ to make the area bigger is true because the circumference is the outside so obviously if you enlarge the outside the area is bound to get bigger.

However, in another class Katrina and Amanda, aged 11 years, wrote:

Guy is wrong - a rectangle is 15 cm by 5 cm
area - ~~75~~ 75 cm^2 circumference - 40 cm

if we enlarge the rectangle ^{circumference} by 10 cm this happens
rectangle is 24 cm by 1 cm

area - 24 cm^2 circumference - 50 cm

but the area is smaller than before.

These examples are the kinds of challenge I use. As you will have noticed, they are not far away from recognizable curriculum content, but they have a different feel for the pupils. Furthermore, they require pupils to accept responsibility for their own investigations and to work at that investigation in the ways most comfortable to them, personally. Unlike much of what passes for problem-solving, they present pupils with situations which are truly problematic to them and allow them the freedom to decide how or what they need to know or do. In research which I have conducted in Britain with pupils aged nine to fourteen years, and more recently with adults reentering education, I have found that this style of classroom quickly enables learners to accept and take control of their own learning. They learn that not to understand is a learning starting point about which they can do something and that working together pools strengths and provides support for weaknesses. They learn to recognize when they have a question in their head. They learn that tackling such questions without using some means to represent them is not functional, that formally presented mathematics is a communicative outcome preceded by the bulk of work which supports their enquiry, that if they don't understand a general statement, the sensible thing to do is to specialize, that when they build up a number of specializations and search through them for a pattern which they state as a generalization, they are doing mathematics. Both with the pupils and with the adults, the adjustment to this style of learning has been extremely rapid. In addition, the commitment and motivation is internally propelled by the satisfaction and pleasure gained. My experience is consistent with other researchers who have reported attitude and performance changes under these conditions, especially by women who find mathematics speaking to them for the first time. Their euphoria is graphic — I recall a woman in her thirties accosting everyone she met with the excited statement, "I can understand fractions."

In a powerful book Carol Gilligan records differences in women's modes of thinking about relationships from those previously accepted by psychologists as the norm, a norm which has been constructed from male data. Challenging the notion that women's development deviates from the norm and is consequently aberrant and problematic, she observed that "relationships, and particularly issues of dependency, are experienced differently by women and men." She recounts the responses of two eleven-year-old children, Amy and Jake, to the following problem: "A man named Heinz considers whether or not to steal a drug which he cannot afford in order to save the life of his wife. Should Heinz steal the drug?" Jake is clear that he should. Carol Gilligan reports:

Fascinated by the power of logic, this eleven-year-old boy locates truth in mathematics which, he says, is "the only thing that is totally logical." Considering the moral dilemma to be "sort of like a math problem with humans" he sets it up as an equation and proceeds to work out the solution. [Gilligan, *In a Different Voice*, Harvard University Press, 1982, p. 26]

Amy, on the other hand, responds in the same vein as the Irish person who, when asked the way to Tipperary by a stranger, said "If I were going to Tipperary I wouldn't start from here!" Amy does not tackle the dilemma as given but places it in a context of relationships out of which it is unreasonable for such a situation to arise. On this basis, Carol Gilligan points out that "she considers the solution to the dilemma to lie in making the wife's condition more salient to the druggist or, that failing, in appealing to others who are in a position to help." Thus the differences in response of the two children are presented in the following way:

Both children recognize the need for agreement but see it as mediated in different ways — he impersonally through systems of logic and law, she personally through communication and relationship. Just as he relies on the conventions of logic to deduce the solution to this dilemma, assuming these conventions to be shared, so she relies on a process of communication, assuming connection and believing that her voice will be heard. [*ibid.*, p. 29]

I find this a powerful endorsement of the validity for women of working in a mathematics environment which allows such reinterpretations and personal evaluations. Consider the following conventional word problem quoted by Stephen Brown:

Suppose a bag of grass seed covers 400 square feet. How many bags would be needed to uniformly cover 1,850 square feet? [McGinty & Myersen, "Problem Solving: Look Beyond the Right Answer," *Maths Teacher* Vol. 73, No. 7, October 1980, p. 501]

As Stephen Brown points out:

So far so dull. It is not only that for many students the above would not constitute a problem, but more importantly it lacks any reasonable conception of context-boundedness. The authors, however, go on to suggest enquiry that is more real worldish than most of the word problems students encounter. They ask:

Should the person buy 5 bags and keep the left over — figuring prices will rise next year?
Buy 5 bags and spread it thicker? Buy 4 bags and spread it thinner?" [*ibid.*, p. 502]

[Brown, "The Logic of Problem Generation," in Burton (ed.), *Girls Into Maths Can Go*, Holt, Rinehart and Winston, 1986]

I have referred already to the writing of Carol Gilligan. I wish to complete this section by reference to the substantial amount of work which has been done by feminist scientists and, in particular, to that of Evelyn Fox Keller. In a book entitled *Reflections on Gender and Science* she wrote:

Having divided the world into two parts — the knower (mind) and the knowable (nature) — scientific ideology goes on to prescribe a very specific relationship between the two... Not only are mind and nature assigned gender, but in characterizing scientific and objective thought as masculine, the very activity by which the knower can acquire knowledge is also genderized. The relation specified between knower and known is one of distance and separation. It is that between a subject and an object. ... The scientific world is set apart from what is to be known, that is, from nature, and its autonomy is guaranteed. ... Masculine here denotes autonomy, separation and distance. It connotes a radical rejection of any commingling of subject and object which are quite consistently identified as male and female. [Keller, *Reflections on Gender and Science*, Yale University Press, 1985, p. 79]

Although mathematics poses us with problems which are distinctive from science, the nature of proof as opposed to empirical verification being just one, we can certainly benefit from the analysis which Evelyn Fox Keller makes of the development of objectivity and its association with masculinity. Her argument is essentially psychoanalytic and is supported, in particular, by object relations theory. She argues that "objectivity is the cognitive counterpart of psychological autonomy, and accordingly must be understood as rooted in interpersonal space; the capacity for objectivity develops together with the articulation of self and gender." By examining the process through which self-identity is established by the child, she postulates a necessary separation from the mother which, for boys, is further exacerbated by the development of their gender identity. Thus, for boys, the establishment of an autonomous self appears to require distance and independence from others whereas, for girls, the development of self-image is connected with and related to mother. She states: "It is essential to note how laden the word *autonomy* is with the prejudices of our culture ... the tendency is to confuse autonomy with separation and independence from others ... This does not mean ... that one's actions are not *influenced* by others, or that one has no need of others." She postulates a static conception of autonomy which is tied to cognitive maturity. For the exercise of cognitive maturity, it has been socially required, most particularly by science, that the subject and object should be distanced. Hence objectivity in science is linked to a conception of autonomy which is predicated on distance and separation. Evelyn Fox Keller asserts the epistemological inadequacy of this view of objectivity, an inadequacy which I am claiming is demonstrable in mathematics as well. In contrast, she proposes a dynamic conception both of autonomy and objectivity. She defines objectivity

as the pursuit of a maximally authentic, and hence maximally reliable, understanding of the world around oneself. Such a pursuit is dynamic to the extent that it actively draws on the commonality between mind and nature as a resource for understanding. Dynamic objectivity aims at a form of knowledge that grants to the world around us its independent integrity but does so in a way that remains cognizant of, indeed relies on, our connectivity with the world... By contrast, ... static objectivity [is] the pursuit of knowledge that begins with the severance of subject from object rather than aiming at the disentanglement of one from the other. ... Dynamic objectivity is thus a pursuit of knowledge that makes use of subject experience in the interests of more effective objectivity. [Keller, *Reflections on Gender and Science*, Yale University Press, 1985. pp. 116-117]

The child's growing interest and skill in pursuing objective enquiry depends on sustaining her interest in the world around her such that she can formulate questions about it and develop her capacity to attend to, focus on and investigate aspects of that world that are distinct from herself. This does not *require* domination or mastery, although those are the terms used by many male scientists and mathematicians when describing their activities. For example, they persist in using the term "problem solving" to describe an activity which when truly enquiry-based reveals more problems than it resolves. To embark upon the solving of a problem is to make decisions which then constrain the direction of solution — with solution comes further questions and new ideas. Far from being a process of closure, as so many pupils experience it, it is a cyclical one of choices which themselves dictate new ideas, future questions and further investigations. Such enquiry is not conditioned by power and domination, but it thrives in an atmosphere of collaboration and connectedness.

In this brief overview I have not done justice to the richness of Evelyn Fox Keller's analysis. Nonetheless, I hope that I have indicated its relationship to mathematics as well as the grounds for my optimism that introducing personal connectedness into both mathematics and its pedagogy would enrich the experience of all pupils but would most especially open it to women.

Femmes et mathématiques: y a-t-il une intersection? My answer is resoundingly yes, but. We can work at gender stereotyped texts, inappropriate use of gender specific language. We can, and do,

conduct experiments on segregating girls and boys into single sex groupings for mathematics. We can ask about social influences on girls and attempt to compensate for the worst stereotyping by offering girls careers workshops on mathematically based alternatives. We can raise awareness in our classrooms to boys dominating space and interaction. We can run special workshops to build confidence and change attitudes. But, when we have done all of these things, we will still not have dealt with the genderization of mathematics itself. Indeed, I do not believe that we will have learnt what our girls pupils are telling us about mathematical pedagogy: that it fails with the majority of pupils because it reflects misguided conceptions of the subject itself and of the manner of using and learning it. Only when we have succeeded in shifting our pupils' experiences of mathematics so that these make space for personal, creative enquiry through which understanding is explored and constructed, will girls in school say yes to mathematics which will relate meaningfully to them.

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GRANTS, ETC.

Dr. Julia Abrahams has recently become the Scientific Officer responsible for the Probability and Statistics Program within the Mathematical Sciences Division of the Office of Naval Research. She says:

ONR is concerned to fully involve women scientists, among other underrepresented groups, in its Contract Research Program. Towards this end, I would like to call ONR's research program in the Mathematical Sciences to the attention of AWM members so as to encourage the submission of appropriate proposals to the responsible scientific officers.

She reminds us that eleven women have received ONR Graduate Fellowships in Mathematics and Computer Science from 1985 through 1988.

A copy of the brochure *Office of Naval Research Guide to Programs* may be obtained from the Department of the Navy, Office of the Chief of Naval Research, Arlington, VA 22217. It includes detailed information on program emphasis, types of support available, and application procedures.

The Division of Mathematical Sciences of the National Science Foundation uses rotators (faculty brought in from research departments for two years) as program directors. This approach is used to bring in fresh ideas, new perspectives, and current technical knowledge. Says Nancy Flournoy of her recent term as Statistics and Probability Program Director: "The experience is definitely a broadening one and a very rewarding one. The experience is one that could not be duplicated in terms of coming to an understanding of a broad variety of current research activity that is going on..." Three of the present thirteen rotators are women: Ann K. Boyle for Algebra and Number Theory, Mary Ellen Bock for Statistics and Probability, and Deborah F. Lockhart for Special Projects. Judith S. Sunley is Division Director.

GENDER AND SCIENCE

report delivered by Jean Burr Smith, Professor, Middlesex Community College,
Middletown, CT
panel on Gender and Science, chaired by Beth Ruskai, MAA Northeastern Section meeting,
Bentley College, Waltham, MA, November 1987
Thanks to Alice Schafer for bringing this to our attention.

When I was asked to be on a panel discussing this topic at the Northeastern Section meeting of the MAA, I decided to do some statistical work to see what the situation was at my college. I wanted to know just how the women actually compared with the men in terms of percentages who registered for science courses, the attrition in these courses, and the comparative marks of those who completed them. Then to see if there appeared to be any change over a period of time, I took data from fall 1980 and fall 1986, purely arbitrary choices, and equally arbitrarily, grouped the courses into three types of science: biological, environmental, and physical.

Table I shows that the percentage of men and of women who registered for science courses either in 1980 or 1986 was approximately twelve percent. In comparing proportions for men and women for 1980 and 1986, in no cases were the differences significant. In 1980, we had approximately 200 men in the law enforcement program which affected the total numbers but did not affect the proportions.

Table II consists of two chi-square tables, one for 1980 and one for 1986, giving the registrations of men and women in the three science course groupings. The values of chi-square indicate that the alignments differ from the expected values. For two degrees of freedom, chi-square larger than 6.00 is significant at the .05 level. Inspection of the differences between observed and expected registration suggests that men and women differ in the biological and physical sciences.

Table III shows the percentage of all science registrations in each type of science, and compares men and women for each of the two years. The percentage of women science registrants on biological rosters exceeded the percentage of men science registrants for both years. Similarly the percentage of men science registrants on physical science rosters exceeded the percentage of women science registrants for both years. Comparing percentages, the critical value of z for the .01 level of significance is 2.58, which is exceeded for these four differences. We do not know how much this was influenced by the fact that with very few exceptions the biological sciences were taught by women and the physical sciences by men.

Table IV consists of two chi-square tables which show numbers of men and women earning marks of A or B, C or D, and F, Withdraw, or Incomplete for each year, for all science courses. Sizes of the chi-squares do not exceed the 6.00 required for significance at the .05 level, and we conclude that there is no significant relationship between sex and performance.

Table V compares percentages of men and women with marks of A or B for each of the three types of sciences for each year. The only difference that is significant at even the .05 level, a z of -1.96, is a higher proportion of women in biological sciences in 1986.

Table VI compares the A or B percentages again between the years 1980 and 1986, for men at the left and for women at the right by type of science and all sciences. The only significant rise was for the men in biological science courses.

Table VII deals with the non-completes: the percentages of withdrawals, incompletes, and F's, comparing men and women for each type of science for each year. There is no significant difference between men and women.

Table VIII compares the percentages of non-completes in 1980 with those for 1986 for each type of science, at the left for men and at the right for women. Again, there is no significant difference.

So what do we conclude?

The same proportions of the college population registered for courses in science in 1980 and 1986, with the women preferring biological science and the men physical. Their performances in terms of percentages receiving A's and B's, and percentages failing to complete courses, are in general the same within the boundaries expected by chance. Certainly there are none of the gender differences that I had been led to expect.

Table I: NUMBERS OF STUDENTS REGISTERED

	1980			1986		
	Men	Women	Total	Men	Women	Total
Entire College	1,403 (42.9%)	1,868 (57.1%)	3,271	953 (32.7%)	1,958 (67.3%)	2,911
All Science Courses	165 (39.0%)	258 (61.0%)	423	121 (34.4%)	231 (65.6%)	352
% Entire College	11.8%	13.8%	12.9%	12.7%	11.8%	12.1%

Table II: REGISTRATIONS AND χ^2 EXPECTED IN THREE TYPES OF SCIENCE

	1980		1986	
	Men	Women	Men	Women
Biological	76 (95)	167 (149)	62 (75)	156 (143)
Environmental	26 (23)	33 (36)	12 (10)	18 (20)
Physical	63 (47)	58 (74)	47 (36)	57 (68)
χ^2	15.75**		9.13*	

** significant at the .01 level
* significant at the .05 level

Table III: PERCENTAGES OF SCIENCE REGISTRATIONS IN EACH TYPE OF SCIENCE AND DIFFERENCES BETWEEN MEN AND WOMEN

	1980				1986			
	Men	Women	Diff.	z	Men	Women	Diff.	z
Biological	46.06% (76)	64.73% (167)	-18.67%	-3.78**	51.24% (62)	67.53% (156)	-16.29%	-2.99**
Environmental	15.76% (26)	12.79% (33)	+2.97%	+0.86	9.92% (12)	7.79% (18)	+2.13%	+0.68
Physical	38.18% (63)	22.48% (58)	+15.70%	+3.49**	38.84% (47)	24.68% (57)	+14.16%	+2.76**
All Sciences	(165)	(258)			(121)	(231)		

** significant at .01

**Table IV: SCIENCE COURSE RESULTS
NUMBERS OF MEN AND WOMEN AND χ^2 EXPECTED
IN THREE COURSE MARK GROUPS**

	1980		1986	
	Men	Women	Men	Women
A or B	51 (56)	92 (87)	49 (44)	80 (84)
C or D	59 (53)	77 (83)	30 (38)	80 (72)
F, W or I	55 (56)	89 (88)	42 (39)	71 (74)
χ^2	1.80		3.59	

**Table V: SCIENCE COURSE RESULTS
COMPARISON OF REGISTRANTS' A OR B MARKS
PERCENTAGES OF MEN AND WOMEN**

	1980				1986			
	Men	Women	Diff.	z	Men	Women	Diff.	z
Biological	17.11%	29.76%	-12.65%	-2.09*	41.94%	33.97%	+7.97%	+1.11
Environmental	38.46%	51.52%	-13.06%	-1.00	25.00%	44.44%	-19.44%	-1.08
Physical	44.44%	43.10%	+1.34%	+1.15	42.55%	33.33%	+9.22%	+1.09
All Science	30.91%	35.66%	-4.75%	-1.01	40.50%	34.63%	+5.87%	+1.09

* significant at .05

**Table VI: SCIENCE COURSE RESULTS
PERCENTS OF REGISTRANTS' A OR B MARKS
AND COMPARISON OF 1980 AND 1986 BY TYPES OF SCIENCE**

	Men				Women			
	1980	1986	Diff.	z	1980	1986	Diff.	z
Biological	17.1%	41.9%	+24.8%	+2.59**	29.8%	34.0%	+4.2%	+1.81
Environmental	38.5%	35.0%	-13.5%	-1.81	51.5%	44.4%	-7.1%	-1.48
Physical	44.4%	42.6%	-1.7%	-1.20	43.1%	33.3%	-9.8%	-1.08
All Sciences	30.9%	40.5%	+9.6%	+1.68	35.7%	34.6%	-1.1%	-1.35

** significant at .01

**Table VII: SCIENCE COURSE RESULTS
COMPARISON OF REGISTRANTS' WITHDRAW/INCOMPLETE/F
PERCENTAGES OF MEN AND WOMEN**

	1980				1986			
	Men	Women	Diff.	z	Men	Women	Diff.	z
Biological	40.79%	35.71%	+5.08%	+1.76	30.65%	37.18%	-6.53%	-1.94
Environmental	23.08%	24.24%	-1.16%	-1.10	25.00%	16.67%	+8.33%	+2.56
Physical	34.92%	36.21%	-1.29%	-1.15	42.55%	40.35%	+2.20%	+1.23
All Science	33.33%	34.50%	-1.17%	-1.25	34.70%	30.70%	+4.00%	+1.95

**Table VIII: SCIENCE COURSE RESULTS
PERCENTS OF REGISTRANTS' WITHDRAW/INCOMPLETE/F
AND COMPARISON OF 1980 AND 1986 BY TYPES OF SCIENCE**

	Men				Women			
	1980	1986	Diff.	z	1980	1986	Diff.	z
Biological	40.8%	30.7%	-10.1%	-1.23	35.7%	37.2%	+1.5%	+1.28
Environmental	23.1%	25.0%	+1.9%	+1.13	24.2%	16.7%	-7.6%	-1.77
Physical	34.9%	42.6%	+7.6%	+1.81	36.2%	40.4%	+4.1%	+1.46
All Sciences	33.3%	34.7%	+1.4%	+1.25	34.5%	30.7%	-3.78%	-1.89

AWM IN THE NEWS

The "Careers" column in *The New York Times* on Tuesday, November 1, 1988 was "A Shortage of Women in Mathematics" by Elizabeth M. Fowler. AWM members Rhonda Hughes, Nancy Kopell, and Pat Kenschaft were all quoted in the article. The article is positive about math as a career and refers to the shortage of women in the field without once mentioning "math genes." From the article:

"It is not a matter of women lacking mentors," Dr. Hughes said, attributing the shortage of women in the field more to a lack of "sensitivity to the difficulties of establishing a professional career and of raising children." ...

She said that few women mathematics professors had received tenure. "Women are not as visible as they should be," she said. "I think having more women in tenured positions is a key criterion that would encourage them to stay in the field." She called Dr. Louise Hay, who heads the mathematics department at the University of Illinois [at Chicago], "a voice in the wilderness." Rutgers University has some female professors with tenure but there are few at Ivy League colleges, she said.

Although there is a mysterious reference to "mathematics majors who become architects," the reporter makes clear the variety of careers a mathematician can pursue. It's good publicity for our side.

DISCRETE MATHEMATICS FOR SECONDARY SCHOOL TEACHERS

a report by Donna Beers, Associate Professor, Simmons College and Program Director

During July, 1988 a special institute on discrete mathematics for secondary school teachers was held at Simmons College. The Program for Women High School Teachers of Mathematics and/or Computer Science to Learn Discrete Mathematics was sponsored jointly by the Association for Women in Mathematics (AWM) and Simmons College and was made possible, in part, through funding by Raytheon Company. Programs like the ones described in this report are important not only for strengthening the competitive posture of the U.S. in scientific and technical fields, but equally important for strengthening the individual women teachers who serve as role models for young women who will be needed as the scientists and engineers of the future.

Rationale for the Program

Discrete mathematics is devoted to the study of distinct and unconnected objects in contrast to the real numbers, which form a continuum. It is the gateway to advanced mathematics courses such as logic, set theory, graph theory, algebraic structures, combinatorics, and probability. Above all, it lays the foundation for computer science, which is based on discrete processes, especially on step-by-step, algorithmic procedures.

Currently a debate is going on in mathematics education over whether it is more natural for high school students to pursue discrete mathematics directly after precalculus or whether they should take calculus. The debate centers on which route, the discrete mathematics route or the calculus route, best enhances the growth of mathematical maturity. A few high schools in Massachusetts, including Lexington High School and Reading High School, have begun to offer discrete mathematics as an alternative to calculus in the senior year. Since most high school teachers graduated from college before discrete mathematics was offered in the college curriculum, Simmons College and AWM thought that the time was ripe to offer such a course for high school teachers.

Publicity and funding

Publicity for the Program for Women High School Teachers of Mathematics and/or Computer Science to Learn Discrete Mathematics was provided in three ways: first, the Program was announced at the Sonia Kovalevsky High School Mathematics Day on April 7, 1988 at Simmons College; in mid-April AWM sent a letter describing the Program to high school mathematics and computer science department heads in the greater Boston area; and, in May, a reminder postcard with registration information was sent out from the AWM office to the department heads just mentioned.

In March 1988 Raytheon Company awarded AWM a grant for \$6000 in support of AWM programs for 1988. The entire amount of this grant was applied towards the 1988 summer institute for high school teachers, with Simmons College covering the remaining costs of the Program.

Description of participants

Twenty-four secondary school teachers took part in the Program on Discrete Mathematics. Two were from junior high schools and twenty-two from high schools. They came from a broad cross-section of public, private, and parochial schools. Schools represented were: Hopkinton Junior-Senior High School, Reading Memorial High School, Sharon High School, Lincoln-Sudbury Regional High School, Sandwich High School, Salem High School, Framingham North High School, Wayland High School, Stoughton Junior High School, Quincy High School, Noble and Greenough School, Waltham High School, Cambridge Rindge and Latin School, Newton South High School, Gloucester High School, St. Mary's High School in Lynn, Winchester High School, Foxborough High School, Brookline High School, Millis High School, Hyde Park High School, and Rockland Junior High School.

The teachers were highly motivated professionals, devoted to mathematics and to teaching. Their goals in taking part in the Program included: the learning of a new area of mathematics in order to develop a course for their schools, intellectual stimulation, and professional advancement (e.g., gaining credit towards certification or promotion to a higher position). They were also concerned to project a positive image as role models for their students. In this regard, it may be noted that six of the twenty-two high school teachers in the course are or have been coaches for Raytheon Company's Math League.

Description of the Program

The Program was officially designated at Simmons College as the Discrete Mathematics Course for Secondary School Teachers (Mathematics 420S), and it carried four graduate credits. Organization of the course was as follows. The instructor for the course, Donna Beers, Associate Professor of Mathematics at Simmons College, lectured from 9 A.M. until the noon lunch break. After lunch, participants divided into small groups in order to work on homework assignments. A special feature of the Program was that a high school teacher who had already taught a discrete mathematics course at her school provided consultation and individual help. Donna Pappalardo, a mathematics teacher at Reading High School, was available each day from 1 P.M. until 3 P.M. Ms. Pappalardo's first-hand experiences with discrete mathematics — pedagogical and curricular — proved invaluable to participants. In addition to regular lectures participants were treated to three guest lectures delivered by Simmons College faculty to complement goals of the Program: "Cooperative Group Learning Techniques," given by Professor Kay Dunn of the Department of Education and Human Services; "Finite-State Machines," given by Professor Margaret Menzin of the Mathematics Department; and "History of the Association for Women in Mathematics," by Professor Alice Schafer of the Mathematics Department. Class time was also given to surveying current textbooks and supplementary materials on discrete mathematics, including special modules on real-life applications as well as computer software.

Evaluations of the Program by participants

In closing, we provide excerpts from a representative sample of evaluations of the Program.

The course was an excellent investment of my four weeks summer time. I worked very hard but feel that I have gotten a great deal out of the course. I plan to introduce a course in discrete mathematics at my high school in the 1989-90 school year. This was an excellent course both in teaching of content and also problem-solving. I wish to continue to project a positive role model for my students — especially the females — and feel that taking this course in preparation to develop a similar course at my high school will keep me in the vanguard of current mathematical trends.

I have learned a great deal of new material in this course. Not only have I benefitted, but I feel my students will benefit from this also. Discrete mathematics sparks an interest in a field of mathematics otherwise unknown to students, and I hope this new knowledge will spread over to my students and encourage them to continue in this field.

I found this course to be one of the most enjoyable math courses that I have ever taken. The course material was interesting and presented in a clear, organized manner. There were several examples ... presented by the teacher that demonstrated applications to areas outside of mathematics, e.g., chemistry, business, communications, etc. Formulas were not just written on the board, but were developed from the context of an example problem. This approach makes the particular formula under discussion more meaningful and easier to remember.

Courses such as this one are most effective. They bring together teachers with differing backgrounds. A melding of minds occurs as teachers share experiences.

My school is thinking about offering a course to seniors that is not necessarily a calculus course. Discrete math is on the top of the list of options, and this course has certainly defined what the content of this course should be. I now feel more comfortable with the topics of discrete math. More importantly, I feel that as a woman teaching the course in my high school, I will show the girls that calculus is not the only route.

[The instructor] gave many real-world applications of the mathematics concepts covered in the course, which I found most useful and effective. They are applications that I can bring into the classroom.

I took this course because I had never seen a course specifically devoted to discrete mathematics. ... But the methods of proof used can be directly incorporated into the curriculum for the geometry course I teach.

Another emphasis was encouraging women in mathematics. I was introduced to programs and associations that promote women in mathematics and hope to bring some materials and ideas back to the school at which I teach.

As a middle school teacher, I was very relieved to experience the support of the instructor as well as from my peers during the study group. ... As a result, I've learned a great deal and feel as though I have been exposed to a very high standard of academic expectation. ...

I am very grateful to have had this opportunity and hope there will be more in the future!

NSF MATHEMATICS ACHIEVEMENT STUDY

A two-year study funded by the National Science Foundation of students' mathematics achievement in Montgomery County, Maryland, has been reported on recently in *Science* (Vol. 241, 22 July 1988, pp. 408-409) and the *AMS Notices* (Vol. 35, No. 7, September 1988, pp. 1005-1006). The study shows that in the public schools of Montgomery County, white and Asian students perform much better on the average than Black and Hispanic students. Also, gender differences have been noted.

from the *Notices*:

The study also gathered data on gender differences in mathematics performance. While girls and boys performed equally well on standardized tests in early grades, the study found substantial differences in the junior and senior years of high school in their performance on the mathematics portion of the Scholastic Aptitude Test. ...

The study found that female students tended to have less confidence in mathematics and tended to perceive the subject as less useful than did male students. There were also differences in career aspirations, with males more likely than females to see themselves in occupations utilizing mathematics or in management positions.

The report says that such attitudes are influenced by parents and, to a lesser extent, by the school environment. With the exceptions of the top female mathematics students, female students receive less encouragement in mathematics from the school, home, and society, the report says. In questions put to parents, the survey found that mothers do not see themselves as competent in mathematics and that parents generally "still view mathematics and science careers as being primarily for men." A significant portion of school counselors and principals attributed differences in mathematics performance of males and females to such factors as a lack of interest on the part of females and the females' perception that they do not need mathematics for their careers.

from *Science*, "Math Education: A Mixed Picture" by Colin Norman:

Racial and ethnic differences begin to show up as early as the first or second grade, and become more pronounced throughout the school years, the study found. By the eighth grade, almost half the black and Hispanic students in Montgomery County schools are performing below grade level. Moreover, "the evidence suggests that once a student falls below the standard level of performance in the curriculum for his/her grade level, he/she is not likely ever to catch up again." ...

Attitudes also appear to have an impact on the participation and performance of girls in mathematics, especially during the final years of high school. Although female students perform as well as males on standardized tests throughout the school years, they "seemed to be somewhat less confident in their abilities than their male counterparts."

Disparities in participation begin to show up after mathematics requirements for graduation and college entrance have been met, when fewer girls than boys take more advanced classes. Career aspirations may have something to do with this. According to the study, "males were more likely to aspire to careers in professional occupations utilizing mathematics or the physical sciences; females were more likely to want jobs that did not emphasize mathematics, and were more likely to view themselves as future managers."

The study did turn up one puzzling disparity in performance between boys and girls. Even in the advanced classes, male and female students perform equally well on two standardized tests, but on the SAT, boys tend to outperform girls. This may indicate that the disparity is unique to the SAT itself.

OF POSSIBLE INTEREST

Science-By-Mail™ is a program of the Museum of Science, Science Park, Boston, MA 02114. Scientists serve as pen pals to small groups of children, grades 4-9, sending them three "science challenge" packets. This year's deadline has passed, but write Stephen Brand, Head of Public Outreach at the Museum if you would like to be a Volunteer next year. The cost for students this year was \$20 for an individual, \$40 for a family or group (limit 4), with scholarships available.

"Peer Harassment: Hassles for Women on Campus" is the latest publication of the Project on the Status and Education of Women, Association of American Colleges, 1818 R St., NW, Washington, DC 20009. Individual copies are \$5 (prepaid); bulk rates are available.

Women's Studies. Beacon Press, 25 Beacon Street, Boston, MA 02108.

DEADLINES: Jan. 24 for Mar.-Apr., Mar. 24 for May-June, May 24 for July-Aug.
AD DEADLINES: Feb. 5 for Mar.-Apr., Apr. 5 for May-June, June 5 for July-Aug.
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;
BITNET: \$L\$MA24@LUCCPUA; USENET: gargoyle!cantor!bore!alm; COMPUSERVE: 73240,2051.
Send all material regarding book reviews to Martha Smith, Dept. of Math.,
University of Texas, Austin, TX 78712.
Send everything else, including ads, to Tricia Cross, AWM, Box 178, Wellesley College,
Wellesley, MA 02181.

JOB ADS

Institutional members of AWM receive two free ads per year. All other ads are \$20.00 (as of January 1, 1989) and must be prepaid. The vacancies listed below are in alphabetical order. All institutions advertising in the AWM NEWSLETTER are Affirmative Action/Equal Opportunity Employers.

ALBION COLLEGE. Tenure track position at the asst. prof. level in mathematics/computer science program. Starts Aug., 1989. Salary competitive, excellent fringe benefits. Ph.D. in mathematics of computer science with strong background in discrete math. Preference to applicants with computer science coursework/experience and evidence of potential for excellence in teaching. Send letters of app., vitae, 3 letters of recommendation to Ronald C. Fryxell, Chair, Albion College, Dept. of Mathematics, Albion, MI 49224.

ARIZONA STATE UNIVERSITY. The Dept. of Mathematics invites apps for tenure track and visiting faculty positions at all ranks and in all areas of mathematics beginning August '89. The Dept. is in its 2nd yr of major development program intended to build nationally recognized research groups of 4 to 7 faculty members in Computational Math, Diff Equations (inc. PDE's), Discrete Math, Dynamical Systems, Operator Theory, Algebraic Geometry, and Number Theory, Systems and Control, and Prob and Stat. In '89 majority of tenure track positions will be made at Asst. Prof level. Candidate must demonstrate potential for outstanding research while providing effective teaching at both the undergraduate and graduate level in a public university environment. Candidates at Assoc. Prof level, additional requirements include a proven record of outstanding research accomplishments and versatile and effective teaching. Full Prof, applicants should be recognized nationally for the quality and scope of their research and leadership activities. Salaries competitive and commensurate with exp. Apps should be received by Jan. 15, 1989. Deadline extended if all avail, positions not filled. Dept. will begin review Jan. 1, 1989. Appointments made following final budgetary approval. Send resume and arrange for at least 3 letters of rec to be sent to: William T. Trotter, Chair, Dept. of Mathematics, Arizona State University, Tempe, AZ 85287-1804.

BARD COLLEGE. Applications are invited for a tenure-track position in Mathematics for Fall OF 1989. Strong interest in building an innovative math program in liberal arts context. Candidates must have a Ph.D. by Fall 1989, and a commitment to teaching and continued mathematical activity. Salary and rank depending on experience. To apply, submit a resume, a statement of teaching and research interests, and 3 letters or recommendation (at least one concerning teaching) to: Prof. Ethan Boch, & Dean's Office, Bard College, Annandale-on-Hudson, NY 12504. Deadline for application: 1/1/89; late applications will considered until position filled. For more information call 914-758-6822, ext. 266,265. Bard will have representatives at the AMS Employment Register at the Jan 1989 meeting in Phoenix.

BOISE STATE UNIVERSITY. Possible tenure track asst prof position starting Aug. 21, 1989. Ph.D. required. Teaching and research expected. New faculty teaching load is 2 classes (8-10 hours) per semester. The dept. offers Bachelor's in math and options in secondary ed and in computer science. Apps in all mathematical sciences urged to apply. Send letter of app, resume, grad transcripts, and 3 letters of reference to the Chairman, Dept. of Mathematics, Boise State University, Boise, Idaho 83725.

BOWDOIN COLLEGE. Two visiting positions, Math Dept., rank open, starting September, 1989. 2 yr terminal positions. Ph.D. expected. Normal teaching load, 6 hrs/week. Candidates with effective undergrad teaching pref. Send resume with 3 letters of recommendation to Wells Johnson, Dept. of Mathematics, Bowdoin College, Brunswick, ME 04011. App review begins April 1, 1989, but new apps accepted until position filled.

CALIFORNIA STATE UNIVERSITY, CHICO. One-yr temp. Lecturer position in mathematics. Ph.D. in Math of Stat. and evidence of teaching excellence are req. Teach 12 units of undergrad math per semester and carry out scholarly research. \$27,588-\$52,968. Submit resume, grad transcripts, supporting documents, and at least 3 letters of reference by Feb. 15, 1989.

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA. Two tenure track teaching positions: one in Math Ed, Doctorate in Math Ed of Math; on in Statistics, Doctorate in Stat of Applied Math. Salary dep on qualifications. Teaching exp and related research req. Apps, resume, copy of transcripts and 3 letters of references to be postmarked by 2/3/89. For additional info or to apply contact: Search Committee, Mathematics Dept., Cal State Polytechnic Univ., 3801 W. Temple Ave., Pomona, CA 91768-4033. #714-869-3467.

CALVIN COLLEGE. One tenure track position opening for 1989-90 academic yr. Apps in Math Ed. Computer Science, and Math Stats will be considered. Calvin College is a Christian liberal arts college, and each faculty member is expected to demonstrate a Reformed and Christian perspective in her or his teaching and professional activities. To apply contact: Professor S. Leestma, Calvin College, Grand Rapids, MI 49506.

CARLETON COLLEGE. Dept. of Mathematics & Computer Science, Northfield, MN 55057. David Appleyard, Chair. Two tenure-track positions to begin 1989-1990. Ph.D. required. Six courses per academic year (two per 10-week term) in math, CS, and/or statistics. Preference given to individuals who can teach in two of these areas. Excellent teaching ability essential; research encouraged. Interviewing at MAA/AMS meeting in Jan. Deadline Jan. 20; applications accepted until positions filled. Send letter of application, resume, graduate transcripts, and 3 recent letters of recommendation to Chair.

CASE WESTERN RESERVE UNIVERSITY. Tenure track, poss senior, positions anticipated to begin August 15, 1989. Outstanding research record and/or proven research potential and teaching excellence req. Pref areas: stat and prob (inc applications in physics, chem, and computer science) but candidates in areas of global analysis, dynamical systems, functional analysis, partial diff equations, and numerical analysis will also be considered. Visiting pos in above areas also possible. Send vita plus 3 letters of recommendations to Professor W. A. Woyczynski, Chair, Dept. of Mathematics and Statistics, Case Western Reserve University, Cleveland, OH 44106.

CENTRAL MICHIGAN UNIVERSITY. Five tenure-track positions at the assistant professor level. One position requires a doctorate (or near doctorate) in mathematics education, K-12 teaching experience preferred. One position requires a Ph.D. in mathematics with research interests in Combinatorics or Approximation Theory preferred. One position requires a Ph.D. in statistics. The remaining two positions will be filled from the three areas above according to qualifications of candidates. Priority will be given to those who can supplement existing research areas within the department. Candidates for all positions should show promise of excellence in teaching and research.

CLAREMONT GRADUATE SCHOOL. Asst/assoc prof to begin 8/89. CGS is the grad sch component of the 6 independent Claremont Colleges, and offers Master's and Ph.D. degrees in pure and app math. Duties: research and teaching, directing Mathematics Clinic projects solving industrial problems, involvement in a joint program in engr math. Exp. with the application of mathematics or stats to engr problems such as pattern recognition or image processing would be valuable. Send vita and 3 letters of recommendation to William Lucas, Chair, CGS, Dept. of Mathematics, 143 E. 10th St., Claremont, CA 91711-3988.

CLAYTON STATE COLLEGE. School of Arts and Sciences, P.O. Box 285, Morrow, GA 30260. Tenure-track position in mathematics starting September, 1989. Duties include teaching 15 credit hours per quarter at the freshman/sophomore level. Rank and salary depend on qualifications. Doctorate in mathematics or mathematics education preferred; Master's degree and teaching experience required. Apply by Feb. 6, 1989, to Catherine Aust, Mathematics Coordinator.

COLLEGE OF CHARLESTON. Mathematics Department. At least two tenure-track positions at the Assistant Professor level available Fall, 1989. Qualifications: Ph.D. in one of the mathematical sciences, commitment to undergraduate teaching and potential for continuing research. Teaching: 9 hours/week normal load for those engaged in research. Send resume and have 3 letters of recommendation sent to W. L. Golightly, Chair, Mathematics Dept., College of Charleston, Charleston, CS 29424.

DARTMOUTH. John Wesley Young Research Instructorship, 2-yrs., new or recent PhD's whose research overlaps dept. member's. Teach 4 ten-week courses spread over 2 or 3 quarters. \$29,500; \$6555 summer research stipend. Send application letter, resume, research/thesis description, graduate transcript, and 3 (prefer 4) references (1 discussing teaching) to Recruiting Committee, Dept. of Math and CS, Department College, Hanover, NH 03755. Files complete Jan 10, 1989 considered first.

DEPAUL UNIVERSITY. Apps are invited for a tenure track position at the asst prof level beginning 9/89. Ph.D. in Math req. Seek candidates in areas of probability or statistics, but will consider strong candidates in any field of research. DePaul is primarily undergraduate institution and strong commitment to teaching essential. Math research and prof activity encouraged. Official teaching load is 9 quarter courses/year, but reduction to 7/year is typical. Apps should send vita and 3-4 letters of recommendation, at least one of which pertains to teaching, to: Hiring Committee, Dept. of Mathematics, 2323 N. Seminary, Chicago, IL 60614.

DUKE UNIVERSITY. Apps are invited for 2 or more tenure track positions in Math rank and salary open, all fields. Please send curriculum vitae, a research plan, and arrange for 3 letters of recommendation to be sent. Address correspondence to: Michael C. Reed, Professor and Chair, Dept. of Mathematics, Duke University, Durham, NC 27706.

EASTERN ILLINOIS UNIVERSITY. Apps invited for tenure track position in Math Ed starting Fall 1989. Doctorate in Math Ed. Recent elementary teaching desirable; should be interested in pre-service and in-service ed of elementary teachers. Position contingent on funding. Contact John W. LeDuc, Chair, Eastern Illinois University, Dept. of Mathematics, Charleston, IL 61920.

EMORY UNIVERSITY. The Department of Mathematics and Computer Science has two openings in mathematics to begin September 1, 1989. The positions are at the level of tenure-track assistant professor or higher, in the case of exceptional candidates. Applicants must have a Ph.D in mathematics and a strong record (or promise) of research. The areas of functional analysis and numerical analysis are of particular interest to us, but applications will be considered from candidates with strong research credentials in any area of mathematics. Teaching load: 6 hrs/wk, including graduate and undergraduate courses. Please send vita and names of three references to Emory University, Dept. of Mathematics and Computer Science, Atlanta, GA 30322. Screening of applications will begin Feb. 1 1989.

FLORIDA ATLANTIC UNIVERSITY. Applications invited for senior level tenured appointment effective Fall, 1989. Rank and salary depend on qualifications. The candidate should have a nationally or internationally distinguished research record and demonstrated excellence in teaching. Applications will be accepted until Feb. 1, 1989. Send vita and arrange for 3 letters of recommendation to be sent to: Prof. F. E. Schroeck, Jr., Chairman, Search Committee, Dept. of Mathematics, Florida Atlantic University, Boca Raton, FL 33431.

FORT HAYS STATE UNIVERSITY. Dept. of Math & Computer Science, 600 Park St., Hays, KS 67601. Anticipated position. Asst. Prof, tenure track position beginning 8/89. Candidates should have doctorate in math or math ed with strong mathematics component. Duties inc teaching 12 hours each sem in math and/or computer science, inc at least one freshman level course, and participation in departmental and university affairs. Commitment to superior teaching of undergrad math required. Review process begins 3/1/89, but apps will be accepted until position is filled. Submit vita and 3 letters of recommendation, inc evaluation of teaching, to Mathematics Search Committee, above address.

FORT LEWIS COLLEGE. Math Dept. anticipates a tenure track position available for 1989-90 year. Terminal degree or evidence of completion is required. 12 hours of undergrad teaching; mixed math and CS. FLC is state supported lib arts college of 3,800 in southwest Colorado. Send letter of app, resume, transcript, 3 current letter of recommendation, inc one that clearly addresses teaching to: H. C. Rosenberg, Chair, Mathematics Dept., Fort Lewis College, Durango, CO 81301. Deadline: 2/13/89.

GEORGE MASON UNIVERSITY. Apps are invited for an appt at level of assoc. or full professor, starting Fall 1989. Prof will be given to candidates who can prove leadership in creating Institute for Applied Mathematics at GMU in coop with local corporate and federal entities. Candidates expected to have commitment to excellence in teaching and outstanding record of research in some area of analysis appropriate to such an endeavor. Send vita and letter describing professional interests and goals and the names of 4 references to: Prof. Ronnie Levy, Chair of Search Committee, Dept. of Mathematical Sciences, George Mason University, Fairfax, VA 22030.

GEORGIA SOUTHERN UNIVERSITY. Apps are invited for 4 tenure track positions in the Mathematics and Computer Science Dept. Advanced degree in math or CS is required and doctorate is preferred. Apps are sought from all areas of pure and applied math and CS, although a specific effort will be made to fill one of the positions with expertise in computer networking and communications. Rank (instructor or asst. prof preferred; assoc. prof considered) and salary commensurate with qualifications. Dept. provides support for personal research. Also, several temporary instructor positions to teach freshman math for which a master's degree in mathematics is required. Send evidence of, or document potential for, outstanding teaching along with curriculum vitae and 3 letters of reference or placement file to Dr. Rick Hathaway, Landrum Box 8093, Georgia Southern College, Statesboro, GA 30460. Deadline: 3/1/89.

GEORGIA STATE UNIVERSITY. (1) Tenure track asst prof position 9/89. Rank and salary commensurate with qualifications & exp. Qual: Ph.D. in math with strong research potential & commitment to teaching. Pref is for analysis. Duties: teaching, research, & service to support B.S. & M.S. degrees in math & comp sci. (2) Tenure track asst prof position 9/89. Rank and salary commensurate with qualifications & exp. Qual: Ph.D. in math with strong research potential & commitment to teaching in computer science. Prefer apps in all areas of comp sci but esp theoretical computer science, artificial intelligence, operating systems, software engr., data comm., networking and analysis of algorithms. Duties: teaching, research & service to support B.S. and M.S. degrees in math and comp sci. Send letter of app, vita without birth date but with citizenship status, 3 letters of reference & transcripts of all undergrad work and postmarked by 2/28/89 to Chair, Dept. of Mathematics and Computer Science, University Plaza, Georgia State University, Atlanta, GA 30303-3083.

GOUCHER COLLEGE. Applications are invited for at least one tenure track position at the Assistant or Associate level beginning August, 1989. Qualifications include a Ph.D. in mathematics or computer science and strong commitment to and demonstrated excellence in undergraduate teaching. Responsibilities include a teaching load of 9-10 hrs/wk and continuing scholarly activity. The selection process will begin Jan., 1989. Send vita and three letters of recommendation to: Dr. Joan S. Morrison, Chair of the Mathematics and Computer Science Dept., Goucher College, Towson, MD 21204.

GRINNEL COLLEGE. Tenure track position as Asst Prof of Math starting fall 1989. Candidates expected to have Ph.D., demonstrate excellence in teaching, and have commitment to teaching in strong liberal arts setting. Seeking best teacher/scholars regardless of math specialty, although candidates with some training in stat considered somewhat more favorably. Send vita and letters of reference to: Charles Jones, Chair Dept. of Math, Grinnell College, Grinnell, Iowa 50112. Search will remain open until position filled; to be assured of consideration, submit all materials by 2/15/89.

HOOD COLLEGE. Department of Mathematics and Computer Science, Frederick, MD 21702. Tenure track position. Rank and salary dependent on qualifications. Require terminal degree in computer science or mathematics or related field, substantial graduate study or related experience in CS, and commitment to excellence in teaching. Teach undergraduate and graduate courses, advise students, and participate in curriculum development for existing bachelor's and master's programs. Hood is a small liberal arts college for women, and has both liberal arts and career-oriented programs. Send resume and letter of application to Dr. E. Chang, Chair.

INDIANA STATE UNIVERSITY. Dept. of Math and CS invites apps for the position of Chairperson. Apps should have a doctorate in Math or CS, a record of successful teaching and research, and a commitment to promoting research, teaching, and other scholarly activities. In addition, apps should have a potential for administering a dept with both Math and CS degree programs. The CS area is undergoing active development, so familiarity with CS curricula issues desirable. Salary and rank commensurate with qualifications and exp. Send letter of app, vita, and 3 letters of recommendation to Dr. George Graham, Chair, Search Committee, Dept. of Math & CS, Indiana State University, Terre Haute, IN 47809 Apps received after 2/15/89 cannot be guaranteed consideration.

INDIANA STATE UNIVERSITY. Apps are invited for a tenure track math position at the Asst Prof level beginning August 23, 1989. Dept. has 25 full-time faculty and offers BA and BS degrees in math, math ed, and computer science, and the MA and MS in math. Apps should possess an earned doctorate and potential for teaching and research excellence. Send letter of app, vita and 3 letters of recommendation to: Dr. Charles Roberts, Acting Chair, Dept. of Math & CS, Indiana State University, Terre Haute, IN 47809. Apps received after 3/15/89 cannot be guaranteed consideration.

INDIANA UNIVERSITY. Because we are undergoing a rapid expansion, we have a number of tenure track positions beginning Fall, 1989. The area of specialization is open and includes most fields in pure and applied math as well as statistics. Inquiries: Indiana University, Dept. of Mathematics, Bloomington, Indiana 47405, Chair: John Ewing.

IOWA STATE UNIVERSITY. Apps are invited for a tenure track position in partial diff equations, with emphasis on applications, at the Asst. Prof rank. Visiting positions at Asst. and Assoc. Prof levels are also likely to be available in areas of discrete math, numerical analysis, and app math. All positions start 8/21/89. Requirements: Ph.D. or equiv., good communication skills, demonstrated potential for excellence in teaching and research. Submit letter of app, curriculum vitae, and 3 letters of reference to: K. A. Heimes, Chair, Dept. of Mathematics, Iowa State University, Ames, Iowa 50011. Full consideration: apps received by 2/1/89. Late apps considered until position(s) filled.

IOWA STATE UNIVERSITY. Dept. of Mathematics seeking Chair. Applications from individuals with nationally recognized scholarship credentials, strong leadership potential, and established and continuing record of funded research in academic, industrial, or Govt environment. Strong commitment to undergraduate and graduate ed is also expected. Preferred areas of research: applied analysis, inc. comp math, numerical analysis and app math although applications from candidates in related areas will be considered. Send resume together with names of 3 references to: William Kelly, Dean of Sciences and Humanities marked Attention: Chair Search Committee, Iowa State University, Ames, Iowa 50011. Nominations are also welcome. Application processing begins early Feb. but apps will be considered until position filled.

INDIANA UNIVERSITY AT SOUTH BEND. The Dept. of Mathematics and Computer Science is filling one or more tenure track positions in mathematics, and possible visiting positions for 1989-1990 academic year. Positions start August, 1989. Applicants must have Ph.D in mathematics by Aug. 1989 or show substantial progress toward completion. Candidates should have strong research record or demonstrated research potential and are expected to be excellent teachers. All areas of mathematics including statistics and numerical analysis will be considered. Applications accepted until Jan. 30, 1989, or until position is filled. Send vitae and three letters of recommendation to: Professor Lee L. Keener, Chair, Dept. of Mathematics and Computer Science, Indiana University at South Bend, South Bend, Indiana, 46634.

INDIANA UNIVERSITY OF PENNSYLVANIA. Apps invited for perm tenure track position at Asst/Assoc Prof rank in Math Ed beginning 9/89. Duties: teach 12 sem hours undergrad/grad courses per semester, assist in curriculum and course revision, advise students and serve on faculty committees, participate in academic and prof activities such as publication of work in prof journals, presentations at meetings or prof organizations, and the writing of grant proposals. Ph.D. or Ed.D. (awarded by June 30, 1989) in math ed required, with emph on and/or exp in teaching math at some K-8 grade level. Evidence of effective teaching and research promise in math ed, prep and ability to teach basic college level math courses. Pref but not required: exp in or evidence of research activity in math ed at K-8 level; membership in recognized pro org; interest in or exp in working with exceptional children; exp in directing a curriculum lab; and exp in working with teachers thru inservice projects. Review of apps begins 2/15/89 and continues until position is filled. Send letter of app, resume, transcripts, and 3 letters of recommendation to Professor Joanne Mueller, Search Committee E., Dept. of Math, Indiana University of Pennsylvania, Indiana, PA 15705.

KANSAS STATE UNIVERSITY. Subject to budgetary approval, apps are invited for 3 tenure track positions commencing 8/18/89; rank and salary commensurate with exp. All fields considered, but pref given to candidates in Group Theory, Global Analysis, and Non-Linear Dynamical Systems. Apps must have strong research credentials and commitment to excellence in teaching. Ph.D. in math or a Ph.D. accepted with only formalities to be completed is req. Application, detailed resume with description of research and 3 letters of recommendation should be sent to: Louis Pigno, Dept. of Mathematics, Cardwell Hall, Kansas State University, Manhattan, KS 66506. Deadline: 2/1/89.

KENNESAW COLLEGE. 2 tenure track positions in math at Asst. Prof level or above beginning 9/89. Ph.D. req with strong commitment to undergrad teaching as well as interest in scholarly activities. Salary and rank competitive and commensurate with credentials and exp. Send resume and a list of 3 references to: Dr. Thomas R. Thomson, Chair, Search Committee, Kennesaw College, P.O. Box 444, Marietta, GA 30061. Deadline 3/15/89 or until position filled.

KENT STATE UNIVERSITY. Apps are invited for a tenure track faculty position in math at the asst or assoc prof level beginning Fall 1989. Apps should expect to have Ph.D. in math with specialization in algebra, or a closely related field, by the starting date. Commitment to quality teaching at undergrad and grad levels and demonstrated research ability. Deadline: 2/17/89, or until position is filled, or until 4/28/89, whichever occurs first. Submit curriculum vita and arrange for 3 letters of recommendation to be sent to: O.P. Stackelberg, Chair, Dept. of Mathematical Sciences, Kent State University, Kent, OH 44242.

LOYOLA MARYMOUNT UNIVERSITY. Department of Mathematics, Los Angeles, CA 90045. One tenure track assistant professorship for Fall 1989, and at least one visiting position. Ph.D. required. There are no restrictions as to area of specialization. The teaching load is 9-12 hours per semester. Evidence of continued scholarship is required. There is an opportunity to teach a wide variety of undergraduate courses. Applications should be received by Feb. 1, 1989. Send cover letter (indicate if you plan to attend AMS/MAA annual meeting in Phoenix, Arizona), resume and three letters of recommendation (at least one on teaching) to C. Weeks, Hiring Committee.

LOYOLA UNIVERSITY. The Department of Mathematical Sciences anticipates at least one tenure track position and several one year positions beginning in August, 1989. Requirements are the Ph.D., an active research program in any area, and a commitment to quality teaching. The department offers courses in mathematics, computer science, and statistics at the undergraduate and masters level. Interviews will begin in January and continue until all positions are filled. Send detailed C.V. and 3 letters of recommendation to: Professor R. J. Lucas, Dept. of Mathematical Sciences, Loyola University of Chicago, Chicago, IL 60626.

MANKATO STATE UNIVERSITY. Fixed term faculty positions anticipated. Rank/salary dep upon qualifications. Masters degree req. Position involves coordinating and teaching developmental math. Apps must have strong interest in teaching freshman level and show evidence of successful teaching at postsecondary level. Teaching load at most 36 quarter hours per 9 month academic year. Successful candidate will teach courses in math, assist with student advising, and serve on various departmental committees. Deadline: 2/1/89 or until filled. Send application letter, vita, teaching interests, and 3 letters of reference to: F.T. Hannick, Chair, Dept. of Mathematics, Astronomy and Statistics, Mankato State University, Mankato, MN 56001.

MANKATO STATE UNIVERSITY. Tenure track faculty positions anticipated. Rank/salary dep on qualifications. Ph.D. required. Apps particularly encouraged from specialties complementing current faculty in areas of applied math, math ed, numerical analysis, and stat. Possibility exists for joint appt. with Computer Science. Must have strong interest in teaching freshman through grad levels and show evidence of successful teaching at postsecondary level. Teaching load at most 36 quarter hours per 9 month academic year. Successful candidate will teach courses in math/stat, assist with student advising, serve on various departmental committees, and conduct appropriate research. Deadline: 2/1/89 or until filled. Send application letter, vita, teaching interests, research interests, and 3 letters of reference to: F.T. Hannick, Chair, Dept. of Mathematics, Astronomy and Statistics, Mankato State University, Mankato, MN 56001.

MEMPHIS STATE UNIVERSITY. Dept. of Mathematical Sciences invites apps for anticipated tenure track positions for 1989. Preferred research areas in computer science include algorithms, parallel and distributive processing, AI/cognitive science, software devel, network design and analysis, data communications, and theory. Preferred research areas in stat include time series, biostatistics, stochastic models, and app stat. Preferred areas in math include app math, numerical analysis, dynamical systems, graph theory, and combinatorics, analysis, diff equations, and related areas. Ph.D. req by 9/1/89, and a strong potential for excellence in teaching and research. Selection begins 2/10/89 and continues until all positions filled. Apps should submit a resume and direct 3 letters of reference to: Ralph Faudree, Chair, Dept. of Mathematical Sciences, Memphis State University, Memphis, TN 38152.

MIAMI UNIVERSITY. Dept. of Math and State anticipates authorization for an asst prof (tenure track) position beginning 8/89. Duties inc teaching 12 hours per semester, service, and scholarship. Applicants should have a Ph.D. in one of the mathematical sciences by August 1989 and a strong interest in teaching. Send a vita, grad transcript and 3 letters of reference to: Middletown Search Committee, Dept. of Math and Stat, Miami University, Oxford, OH 45056 by 2/1/89. Late apps may be considered.

MICHIGAN STATE UNIVERSITY. 2 Postdoc fellowships in Mathematics. Appt is 2 years. Duties: Teaching 1 course each term of academic year with expectation that fellow will devote remaining time to research. These fellowships normally open to persons (regardless of age) who have Ph.D. less than 2 yrs. Some instructor positions also available. Have resume and 3 letters of recommendation sent to: Professor Kyung Whan KWUN, Chair, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027. Applications received by January 2, 1989 will be given more attention.

MICHIGAN STATE UNIVERSITY. There will be several open tenure track positions at the Assistant, Associate and possibly Full Professorship levels in all fields with particular emphasis on algebra, analysis, differential equations, and mathematics education. Excellence in research and teaching essential. Please send a resume and have three letters of recommendation sent to Professor Kyung Whan KWUN, Chair, Department of Mathematics, Michigan State University, East Lansing, MI 48824-1027. Applications received by January 2, 1989 will be given more attention.

MICHIGAN TECHNOLOGICAL UNIVERSITY. Department of Mathematical Sciences, Houghton, MI 49931. Associate of Full Professor position is expected starting September 1989. Applications in all areas of mathematics are invited. Candidates in computational mathematics, applied mathematics, or statistics are particularly encouraged. Excellent research record and commitment to teaching required. Send vita and three letters of recommendation to Recruitment Committee.

The Department of Mathematics Sciences is also seeking a director of the Fluids Research Oriented Group (F.R.O.G.). F.R.O.G. is an interdisciplinary group, involving departments of Mathematics Sciences, Mechanical Engineering, and Chemical Engineering, engaged in an active program of research in Fluid Mechanics. Primary areas of interest are turbulence, Non-Newtonian flows, heat and mass transfer, and geophysical fluid mechanics. This position will carry an appointment as Associate Professor or Professor. Candidates should have an active research record in Fluid Dynamics or Computational Mathematics. A good funding record and experience with Ph.D. students is required. The position starts September 1989. Send a curriculum vitae and three letters of recommendation to Recruitment Committee, Department of Mathematical Sciences, Michigan Technological University, Houghton, MI 49931. MTU is a state supported institution emphasizing science and engineering. The Department of Mathematical Sciences offers a B.S. and M.S. degrees and is considering a Ph.D. program.

MONTCLAIR STATE COLLEGE. Two tenure track positions to be selected from Applied Mathematics, Computer Science, Mathematics Ed and Statistics. Applicants must have strong teaching skills and interest in pursuing grants. Scholarly and prof activity is also expected. Applicants should have Ph.D. in Applied Math, Computer Science, Math Ed, Statistics, or related field. Send letter and resume to: Dr. Kenneth C. Wolff, Dept. of Math and Comp Sci., Montclair State College, Box C316 V, Upper Montclair, NJ 07043. Include names, addresses, and phone #s of 3 references. Deadline: 3/3/89.

NAZARETH COLLEGE. The Math/CS Dept. invites apps for tenure track position at Asst Prof rank beginning 8/89. Candidate should have interest in Database, MIS, Business Apps, Data Communications and ability to teach intro math courses. Adv. degree in CS and Ph.D. in related areas required. Apps will be considered as received until position is filled or 4/1/89. Send current vita, off transcripts, evidence of teaching ability and 3 letters of recommendation to: Dr. Judith Rose, Chair, Dept. Math/CS, Nazareth College, 4245 East Ave., Rochester, NY 14610.

NORTH CAROLINA SCHOOL OF SCIENCE AND MATH. Full-time (10 month) faculty position. General req: enthusiasm; high energy; doctorate or master's degree in subject field; teaching exp preferably with advanced students; exp and commitment in curriculum design; and a willingness to participate in residential school program inc social, recreational, and advisory responsibilities at times other than the usual school hours. Candidates should be comfortable teaching math courses from alg II level thru 3rd semester calculus and discrete math and beginning computer courses. Interested apps are invited to send a resume and a statement of their educational philosophy and how they foresee contributing to the school's mission to: Personnel Office, N.C. /school of Science & Mathematics, P.O. Box 2418, Durham, NC 27705. Deadline: 1/31/89.

NORTH CAROLINA STATE UNIVERSITY. A tenure track position will become open 7/1/89 at the junior level in prob and stochastic processes. Apps must have a strong potential or record in research and instruction. To apply, send a resume, any reprints or preprints, a thesis abstract, and arrange to have 3 letters of reference sent to: J.W. Bishir, Dept. of Math, Box 8205, North Carolina State University, Raleigh, NC 27695-8205.

NORTH CAROLINA STATE UNIVERSITY. Two tenure track positions will become open 7/1/89 at the junior level in numerical analysis and scientific computing. Emphasis for one of these pos will be given to finite element methods for partial diff equations. For the other pos, the area is open, but expertise in parallel computing is desirable. Apps must have a strong potential or record in research and instruction. To apply, send a resume, any reprints or preprints, a thesis abstract, and arrange to have 3 letters of reference sent to: C.T. Kelley, Dept. of Math, Box 8205, North Carolina State University, Raleigh, NC 27695-8205.

NORTHERN KENTUCKY UNIVERSITY. Three tenure-track positions beginning August, 1989. One position is in computer science. Areas for the other two positions are open. Persons in secondary or middle school mathematics with a strong mathematics background and persons in OR are particularly encouraged to apply. Responsibilities include undergraduate teaching (12 hrs./semester), scholarly activity, and service. The emphasis is on quality teaching. A doctorate is required. ABDs will be considered provided all requirements for the doctorate will be met by Aug. 15, 1989. Review of applicants will begin Feb. 15, 1989. Apply to: Professor Frank Dietrich, Chair of Search Committee, Department of Mathematics, Northern Kentucky University, Highland Heights, KY 41076.

OBERLIN. Two year visiting professor position beginning in fall 1989-90. Required: Ph.D. completed or exp by 9/89, strong interest in undergrad teaching. Pref. specialties: stat or operations research. Teach 5 courses per year. Rank: asst. prof or higher, salary commensurate with exp. Have resume, transcripts, and 3 letters of reference sent to Robert M. Young, Chair, Mathematics Dept., Oberlin College, Oberlin, OH 44074 by 2/17/89. Apps received after that date will be considered until position filled.

OHIO NORTHERN UNIVERSITY. Asst. or Assoc. Prof, Ph.D. req. Good teacher with teaching experience. Pref for expertise in Analysis, Stat, and/or Computer Science. Ohio Northern is private, church related, 2500 students. Send resume and 3 letters of reference by 3/6/89, to: Dr. Robert Hovis, Chair, Dept. of Mathematics & Computer Science, Ohio Northern University, Ada, Ohio 45810.

PENN STATE UNIVERSITY AT HARRISBURG. Dept. of Math Sci and CS invites apps for a tenure track position with primary responsibility in CS. Candidate should hold Ph.D. in CS or math and be committed to high quality teaching of junior, senior, and master's level courses. Research is req. and consulting encouraged. Apps will be accepted until position is filled. Forward vitae, transcripts, and names of 3 references to: J.S. Hartzler, Chair, Mathematical Sciences/Computer Science, Penn State Harrisburg, c/o R.H. Hamill, Box AWM, Middletown, PA 17057.

POMONA COLLEGE. Tenure track position at Asst. Prof rank in the math sciences beginning fall 89. Ph.D. required with demonstrated effectiveness in teaching and strong research capability. Must be able to teach a variety of undergrad courses, and provide intellectual leadership for majors. Submit application, inc resume, transcripts, and 3 letters of reference to: Prof. Richard Elderkin, Chair, Search Committee, Dept. of Math, Millikin Lab, Pomona College, Claremont, CA 91711-6348. Search closes after 2/1/89 whenever the position is filled.

PORTLAND STATE UNIVERSITY. 4 tenure track positions, 3 in stat, applied or pure math; and, one in math ed. Required: Ph.D. or equivalent, evidence of success in research and commitment to good teaching. Apps review begins 2/1/89 and continues until positions are filled. Send vita and at least 3 letters of reference to Bruce Jenson, Chair, Dept. of Math, P.O. Box 751, Portland, OR 97207-0751.

PURDUE UNIVERSITY. Department of Mathematics, West Lafayette, IN 47907. Joseph Lipman, Head. Possible position at the Associate Professor/Professor level beginning Aug. 1989. Excellent research credentials required. Send resume and three letters of recommendation.

PURDUE UNIVERSITY. Department of Mathematics, West Lafayette, IN 47907. Joseph Lipman, Head. Several regular or research professorships beginning Aug. 1989. Exceptional research promise and excellence in teaching required. Send resume and three letters of recommendation.

RENSSELAER POLYTECHNIC INSTITUTE. Seek extremely high quality candidates for several tenure track openings at all levels in areas of app math, inc. math programming, starting 9/89 or earlier. Ph.D. and very strong research potential req. for junior level appts. and demonstrated outstanding record for senior level appts. Also anticipate one or two visiting and postdoc appts. Dept. of Math Sciences, RPI, Troy, NY 12180. J.G. Ecker, Chair.

RENSSELAER POLYTECHNIC INSTITUTE. Math Sci Dept. seeks highly qualified apps for the Eliza Ricketts Foundation Professorship in Mathematics. Candidates for this endowed chair should have an international reputation and an outstanding record, pref in numerical analysis and scientific computation. Candidates should send their vitae to Professor Joseph Ecker, Chair of Mathematical Sciences, RPI, Troy, NY 12180. Apps received by 2/1/89 are assured of being considered. Search will continue until position filled.

RICE UNIVERSITY. One opening for tenure track asst. prof. with possible upgrade for exceptional senior candidate. Must have strong research background and good teaching skills. Preference for low-dimensional topology, although outstanding candidates in analysis, geometry, and topology will also be considered. Send CV and at least 3 letters of recommendation to Appts. Committee, Dept. of Math., Rice University, PO. Box 1892, Houston, TX 77251.

RUTGERS UNIVERSITY. Job openings for assistant professor and possibly senior professor in statistics and biostatistics for Fall 1989. Candidates for assistant professor should have a Ph.D. prior to December, 1989. Duties include teaching undergraduate and graduate courses; possibility of statistical consulting; research leading to publications in refereed journals. Senior level candidate to have outstanding research and teaching background. Send vita and three letters of recommendation to: Chairman Statistics Dept., Rutgers University, Hill Ctr., Busch Campus, New Brunswick, NJ 08903, (201)932-2691.

COLLEGE OF ST. CATHERINE. Tenure track position starting Fall 1989. Ph.D. in math, all areas considered. Excellence in undergrad teaching essential; scholarly activity encouraged. Teaching load: 6 courses per year. Rank and salary dependent upon qualifications and exp. Send resume and transcripts and have 3 letters of reference sent to: Sister Adele M. Rothan, Chair, Dept. of Mathematical Sciences, College of St. Catherine, St. Paul, MN 55105. Consideration of apps begins 2/15/89.

ST. CLOUD STATE UNIVERSITY. Dept. of Math & State invites apps for 5 tenure track math positions at rank of Asst. or Assoc. Prof to begin 9/89. 2 positions req specialization in math ed, the others are open to all areas of specialization. Apps must have commitment to undergrad ed, excellent teaching credentials, and a record or/ or strong potential for scholarly and professional activity. A doctorate is preferred, but ABDs are encouraged to apply. Send resume, transcripts, and arrange for 3 letters of recommendation to be sent to: Gail Earles, Chair, Dept. of Math and Stat, St. Cloud State University, St. Cloud, MN 56301. To assure consideration, apps should be received by 2/10/89

SAN DIEGO STATE UNIVERSITY. Apps are invited for a tenurable position in math ed. Rank: open. Require Ph.D. in math ed, math, or closely related field by 9/89. Duties inc teaching undergrads and grads, curriculum development, directing master's research, and conducting one's own research. Closing date: 1/20/89. Apps received after date will be considered if position is still open. Send vita, and have 3 letters of recommendation sent to Mathematics Ed Search Committee, Dept. of Mathematical Sciences, San Diego State University, San Diego, CA 92182.

SAN JOSE STATE UNIVERSITY. 3 tenure track faculty positions for Asst. or Assoc Prof (Prof in exceptional case), Ph.D. in math sciences; prefer expertise in partial differentials, numerical analysis, app math, math ed, stat, or CS. Candidates must have a commitment to quality teaching at all levels and interest in dept. affairs. Significant scholarly or professional activity is required for eventual tenure consideration. Salary range: \$28,800-\$55,400 per academic year. FPS 89-82, 83,84.

2 tenure track positions for Asst. or Assoc. Prof (Professor in exceptional case), Ph.D. in computer science preferred, but a Ph.D. in any mathematical science together with substantial teaching/research exp in CS may also be acceptable. Candidates must have commitment to quality teaching at all levels and interest in dept. affairs. Significant scholarly or professional activity is required for eventual tenure consideration. Salary range: \$35,200-\$59,800 per academic year. FPS 89-80, 81.

One tenure track position in math ed at the Asst. or Assoc. Prof rank (professor in exceptional case). Ph.D. with emphasis in math ed and master's degree in mathematics or equivalent. Pre-college teaching exp. Significant scholarly or professional activity is required for eventual tenure consideration. Salary range: \$28,800-\$55,400 per academic year. FPS 89-79.

Apps deadline 3/3/89. Send vita, 3 letters of recommendation and transcripts to: Dr. Veril L. Phillips, Chair, Dept. of Mathematics & Computer Science, San Jose State University, San Jose, CA 95192-0103.

SLIPPERY ROCK UNIVERSITY. One tenure track position at the asst/assoc prof rank beginning fall 1989. Earned Doctorate in math req. Candidates must demonstrate ability to teach intro and advanced undergrad courses in math, advise students, serve on committees, and carry out appropriate research activities. Send letter of app, resume, transcripts, and 3 letters of recommendation to: Mathematics Dept. Search Committee, Slippery Rock University, Slippery Rock, PA 16057. To ensure consideration, apps materials should be submitted by 2/15/89.

SOUTH DAKOTA STATE UNIVERSITY. One tenure track, Asst. Prof. position starting mid-August '89. Doctorate in math science required. All specialties considered but pref to algebraist with potential of contributing to MS program. Demonstrated skills in teaching and research. Duties include teaching 12 hours per sem of primarily undergrad math, service, and scholarly activities. Salary competitive. 2nd tenure-track Asst. Prof position possible with specialty open. Closing date: 2/16/89 or until position filled. Send letter of app, curriculum vita, transcripts of grad work, and arrange to have 3 letters of recommendation (at least one pertaining to teaching) sent to the above address.

SOUTHWEST MISSOURI STATE UNIVERSITY. Apps invited for tenure track position as Asst. or beginning Assoc. Prof in Math Ed. Doctorate with strong math background required. Demonstrated excellence in teaching and strong research potential. Record of research, success in obtaining grants, and secondary teaching exp desirable. Duties include teaching (content and methods courses), research, and service. Starting date Fall 1989. App deadline: 3/1/89. Send apps (resume, 3 current letters of recommendation, grad transcripts, and a letter of interest) to: Dr. M. Michael Awad, Head, Dept. f Mathematics, Southwest Missouri State University, Springfield, MO 55804-0094.

SOUTHWEST MISSOURI STATE UNIVERSITY. Tenure track position as Asst. or beginning Assoc. Prof in Math available 8/21/89. Ph.D. in math required. Evidence of excellence in teaching and continuing commitment to research. Pref given to apps with interests compatible with current faculty. Duties inc teaching (primarily undergrad courses), research, and service. Deadline: 3/1/89. Send apps (resume, 3 current letters of recommendation, grad transcripts, and a letter of interest) to: Dr. M. Michael Awad, Head, Dept. of Mathematics, Southwest Missouri State University, Springfield, MO 55804-0094.

SUNY-PLATTSBURGH. Apps invited for tenure track position beginning Fall 1989. Appt. possible at all levels. Duties: Primary responsibilities are undergrad teaching, research, and service. Qualifications: Ph.D. in Math or Stat. Closing date: 1/20/89 or until position is filled. Send letter of app, current resume, and 3 letters of recommendation to: Chair, Search Committee, c/o Office of Personnel/AA, SUNY Plattsburgh, Box 1567-181, Plattsburgh, NY 12901.

SUNY-STONY BROOK. Tenure track position for Visiting Asst. Prof anticipated starting 9/89. Demonstrated excellence in one or more of following areas: computational fluid dynamics and math modeling of petroleum reservoirs, hyperbolic conservation laws and wave interactions, scientific computing and fluid instabilities. For Fall '89 and/or Spring '90 semesters, may be position at Visiting Professor level in same areas. One or more postdoc positions may also be available in scientific computing and math modeling of fluid dynamics. Apply: SUNY-Stony Brook, Dept. of Applied Mathematics and Statistics, Stony Brook, NY 11794-3600.

SUNY COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY. Two academic-year, tenure track, asst profs to begin 9/1/89. Biometrician: Ph.D. in stat or biometrics; expertise in experimental design and data analysis in biological sciences. Duties: teaching AOV, experimental design, and multivariate analysis; conducting research in quantification of natural and managed ecosystems. Environmental systems modeler: Ph.D. in stat, science, or engr.: teaching systems simulation, modeling, and risk assessment; conducting research in environmental risk assessment and environmental systems modeling and management. Both: provide quantitative assistance to grad students and faculty; share teaching responsibilities in intro stat and quantitative analysis. Send letter of app, c.v., statement of research interests, transcripts, and 3 letters of reference by 1/31/89 to Drs. C.A. Maynard (315-470-6560, Biometrician) or R.C.Smarden, (315-470-6576, Environmental Systems Modeler), Search Cmte., SUNY-CESF, Syracuse, NY 13210.

SYRACUSE UNIVERSITY. Department of Mathematics, Box 1, Syracuse, NY 13244-1150. We anticipate positions available beginning Fall 1989. Candidates should have outstanding research ability and evidence of excellence in teaching. Applications are invited in any area of mathematics and in mathematics education and statistics. Send a letter of application and vita with a list of publications, and have three letters of reference sent to Daniel Waterman, Chair.

TOWSON STATE UNIVERSITY. (1) Tenure track asst. prof in math ed available Fall '89, contingent on state funding. Teach 12 hrs/sem of undergrad courses. Doctorate in math ed and commitment to teaching and research required. Pref to apps with 3 years teaching/research exp in elementary and/or early childhood ed. Salary range in mid-twenties to mid-thirties. Send resume, 3 letters of recommendation, and transcripts by 2/1/89 to Dr. Florence Fischer, Chair, Search Committee, Towson State University, Mathematics Dept., Baltimore, MD 21204. (2) Tenure track asst. professorships in math available Fall '89, contingent on state funding. Teach 12 hrs./sem of undergrad courses. Ph.D., commitment to teaching and research, 3 years teaching/research exp pref. Salary: mid-twenties to mid-thirties. Send resume, 3 letters of recommendation, and transcripts by 2/1/89 to Dr. Coy May, Chair, Search Committee, Towson State University, Mathematics Dept., Baltimore, MD 21204.

TUFTS UNIVERSITY. Asst. Prof., tenure track, beginning 9/1/89. Ph.D., promise of strong research in any field of analysis (pref to math stat, numerical analysis, ode/pde, dynamical systems, ergodic theory) and evidence of strong teaching ability required. Send C.V. and 3 letters of recommendation to Z. Nitecki, Search Committee Chair, Dept. of Mathematics, Tufts University, Medford, MA 02155, by 2/15/89. Asst. Prof, tenure track, beginning 9/1/89. Ph.D., promise of strong research in combinatorial group theory, Lie theory, finite groups, algebraic groups or algebraic geometry, and evidence of strong teaching ability required. Teaching load: 2 courses/sem. Send C.V. and 3 letters of recommendation to R.Weiss, Search Committee Chair, Dept. of Mathematics, Tufts University, Medford, MA 02155, by 2/15/89.

UNION COLLEGE. Apps invited for 3 year Visiting Asst. Prof.(s) beginning 9/89. All fields considered. Teaching load: 5 courses/year typically split 2-2-1 over three 10 week terms. Salary negotiable and depends on qual. Excellence in teaching and strong interest in scholarship required. Send vita and 3 letters of reference - at least one discussing teaching qualifications- to: W. S> Zwicker, Chair, Union College, Dept. of Mathematics, Schenectady, NY 12308.

UNIVERSITY OF ALABAMA AT BIRMINGHAM. Faculty positions at all ranks. Especially interested in: Numerical PDE/Scientific comp, math physics, dynamical systems and non-linear analysis. (Faculty members have access to AL Super Computer using Sun Station and T-1 line to Cray X-MP/24). Other areas considered. Apps for senior positions must have demonstrated excellence in research, apps for junior positions must exhibit promise of excellence. Send asap a c.v., selected reprints, and 3 letters of ref (candidates for senior pos may send list of references) to Search Committee, Dept. of Mathematics, U of Alabama at Birmingham, Birmingham, AL 35295.

UNIVERSITY OF ALABAMA AT HUNTSVILLE. Apps are invited for tenure track asst. or assoc. prof. position beginning 9/89. Rank and salary depend on credentials. Ph.D. in math or related field with emphasis in applied math, evidence of good teaching skills, and excellent research ability. Preferred areas: numerical analysis, diff equations, dynamical systems, math modeling, fluid dynamics, discrete math, and prob/stat. Send letter of app, vita, and 3 letters of ref to: Peter M. Gibson, Chair, Math & Stat Dept., University of Alabama in Huntsville, Huntsville, AL 35899.

UNIVERSITY OF ALASKA ANCHORAGE. Tenure track position. Ph.D. in math or stat required; completing degree by 8/89 will be considered. Background of successful teaching at postsecondary level in variety of undergrad math courses and evidence of research ability. Special encouragement to candidates in applied stat and applied math. Primary responsibilities: instruction in mathematics and statistics at undergrad level. Teaching load: 9 hours or equivalent per semester. Proof of doctorate required of finalist. Only complete apps considered. Send resume and 3 letters of recommendation to: U. of Alaska Anchorage, Personnel Services Office, 3211 Providence Dr., Anchorage, AK 99508.

UNIVERSITY OF ARIZONA. Tenure track positions. Ph.D., excellent research record or potential, strong commitment to teaching required. Field is less important than ability but should complement existing strengths in algebra, computational science, differential equations, dynamical systems, geometry, mathematical physics, nonlinear analysis, number theory, probability, and statistics. Applications received by Feb. 1, 1989 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications to Department Head, Department of Mathematics, The University of Arizona, Tucson, Arizona 85721.

The Mathematics Department at the University of Arizona will have several visiting positions for next year. Applications received by Feb. 1, 1989 will be considered first, if suitable candidates are not found then late applications will be reviewed. Send applications to Department Head, Department of Mathematics at the above address.

The Mathematics Department at the University of Arizona announces several postdoctoral fellowships (Research Associate) available beginning August, 1989. Applicants with strength in applied mathematics, computational science and nonlinear optics may qualify for special Center of Excellence Awards. Only candidates with outstanding research records or potential should apply. Applications received by Feb. 1, 1989 will be considered first, if suitable candidates are not found, late applications reviewed. Send applications to Department Head, Department of Mathematics at the above address.

UNIVERSITY OF CALIFORNIA, SANTA CRUZ. Math Dept. expects to have several visiting positions available during the academic year 1989-1990 and invites applications from qualified mathematicians in all fields. Appts. will be Visiting Asst. Prof, Assoc., or Full Professor, as appropriate. Positions available for periods ranging from one quarter to 2 years. Possibility that 3 year visiting positions at level of beginning Asst. Prof will be available. Pref to those who can teach for at least the entire year. Applicants must hold Ph.D. in Mathematics. University teaching exp desired. Send vitae, 3 letters of reference speaking to research and teaching experience to: Recruiting Committee, Mathematics Dept., University of California, Santa Cruz, CA 95064. Please refer to #T88-13 in your reply.

UNIVERSITY OF CINCINNATI. Dept. of Mathematical Sciences, Cincinnati, Ohio 45221-0025. Asst. prof position expected pending budget approval. Preference to candidates who will strengthen existing research areas in the Department. Outstanding potential for research, scholarship, and teaching required. Visiting positions, inc. Otto Szasz Visiting Professorship, also available. Send vita and direct 3 letters of reference to C. W. Groetsch, Head.

UNIVERSITY OF COLORADO. Dept. of Mathematics, New Applicants, Campus Box 426, Boulder, CO 80309. Apps are invited for instructors or visiting asst prof positions beginning fall 1989 in Program for Applied Mathematics. Pref to candidates with research emphasis in either: physical applied math, non-linear phenomena, and computational math. The Program, an interdisciplinary effort, inc faculty from CS, engr, math, astrophysical sciences as well as other departments, institutes, and centers. Apps should send current c.v., reprints, and 3 letters of recommendation to Professor James Curry, Associate Director, Program in Applied Mathematics. Deadline: 2/10/89. Consideration for unfilled positions until 4/15/89.

UNIVERSITY OF DELAWARE. Three tenure track positions available beginning 9/1/89; senior pos in numerical analysis (closing date 1/1/89) and two asst prof positions - one in stat and one in either combinatorics, computational algebra or nonlinear functional analysis (closing date: 2/1/89). Strong research and teaching credentials required. Send vita and 3 letters of recommendation to Dr. Ivar Stakgold, Chair, U. of Delaware, Dept. of Mathematical Science, Newark, DE 19716.

UNIVERSITY OF IDAHO. Tenure track teaching and research position. Ph.D. in Math required. Dept. has 20 faculty and 20 TAs and gives degrees through the Ph.D. Grad programs at U. of Idaho and nearby Washington State U. allow students at either university to take courses at the other without incurring additional fees. Closing date: 2/1/89 or until position is filled.

UNIVERSITY OF IOWA. Pending funding, Dept. expects to have one or more visiting appts available fall 1989. Pref given to candidates whose interests are compatible with current research activity in the dept. Ph.D. in Math or equivalent training, and effective teaching ability at undergrad and grad levels. Provide c.v. and have 3 letters of recommendation, at least one addressing teaching qualifications, sent to: William A. Kirk, Dept. of Mathematics, U. of Iowa, Iowa City, Iowa 52242.

UNIVERSITY OF LOUISVILLE. A tenure-track Assistant Professorship is available for a person with an active research program in Algebra, Geometry, Foundations, or related area. Preference will be given to those with active research in Algebra and advanced training in Geometry. Starting date is Fall, 1989: Ph.D by August 1989 is required: some teaching experience is preferred. Candidates should send a letter of application with vitae, at least three letters of recommendation, and an official transcript to: Dr. Lael F. Finch, Department of Mathematics, University of Louisville, KY 40292. Consideration will begin Jan. 1, 1989 and continue until the position is filled. We will interview at the AMS Meeting in Phoenix.

UNIVERSITY OF LOUISVILLE. Dept. of Math seeks an established mathematician to be Department Chair beginning Fall 1989. Candidates should have active research program, substantial scholarly research achievement, teaching and administrative experience, and interest in both undergraduate and graduate program development. Ph.D. in mathematics required. Research areas compatible with those already in Department are desirable, but not required. Experience directing Ph.D. theses desirable, but not essential. Appt. will be at the Assoc. Prof. or Professor level, depending upon qualifications. Interested candidates should send letters of application, vitae, and at least 3 letters of recommendation to Prof. Richard Davitt, Dept. of Mathematics, Univ. of Louisville, Louisville, KY 40292. Deadline: 1/3/89.

UNIVERSITY OF MAINE. Department of Mathematics, 333 Neville Hall, Orono, ME 04469. Applications are invited for Assistant Professor of Mathematics for a full-time tenure-track appointment in teaching and research, beginning in September 1989, pending administrative approval. Ph.D. or equivalent required. Two course teaching load. Preference will be given to applicants who show promise of augmenting research in current areas of department interest. These include Analysis, Computational Mathematics, Discrete Optimization, Dynamical Systems, Fluid Mechanics, Geometry, Mathematics Education, Number Theory and Statistics. Salary negotiable depending on qualifications. Closing date Feb. 15, 1989. For further information contact Dr. Grattan Murphy, Chair.

UNIVERSITY OF MARYLAND. College Park, Dept. of Mathematics, College Park, MD 20742. Apps. are invited for possible tenure or tenure-track positions to begin Aug. 1989. Rank and salary depend on qualifications. Joint appointments with other units, in particular with the Institute for Physical Science and Technology, are possible. Exceptionally strong research program necessary. Deadline for full consideration: 2/1/89. Vita, description of current research and at least 3 letters of recommendation should be sent to Prof. Nelson G. Markley, Chair.

UNIVERSITY OF MARYLAND BALTIMORE COUNTY CAMPUS. Apps invited for a Senior Statistician, assoc or full prof rank. Apps with strong research records are encouraged to apply. Send C.V., list of publications, and a list of references to James M. Greenberg, Chair, Dept. of Mathematics and Statistics, University of Maryland Baltimore County, Baltimore, MD 21228. Apps considered until position is filled.

UNIVERSITY OF MICHIGAN - DEARBORN. Tenure track position at asst/assoc prof level available 9/89. Appt. in Dept. of Math with primary responsibilities in Interdisciplinary Computer Science program (Business, Engr., Math). Ph.D. in one of the computer or information sciences with grad level work in one of the math sciences or a Ph.D. in one of math sciences with master's degree or equiv in one of computer or info sciences required. 9 hours teaching load per sem, released time for research avail to junior faculty. Send vita, 3 letters of recommendation, official transcripts to: Chair, Search Committee, Dept. of Math and Stat, University of Michigan-Dearborn, Dearborn, MI 48128-1491.

UNIVERSITY OF MICHIGAN - DEARBORN. Tenure track position starting 9/89. Asst Prof level, Ph.D. in Math required. Pref to research interest in applied areas. Teaching capability in an applied area of math or in stat also a plus. Teaching load: 9 hours/sem. Send resume to: James Brown, Co-Chair, Search Committee, Dept. of Math and Stat, University of Michigan-Dearborn, Dearborn, MI 48128.

UNIVERSITY OF MICHIGAN - FLINT. Mathematics education, asst prof, tenure track position, 9/89. Major responsibilities: teach undergrad math ed in urban oriented teacher ed program. Related assignments may inc curriculum development in math ed and supervising student teachers. Qualifications: earned doctorate completed or anticipated by 12/31/89 in math ed, elem and/or middle school teaching exp, evidence of scholarly potential, exp teaching math ed courses. Apps reviewed beginning 2/12/89, and will continue until position is filled. Send letter of app, vita, transcripts, and names, addresses, and phone numbers of 3 references to: Dr. Gene Sullivan, Chair, Search Committee, Education Dept., The University of Michigan-Flint, Flint, MI 48502-2186.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS. School of Mathematics Dunham Jackson Instructorship. Three-year appt. from Fall 1989 to Spring 1992, with reduce teaching load of one course per quarter. Outstanding research required. Preference given to candidates whose research interests are compatible with those of the School. Ph.D. received no earlier than 1/88. Summer school teaching available during '90 and '91 to support. regular stipend. Salary competitive. Consideration of applications begins 12/1/88. Contact Richard McGehee, Head, School of Mathematics, 127 Vincent Hall, 206 Church St. S.E., U. of Minnesota, Minneapolis, MN 55455.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS. May have available one or more tenure track positions starting Fall, 1989. Ph.D., outstanding research and teaching abilities required. Apps at all levels are invited, but preference will be given to Asst. or beginning Assoc. Prof. level. Preference will also be given to candidates whose research interests are compatible with those of the school. All fields considered, but particular interest in: Several Complex Variables, Classical Analysis, Numerical Analysis, Topology, Algebraic Geometry, Differential and Riemannian Geometry. Salary competitive. Consideration of apps begins 12/1/88. Contact Richard McGehee, Head, School of Mathematics, at the address above.

UNIVERSITY OF MINNESOTA, MINNEAPOLIS. Several visiting positions at all levels from Lecturer to Full Professor available from one quarter to one year for 1989/1990. Strong research and teaching abilities required. Preference will also be given to candidates whose research interests are compatible with those of the school. Salary competitive. Consideration of apps begins 12/1/88. Contact Richard McGehee, Head, School of Mathematics, at the address above.

UNIVERSITY OF MISSOURI-COLUMBIA. Apps at all faculty levels are invited for several tenure track positions beginning 8/89. Ph.D., quality teaching, and a commitment to a distinguished research career required. Selection for each position based primarily on demonstrated research achievement in a field represented in the Dept. Send vita and arrange to have 3 letters of recommendation sent to: Prof. L.J. Lange, Chair, Dept. of Mathematics, U. of Missouri Columbia,, Columbia, MO 65211.

UNIVERSITY OF NEBRASKA-LINCOLN. Tenure-track position at the Associate (or Assistant) Professor level in partial differential equations available next Fall, 1989. Ph.D. required with proven excellence in teaching, a strong research record, and the ability to direct doctoral dissertations. Preference to candidates with expertise in numerical methods or modeling. Send vita and three letters of recommendation to Professor Tom Shores, PDE Search Committee Chair, Department of Mathematics and Statistics, University of Nebraska-Lincoln, Lincoln, NE 68588-0323. Application deadline February 1, 1989 or until position is filled. 402 472 7233.

UNIVERSITY OF NEBRASKA-LINCOLN. Tenure-track position at the Assistant Professor level in either Combinatorics or Global Analysis available Fall, 1989. Ph.D. required with strong potential for research and quality teaching. Send vita and three letters of recommendation to Professor Earl Kramer, Search Committee Chair, Department of Mathematics and Statistics, University of Nebraska-Lincoln, NE 68588-0323. AA/EOE. Application deadline February 1, 1989 or until position is filled. 402 472 7246.

UNIVERSITY OF NEBRASKA-LINCOLN. Tenure-track position in Statistics at the Associate Professor level beginning Fall, 1989. Ph.D. required with excellent teaching skills and strong research credentials along with commitment to strengthen the existing Ph.D. program. Send vita and three letters of recommendation to Professor K. H. Lal Saxena, Statistics Search Committee Chair, Department of Mathematics and Statistics, University of Nebraska-Lincoln, NE 68588-0323. Deadline February 1, 1989 or until positions are filled. 402-472-7246.

UNIVERSITY OF NEBRASKA - LINCOLN. Tenure track position at asst. prof level (assoc level considered for exceptionally strong cases) fall 1989. Ph.D. required with strong potential for research and quality teaching. Subject to the requirement that the candidates be outstanding, pref given to candidates in commutative algebra or algebraic geometry, then to candidates in areas related to those already in the dept. Send vita and 3 letters of recommendation to Prof. Roger Wiegand, Hiring Committee Chair, Dept. of Math and Stat, U. of Nebraska-Lincoln, Lincoln, NE 68588-0323.

UNIVERSITY OF NEBRASKA - LINCOLN. The University seeks a dynamic individual for the position of Chair of the Dept. of Computer Science and Engineering. Qualifications require earned doctorate in computer science or related field, strong leadership for research and academic programs, and credentials appropriate for appointment as a full professor. Administrative experience is desirable. Starting date for appt.: 9/89. Deadline for app: 2/15/89, or until position is filled. Salary will be commensurate with qualifications. Send resume and names of 3 references to Prof. Spyros S. Magliveras, Chair, Search Committee, Computer Science and Engineering Dept., Ferguson Hall, U. of Nebraska, Lincoln, NE 68588-0115. E-mail address: spyros@fergvax.unl.edu.

UNIVERSITY OF NORTH CAROLINA, GREENSBORO. Apps invited for 2 tenure track positions specializing in Computer Science, beginning 8/89. One (Assoc Prof level) requires Ph.D. in CS. or closely related field; the other (ASst. Prof level) a Ph.D in Computer Science. Initial appt 3 years/9 month per year. Salaries competitive and negotiable. Apps evaluate beginning 2/15/89, until positions filled. Send vita, transcripts, and 3 letters of reference to P. Duvall, Head, Dept. of Mathematics, UNCG, Greensboror, NC 27412. For more info contact DUVALL@UNCG.BITNET.

UNIVERSITY OF OKLAHOMA. Dept. of Mathematics, 601 Elm St., Room 423, Norman, OK 73019. Applications are invited for one or more anticipated tenure or tenure-track positions in Mathematics beginning Fall 1989. Candidates must have a Ph.D. degree, demonstrated excellence in research, and potential for high-quality teaching. Strong candidates in all areas will be considered with preference given to research interests compatible with those of our current faculty. Duties include research, normally teaching six hours per semester, and Departmental and University service appropriate to rank. Salary and rank will be commensurate with qualifications and experience. There may also be visiting positions. Applicants should send their vita and have at least 3 letters of reference sent to: Dr. Darryl McCullough, Search Committee Chair. Closing dates are 12/15/88 and every two weeks thereafter.

UNIVERSITY OF SOUTH CAROLINA. Apps invited for full-time positions teaching freshman and soph college courses in math. Tenure track position available 9/89. Min Qualifications: Master's degree in math and strong commitment to teaching. Ph.D. in math or Ed.D. in math ed preferred. Salary and rank commensurate with qualifications and experience. Send c.v., transcripts, and 3 letters of recommendation by 1/23/89 to: Dr. Bob Nerbun, Chair of Science, Math, and Engineering, U. of South Carolina at Sumter, Sumter, SC 29150-2489.

UNIVERSITY OF SOUTH CAROLINA. Apps invited for anticipated tenure track positions at all ranks. Apps in all areas of math considered. Dept. seeks to build on existing research strengths and to increase scope of programs, particularly in applied and computational math. Ph.D. or equiv required. All appts consistent with Dept's commitment to excellence in research and teaching at undergrad and grad levels. Send detailed resume, containing summary of research accomplishments and goals, and 4 letters of recommendation to: Dr. Colin Bennett, Chair, Dept. of Math, USC, Columbia, SC 29208. Deadline: 3/31/89.

UNIVERSITY OF SOUTHERN MAINE. Tenure track position at Asst. Prof. level. Salary negotiable. Ph.D. or completing Ph.D. in combinatorics, functional analysis, graph theory, operations research or stat and should show potential for quality teaching and productive research. Teaching responsibilities inc undergrad and master's level grad courses. Apps will be reviewed immediately. Send C.V., grad transcripts, and 3 letters of recommendation to: Dr. Sat Gupta, Chair, Search Committee; Dept. of Math and State, U of Southern Maine, Portland, ME 04103.

UNIVERSITY OF TEXAS at ARLINGTON. Expect to fill several positions beginning fall 89. Salary and rank commensurate with qualifications. Excellent credentials in research and teaching. Desired areas of expertise: Differential or Algebraic Geometry, Computational Geometry, Partial Differential Equations, Functional Analysis and Applied Math. A resume and 3 letters of recommendation should be sent to: R. Kannan, Dept. of Mathematics, UTA, Box 19408, Arlington, TX 76091.

UNIVERSITY OF TEXAS at AUSTIN. Dept. of Mathematics, Austin, TX 78712. A number of appointments are expected for Fall 1989 at all levels, inc. Instructor (customarily appointees are new Ph.D.s), Asst. Prof (customarily appointees have at least 2 years exp beyond the Ph.D.), Assoc. Prof. and Professor. Candidates should have outstanding research ability and concern for teaching. Salaries competitive. Send vita, detailed summary of research interests, and three recommendation letters to address above as follows: Instructor and Asst. Prof.: Recruiting Committee. Assoc. Prof. and Professor: %John Dollard, Chairman.

UNIVERSITY OF WISCONSIN-EAU CLAIRE. 1 or more tenure track positions. All specialties considered, some pref to stat or geometry, especially with interest and experience in teaching upper-level undergrad courses in geometry. Doctorate strongly pref, tenure without Ph.D. unlikely. Load: 12 hours, with 2 preparations. Primarily and undergrad teaching institution with grad programs for teachers and which actively encourages research and scholarly activities. Apps must present evidence of potential for excellence in teaching. 1 or 2-year initial appt. Closing date: 2/15/89, or until position filled. Send letter of app, resume, grad and undergrad transcripts, and 3 letters of recommendation to: U. of Wisconsin-Eau Claire, Marshall E. Wick, Chair, Dept. of Mathematics, Eau Claire, Wisconsin 54702-4004.

UNIVERSITY OF WISCONSIN - MADISON. Apps solicited for tenure track position directing and teaching in extension and outreach program in mathematics beginning 7/1/89. Asst. Prof level unless qualifications and exp require appt at higher rank. Responsibilities inc administration and development and teaching in prog of the Division of University Outreach and a limited amt of teaching in Dept. of Math. New faculty member will have challenge of developing continuing and professional ed programs designed to introduce new developments in math sciences to the broad public at all career levels. To assure full consideration all materials should be received by 3/1/89. App forms avail from Mathematics Extension Search Committee, Math Dept., 223 Van Vleck, 480 Lincoln Drive, Madison, WI 53706.

UNIVERSITY OF WISCONSIN - MILWAUKEE. Dept. of Mathematical Sciences, P.O. Box 413, Milwaukee, WI 53201. We anticipate a full or associate level professorship (with tenure) beginning 8/89. Appt. will be in applied analysis and/or dynamic systems. Duties consist of research and teaching 2 courses per semester. Apps must have strong research and publication record. Salary commensurate with experience and qualifications. Submit vita, a list of publications, and at least 5 letters of recommendation to Search Committee at the above address by 1/27/89.

UNIVERSITY OF WISCONSIN - MILWAUKEE. Dept. of Mathematical Science, P.O. Box 413, Milwaukee, WI 53201. Apps invited for several anticipated tenure track assistant professorships beginning Fall 1989. We especially seek candidates in applied mathematics and/or numerical analysis, applied analysis and/or dynamic systems, topology, complex variables, statistics. Candidates should have proven ability or demonstrated potential for research as well as good teaching qualifications. Duties consist of research and teaching 2 courses per semester. Send credentials and at least 3 letters of recommendation by 1/27/89 to Search Committee at the above address.

UNIVERSITY OF WISCONSIN - OSHKOSH. 2 or more entry level tenure track positions anticipated beginning 9/89. Ph.D. in a mathematical science required. Good teaching is essential. Primary responsibility is undergrad teaching, with opportunity for some grad teaching. Usual teaching load is 3 courses per semester. Scholarly activity required, and, where appropriate, pursuit of extramural funding is expected. Anticipate need for faculty in Computational Math, Math Ed, and Stat. However, all areas will be considered. Screening apps begins 1/23/89 and will continue until positions are filled. Send letter of app, resume, official transcripts, and 3 current letters of recommendation to: N. Kuenzl, Chair, Dept. of Mathematics, U. of Wisconsin Oshkosh, Oshkosh, WI 54901.

UNIVERSITY OF WISCONSIN- OSHKOSH. Apps invited for a 1-year-only academic staff lecturer position beginning 9/89. Master's degree in Computer Science required. Pref given to individuals with additional course work or Ph.D. in CS and/or teaching exp. Teaching assignments: entry level courses and perhaps one upper level course. Screening of apps: 3/15/89 or until position is filled. Send letter of app, resume, copies of all transcripts, and 3 letters of reference via U.S. Mail to: Wayne Wallace, Chair, Computer Science Dept., University of Wisconsin Oshkosh, Oshkosh, WI 54901..

UNIVERSITY OF WISCONSIN - PARKSIDE. Asst. Prof of Mathematics: 1 or more tenure track positions, Ph.D. and commitment to excellence in teaching and math research required, 9-10 hrs/semester teaching. Current research interests at UWP inc group theory, ring theory, topology/geometry of manifolds, Clifford algebra, computer applications. Send vita and 3 letters of reference to: N. Wielenberg, Chair Math Recruitment, UWP, Box No. 2000, Kenosha, WI 53141. Inquiries: 414-553-2487. Apps accepted until position filled.

WAKE FOREST UNIVERSITY. Apps invited for a tenure track position in computer science at asst prof level beginning 9/89. Position supported by grant from Dana Foundation and person filling it will be designated as Dana Faculty Fellow. Duties inc teaching, research, and providing leadership in a developing program in computer science. Ph.D. in computer science or equiv required. Send letter of app and resume to: Richard D. Carmichael, Chair, Dept. of Math and CS, Wake Forest University, Box 7311, Winston-Salem, NC 27109.

WAKE FOREST UNIVERSITY. Apps invited for tenure track position at asst prof level beginning 1989. Duties inc teaching stat and prob courses, doing research, and providing leadership in dept. and resume to: Richard D. Carmichael, Chair, Dept. of Math and CS, Wake Forest University, Box 7311, Winston-Salem, NC 27109.

WASHINGTON STATE UNIVERSITY. Dept. of Elem. & Sec. Education, Pullman, WA 99164-2122, C. S. Johnson, Chair Math Ed Search Committee. Joint tenure track position in Math and Education beginning 8/89. Qualifications: Ph.D. in math ed or related field, strong math background and excellence in research and teaching in math ed. Have vita and 3 references sent to Chair. Review begins: 2/15/89, continues until position is filled.

WASHINGTON STATE UNIVERSITY. At least 1 temp position available for academic year 89-90 starting 8/16/89, although status may be upgraded to tenure track. Apps must have demonstrated research ability in Comprehensive applied Mathematical Modeling preferably with applications to Life Science Phenomena and have potential to supervise doctoral dissertations. Ph.D. required with competence in teaching relevant grad and undergrad courses. Appt. is Asst. Prof level but especially qualified senior apps may also be considered. Apps accepted thru 2/15/89, or until position is filled. C.V. and the names of at least 3 references should be sent to: Professor David J. Wollkind, Chair, Life Sciences Mathematical Modeling Search Committee, WSU, Pure and Applied Mathematics, Pullman, WA 99164-2930.

WAYNE STATE UNIVERSITY. 2 Assoc Prof/Prof positions available; one with emphasis in Applied Math or Stat and one in Analysis. Also possible Visiting positions. Ph.D. required. Excellence in teaching and research expected. Salary to be negotiated. Apps should inc a detailed resume, description of current research and 3 letters of recommendation, sent to: WSU, Bertram M. Schreiber, Chair, Dept. of Mathematics, Detroit, MI 48202.

WESTERN ILLINOIS UNIVERSITY. Macomb, IL 61455. 2 Tenure track positions in math ed available Fall 1989 subject to funding. Appt at asst. or assoc prof rank possible. Pref for one appt for secondary/junior high level and other at elem/middle school level. 8 to 10 hours teaching load. Earned doctorate required. Must demonstrate superior teaching and participate in appropriate research and service activities. Successful precollege teaching exp or equiv is desired. Send C.V. and photo copy of grad transcripts to Larry Morley, Chair: Dept. of Mathematics. Selection process begins 2/1/89 and continues until position is filled.

WESTERN ILLINOIS UNIVERSITY. Macomb, IL 61455. 3, possibly more, tenure track positions available beginning Fall 1989 (subj. to funding). Apps are invited from all areas of math sciences inc math ed and stat. Evidence of the potential for superior teaching and research/creative activities is expected. 8-10 hours teaching load. Earned doctorate completed by beginning of appointment. Asst. or Assoc Prof rank possible depending on experience. Send C.V. and copies of grad transcripts to Larry Morley, Chair, Dept. of Mathematics. Apps are also to arrange for at least 3 letters of reference.

WESTERN ILLINOIS UNIVERSITY. Apps and nominations for position of Chairperson and Assoc. Prof/Prof of Mathematics are invited. Ph.D. in math, stat, or math ed required. Dept. of Math with 30 tenure track faculty positions in pure and applied math, stat, and math ed offers undergrad and masters level programs. Nominations must be received by 2/1/89. Apps accepted until position is filled, however, apps will be reviewed beginning 2/15/89. Send apps, vita, and at least 3 letters of reference to Chair Search Committee, Dept. of Mathematics, WSU, Macomb, IL 61455. (309-298-1054)

WESTERN ILLINOIS UNIVERSITY. Several faculty openings anticipated for Fall '89 for persons qualified to teach undergrad and masters level courses in any area of Computer Science. Ph.D. in CS or closely related field required. 9 month salary: \$35K to 45K depending upon qualifications. WIU stresses excellence in teaching. Send cover letter describing qualifications, a resume, and the names, addresses and phone numbers of 3 references to: David Ballew, Chair, Dept. of CS, WIU, Macomb, IL 61455. Apps will be accepted and processed until position is filled.

WESTERN WASHINGTON UNIVERSITY. Dept. of Mathematics, Bellingham, WA 98225. Thomas T. Read, Chair. Tenure track and Visiting positions for Fall 1989. Ph.D. required. Candidates especially sought in: (1) Applied mathematics, especially nonlinear diff equations, dynamical systems, optimization. (2) Mathematics education, elementary or secondary teaching exp preferred. Must be active in research, interact at the research level with current dept. members, and be good teachers. Salary open, but substantial research record required for appt. above Asst. Prof. level. Send letter of app, vita, transcript, and 3 letters of recommendation to Chair by 2/1/89. Later apps considered if positions remain.

WESTMINSTER COLLEGE. Dept. of Mathematics and Computer Science, New Wilmington, PA 16172. Thomas R. Nealeigh, Chair. Anticipates one tenure track position beginning 9/89. Ph.D., expertise CS, excellent teaching ability, strong commitment to scholarship. Apps accepted until position filled. Send letter of app, resume, grad transcript, and 3 recent letters of recommendation to Chair.

WILKES COLLEGE. Dept. of Mathematics and Computer Science, Professor Samuel Merrill, Chair, Wilkes-Barre, PA 18766. 2 Tenure track positions for Fall 1989. Ph.D. in Math or CS required. Rank and salary are open, depending on experience and qualifications. Send resume, grad transcripts, and 3 letters of recommendation to the Chair.

COLLEGE OF WILLIAM AND MARY. Dept. of Mathematics, Williamsburg, VA 23185. Apps invited for one or more tenure track positions at the asst. prof level or above beginning 8/16/89. Ph.D. in a math science required. Candidates expected to carry out strong sustained research program, and have commitment to effective teaching. Those with research interests in discrete math, matrix theory, num analysis or systems theory are especially encouraged to apply. However, strong candidates in any are of math considered. Send a letter of app, together with C.V. and the names of at least 3 professional references to Mathematical Search Committee at the above address. Initial screening begins: 2/1/89. Will continue until positions filled. 804-253-4481.

XAVIER UNIVERSITY. Cincinnati, Ohio 45207. Apps invited for 2 tenure track positions at Asst. Prof. or above beginning 9/89, one each in applied math and discrete math. Candidate will have, or be completing, an earned doctorate and will possess a strong commitment to teaching a wide variety of undergrad courses within framework of a Jesuit liberal arts institution. Position requires teaching 12 hours/semester, advising majors, and assisting in course and curriculum revision while continuing a program scholarly development. Apps reviewed as received and process until positions are filled, with final deadline of 4/15/89. Send resume, transcripts, and 3 letters of reference to D.C. Trummell, Chair, Dept. of Mathematics.

YORK UNIVERSITY. Apps invited for a contractually-limited appt for two years at Asst. Prof rank commencing 7/1/89. Apps should hold Ph.D. in Mathematics and have ability to teach effectively in French and English. Teaching exp in both languages an asset. Duties inc research and teaching 3 math courses. Salary commensurate with exp and in accordance with the Collective Agreement. Apps, C.V., and 3 letters of reference should be sent to Prof. J. C. Bouhenic, Chair, Math Dept, Glendon College, York University, 2275 Bayview Ave., Totonto, Ontario, Canada. Apps must be received by 2/28/89. In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada.

ASSOCIATION FOR WOMEN IN MATHEMATICS
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January-February 1989

Marie A. Vitulli
Univ of Oregon
Dept of Math
Eugene

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