

# Association for Women in Mathematics

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NEWSLETTER

November-December 1988

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## PRESIDENT'S REPORT

Congratulations to the American Mathematical Society on a fine Centennial Celebration. The AMS should be commended for providing travel grants for graduate students to attend the Providence meeting. Their presence, and the youthfulness of the principal lecturers, contributed to a sense of optimism for the next one hundred years. I enjoyed Everett Pitcher's remarks at the Opening Ceremonies, where he recalled the early days of the AMS, when women seemed to play as prominent a role in the profession as they do now. AWM was presented with a silver bowl, engraved "Association for Women in Mathematics — American Mathematical Society, 17 Years of Cooperation 1971-1988," which will be passed on to Jill Mesirov in January. If you would like a copy of "The Emmy Noether Lecturers" commemorative booklet that we presented to the AMS, please send fifty cents in stamps (or fifty cents) to the AWM office, to cover postage costs.

The AMS short course "Chaos and Fractals," organized by Bob Devaney and Linda Keen, was warmly received by the hundreds of participants in attendance.

Our panel discussion was particularly moving, with poignant statements by Mabel Barnes, Olga Taussky-Todd, and Vivienne Malone-Mayes and historical perspectives by organizers Jeanne LaDuke and Judy Green. The proceedings appear in this issue.

The AWM party was elegantly arranged, as usual, by Meetings Coordinator Bettye Anne Case with the assistance of the AMS staff. Although we had fine music supplied by Novacaine, the unfortunate shortage of dancers suggested an apt topic for a future short course.

The Executive Committee came out in full force for our meeting, with almost everyone, including former presidents, in attendance. This provided an opportunity to discuss long-range goals for AWM, many of which involve increased fundraising efforts to support our programs at the high school and college levels.

Executive Director. I am pleased to announce that our new Executive Director is Tricia Cross, formerly Centennial Coordinator for the AMS. We are extremely fortunate to have a Director with Tricia's experience, and we warmly welcome her to the office. Tricia will take an active role in fundraising and will lend her energies to a wide range of AWM projects.

During the summer, Tracy O'Brien, a recent Wellesley graduate, took over for us. Many of you may have met her in Providence. She pulled many things together for us in time for the meeting and did a nice job with the AWM table. We wish her well in her new job with the Boston Public Library.

Alice Schafer Leaves Boston Area. Our devoted former president left Belmont, MA in September for a new home in Arlington, VA. Alice has kept a watchful eye on the AWM office for nearly two decades and has lent invaluable help to presidents past and present (she did a good deal of running around on my behalf, often on rather short notice!). We shall miss her presence at Wellesley, and wish her and Dick much happiness in their new home.

China trip. Alice Schafer has had an enthusiastic response from many of you interested in participating in the AWM delegation to China. The cost is high, and we have already had one anonymous contribution to subsidize the travel costs of a delegate unable to afford the trip. If you would like to make such a contribution, Alice and I will see that a worthy recipient will be funded.

Phoenix meeting. Jill Mesirov has organized the AWM panel for Phoenix, "Gender Differences in Mathematical Ability — Perceptions vs. Performance," with panelists Gila Hanna and Pat Rogers. It

will be held on Wednesday, January 11, 3:20-4:20 P.M. The Emmy Noether Lecture will be delivered Thursday, January 12 at 9:00 A.M. by Professor Mary Wheeler of the University of Houston.

Emmy Noether – Richard Brauer correspondence. The Brauer family and Alice Schafer have generously given Bryn Mawr College eight letters and sixteen postcards written by Emmy Noether to Richard Brauer between 1927 and 1934. The letters have been painstakingly translated and contain fascinating insights into Noether's mathematical life. These letters should be of interest both to mathematicians and to historians of mathematics.

AMS Statistics. The September issue of the *Notices* contains the annual report on Statistics on Women Mathematicians, listing percentages of women members, invited hour speakers, speakers at special sessions, and members of editorial boards and journals. The percentages remain very low, despite some efforts by the AMS in this area. The percentage of women Ph.D.'s who are U.S. citizens has remained steady at around 20% for several years.

Congratulations to Nancy Levenson of the University of California, Irvine, who has been awarded a VPW award from the NSF. She will visit MIT.

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### THIRD ANNUAL MEETING OF EUROPEAN WOMEN IN MATHEMATICS

The European version of AWM, first conceived following the panel discussion at the ICM in Berkeley in 1986, is now getting itself well established. We have had two meetings, one in Paris in 1986 and one in Copenhagen in 1987. The third meeting is to be held at Warwick University, England, from December 10-12, 1988. The programme will include expository lectures, a talk for local schoolgirls and discussion on the theme "Family and career: is conflict inevitable?" The expository talks will be held on Monday 12th December, and are open to the general mathematical public. The discussion and business part of the meeting at the weekend is intended for women only. We have been quite successful in obtaining funding for the meeting, from the European Economic Community and the London Mathematical Society, so that some help will be available for European participants who cannot cover their own costs. For more information please contact Dr. Sarah Rees, Mathematics Institute, Warwick University, Coventry CV4 7AL, UK, (tel. 0203-523523 ext. 2578) or via electronic mail at ser@maths.warwick.ac.uk.

#### 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 discussion of how the proposed travel would benefit their research program and a curriculum vita to Association for Women in Mathematics, Box 178, Wellesley College, Wellesley, MA 02181.

# REPORT OF THE TREASURER

SEPTEMBER, 1988

Accounting for the period June 1, 1987 to May 31, 1988

Balance as of June 1, 1987 . . . . . \$47,251.31  
 Total Assets, June 1, 1987 . . . . . 47,363.19  
 Note: The figure \$47,363.19 represents \$47,251.31 cash-on-hand plus 5 shares  
 of Washington Water Power, valued at \$111.88 as of 5/31/79.

## RECEIPTS

Dues- Individuals	\$21,574.70
Families	1,497.62
Institutional	10,603.00
Pfizer Grant for AWM	1,000.00
Raytheon Corp. grant for Summer Program	6,000.00
MITRE Corp. grant for Sonia Kovalevsky Day	500.00
Arthur D. Little grant for Sonia Kovalevsky Day	1,000.00
Purchases: Directory of Women in the Mathematical Sciences	385.00
Interest Income	3,286.10
Contributions	2,147.25
Advertising Fees	1,215.00
Registration Fees for Computer Science Summer Program	500.00
Miscellaneous	606.11

TOTAL RECEIPTS . . . . . \$50,314.78

## EXPENSES

Wages, FICA, HCHP for Executive Director	\$18,572.30
Newsletter expenses: CBS printing	9,024.11
Operating Expenses	6,037.17
AWM National Meetings	2,547.26
Dues & Fees: CBMS, Bulk Mail Permit, Mass. Incorpor. Fee	1,481.75
Speakers' Bureau	850.38
Sonia Kovalevsky Day	4,443.54
Directory of Women in Mathematical Sciences	1,900.94
Massachusetts Income Tax	163.68
Miscellaneous	107.32

TOTAL EXPENSES . . . . . \$45,728.45

BALANCE as of May 31, 1988 . . . . . \$51,837.64

Respectfully submitted,

Jenny A. Baglivo, Treasurer of AWM  
Mathematics Department, Boston College

## CENTENNIAL REFLECTIONS ON WOMEN IN AMERICAN MATHEMATICS

AWM panel held at the AMS Centennial Meeting, Providence, RI, August 9, 1988  
The speakers, in the order in which they spoke, were: Jeanne LaDuke, Associate Professor, DePaul University; Mabel S. Barnes, Professor Emeritus, Occidental College; Olga Taussky-Todd, Professor, California Institute of Technology; Vivienne Malone-Mayes, Professor, Baylor University; Judy Green, Associate Professor, Rutgers University, Camden.

### Jeanne LaDuke

I will give a brief overview of the participation of women in mathematics in this country during the first seventy years of the life of the AMS. Fortunately, there were so many women involved and in such diverse ways, that any attempt on my part to be comprehensive will be seen as impossible by all of us. I may not even mention the name of someone you feel is a major figure, and I am bound to omit substantial aspects of the involvement of women in the life of mathematics in this country. Our hope is to catch a bit of the flavor of different decades and to see some overall trends.

By 1888 women had already made important contributions to mathematics. They had been college teachers of mathematics for a quarter of a century. Christine Ladd, who had completed a dissertation under Charles Sanders Peirce but been denied a Ph.D. at Johns Hopkins because of her sex, had published in the *American Journal of Mathematics* and elsewhere. In 1886, two years before Thomas Fiske and his friends met at Columbia to start the New York Mathematical Society, Winifred Edgerton had received her Ph.D. cum laude in mathematics from Columbia, the first American woman to be granted a Ph.D. in mathematics.

For the first two and one-half years the New York Mathematical Society had no women members, although the desire to publish a journal, the *Bulletin*, provided impetus for a major membership drive. Hence, in 1891, upon invitation, the first six women joined the NYMS. The first, admitted in May of that year, was Charlotte Scott, holder of a doctorate from the University of London and head of the mathematics department at Bryn Mawr College. Scott, a distinguished geometer, became one of the most active and recognized women in the AMS in the early history of the Society, serving on its Council and as vice-president. Of the other five women who joined the Society in 1891, two were astronomers (one at Smith and one at Vassar); one was a professor of mathematics and astronomy at Swarthmore; the fourth, a member of the mathematics faculty at Wellesley, had been an early graduate of Oberlin; and the fifth taught mathematics and physics at a private school in New York City.

Lest we infer that all the early activity occurred on the East Coast, we should note the opening in 1892 of the University of Chicago, soon to become a major center for graduate work in this country. In 1893 the International Mathematical Congress was held in Chicago in connection with the World's Columbian Exposition. Among the 45 whose names appear on the official register are four women. One was an early professor at Vassar. The other three were graduate students. Charlotte C. Barnum, who had just finished her first year of graduate school, would become, in 1895, the first woman to get a mathematics Ph.D. from Yale. Mary Francis Winston, a graduate of Wisconsin, became the first American woman to receive a European doctorate in mathematics. Ida M. Schottenfels received a master's degree from Chicago in 1895. Throughout the first decade of this century, she was a regular contributor to sessions at AMS meetings and to journals, mainly in the area of finite groups.

When the MAA was organized in 1915 in Columbus, Ohio, women were welcomed and involved. About 12% of the charter members were women. Helen A. Merrill, chairman of the department of mathematics at Wellesley who served as associate editor of the *Monthly*, was an early member of the Executive Council and became vice-president in 1920.

During the next decade two women were highly visible as scholars and as members of the Society. Anna Pell Wheeler published in functional analysis, directed seven Ph.D. dissertations at Bryn Mawr, and was actively involved in the AMS. In the 1920s, she served on the original Board of Trustees, served on the Council, and was the first woman to give an invited address and to deliver the Colloquium Lectures.

Another Chicago Ph.D., Olive C. Hazlett, was a noted algebraist who worked in the areas of modular invariants and linear associative algebras. Of the many papers she gave, one was delivered at the International Congress in Toronto in 1924, another at the International Congress in Bologna in 1928, at the beginning of a two-year Guggenheim fellowship period in Italy, Switzerland, and Germany. Hazlett also served as cooperating editor of the *Transactions*. The only other woman who served in that editorial position during the AMS's first fifty years was Caroline E. Seely, a 1915

Columbia mathematics Ph.D. and clerk to the secretary of the AMS, whose contributions Professor Pitcher described at the opening session.

The devastating effects of the depression in the early 1930s are well known. Less well known, however, is the influx in this period of a large number of women religious into graduate schools. Many in mathematics earned Ph.D.'s at Catholic University, usually in algebraic geometry, and then taught in Catholic women's colleges.

The 1936 International Congress at Oslo attracted a strong contingent of women; the list of attendees includes seventeen women among the eighty-seven AMS members from North America. Among these are Nancy Cole, Mina Rees, Grace Shover Quinn, Anna Stafford Henriques, and Olga Taussky, three of whom are at this meeting.

During the first half century of the existence of the AMS women were a substantial presence within the American mathematical community. More than 14% of the mathematics Ph.D.'s granted in the United States in that period went to women. Women attended conferences, presented talks, and published papers. Most taught in colleges and universities; some held positions outside of academia. They were officers, editors, and committee members in the AMS and the MAA.

The advent of World War II introduced major changes in the life and activities of mathematics departments in this country. For example, the total number of Ph.D.'s granted in the US and Canada dropped from an average of just under a hundred a year in the late 1930s and early 1940s to a low of 28 in 1945. Meanwhile, teachers of college mathematics were desperately needed for training programs for the Army and Navy. In 1943, the government estimated that approximately 250,000 trainees would be sent to a selected group of about 300 colleges and universities; and it was estimated that at least 2500 teachers of mathematics would be required for the various programs. In some cases, women who had not been permitted to take positions because of anti-nepotism rules were pressed into service. For example, Helen Owens, a 1910 Cornell Ph.D. whose husband was head of the mathematics department at Penn State, finally obtained a position there in the early 1940s. Even though many women found teaching opportunities at this time, these opportunities did not remain. In 1944 a department head at a women's college who was seeking someone to hire was advised, "I suggest you write Professor Coble; he has several girls teaching mathematics in the emergency and these are being let out. There must be a good many institutions such as Minnesota, Wisconsin and Kansas where similar things have happened."

With some exceptions, the 1940s and 1950s were not a hospitable period for women in American mathematics. While the total number of mathematics Ph.D.'s awarded in the 1950s was three times the number granted in the 1930s, women did not participate in this post-war growth. In fact, roughly the same number of women earned degrees in the 1950s as in the 1930s. Thus, the percentage of Ph.D.'s going to women fell to a low of 5% in the 1950s.

Not only was the number of women obtaining advanced degrees not increasing in the 1940s and 1950s, but also the visibility of women in the mathematical community generally declined dramatically. In the 1940s, for example, about 3% of the abstracts in the *Bulletin* were by women. In the 1940s and 1950s no women were on the Council of the AMS, and with the exception of one who was on the Board of Trustees in the 1950s none were on major committees. (Another exception should be noted; the entertainment committee for the International Congress in Cambridge in 1950 was in fact half women!)

Fortunately, there were exceptions to this rather dismal state of affairs. An indication of the indelible influence of one woman on the field of mathematics during and after the years of World War II is a resolution adopted by the Council of the AMS at its annual meeting in December 1953. It read in part,

The very striking and brilliant contributions made by pure (non-military, non-applied) science, not least of these by mathematics, to the winning of World War II is well known. It was clearly seen by the government and those responsible for the armed services that a large scale fostering by the U.S. government of fundamental research, the basis of all research, was unavoidable. ... Needless to say as the purest of all sciences, mathematical research might well have lagged behind in such an undertaking. That nothing of the sort happened is beyond any doubt traceable to one person — Miss Rees. Under her guidance, basic research in general, and especially in mathematics, received the most intelligent and wholehearted support. No greater wisdom and foresight could have been displayed and the whole postwar development of mathematical research in the United States owes an immeasurable debt to the pioneer work of the Office of Naval Research and to the alert, vigorous and farsighted policy conducted by Miss Rees.

I will now leave us here in the 1950s, but before I do I want to close on a more personal note. First, I would like to wish the AMS a happy 100th birthday. Second, I want to observe that in about six months I expect also to wish a happy 100th birthday to my aunt, Mabel L. Lauder, a mathematics major at Indiana University in the early teens and subsequently a high school mathematics teacher at Lane Technical High School in Chicago. Because of her enthusiasm and respect for "the calculus," I was unaware, until it was much too late to matter, of that axiom, so prevalent especially in the 1950s, that "girls don't do mathematics."

### Mabel S. Barnes

My reflections on women in American mathematics will be basically an account of one woman's experiences and observations beginning with student days in the Midwest in the '20s and ending with retirement from Occidental College in Los Angeles in 1971. The account of ups and downs eventually has a happy ending with finding just what I was looking for at Occidental. The time covered is roughly from the 30th to the 80th year of the American Mathematical Society. I shall try also to give you some impression of the flavor of those times.

I always enjoyed mathematics, beginning with arithmetic in a one-room country school in Iowa. In high school and college an interest in mathematics was considered unusual for a girl but certainly was not discouraged. I entered college with a firm intention of majoring in Latin. Along with Latin I took mathematics because I liked it too, and taking calculus changed my mind about majoring in Latin. (In those days calculus was a college sophomore subject.) In the mathematics department my interest was encouraged, but more generally the attitude was that pursuing a Ph.D. in mathematics was something for a man to do, not a woman.

In the '20s women were received cordially in the Midwest graduate schools. There even were a few women on the university mathematics faculties. There was an underlying assumption though that, of course, men would go into better jobs than women after finishing graduate work.

When I was completing my graduate work in 1930, I enrolled in a teachers' employment agency and through it found a job filling in a leave of absence at Nebraska State Teachers College, Wayne. Of course, at that time the job scarcity of the Depression had not yet quite hit. There was no prejudice against women on the faculty at Wayne, possibly because they could be had for less money. In view of the number of them in the education department, I think they were actually a substantial majority. There were two and a half persons in the mathematics department, and the other full-time person was a woman. Mathematics was not an especially popular major for girls, though. In the small high schools of northeast Nebraska it was traditional that the coach teach mathematics. Consequently, quite a few athletes turned up in my classes, among them some very good students.

The curriculum at that time would have been very poor preparation for graduate work. Among our advanced courses were subjects like theory of equations and higher Euclidean geometry. Our students didn't learn advanced calculus or modern algebra, but they did learn why you couldn't trisect angles, square circles, or duplicate cubes with ruler and compasses, and they learned about some remarkable sets of collinear points and tangent circles connected with triangles, and about the nine-point circle.

It was a vastly different world in the early '30s. Transportation and communication were, from the present point of view, extremely slow. Consequently distances seemed very great. For most of the young people of northeast Nebraska, going to college meant going to Wayne, whether or not they were interested in teaching as a career. Wayne was at least accessible. The total student enrollment was only something in the hundreds.

The leave of absence and my job stretched to three years, at the end of which my predecessor would be back, having acquired three years of graduate work but no Ph.D. At that time the two were considered equivalent for accreditation purposes for the college. There was a possible prospective vacancy at Nebraska State Teachers College, Chadron, in the northwest corner of the state, and the president at Wayne was prepared to give me a strong recommendation to his friend, the president at Chadron, but it turned out that the vacancy did not materialize. Had I gone to Chadron my life would have been very different.

By this time the Depression was upon us. Anyone who did not experience it can hardly imagine what it was like from hearing descriptions of it and seeing pictures. It turned out that my experience with it was decidedly less traumatic than that of most people. There was plenty of uncertainty and anxiety along the way, but as a last resort I could always have gone home to my parents. They did not

lose their farm as many of their neighbors did, and they ate well. In 1933 there were no jobs at all for men or women. What to do now?

Even in remote Nebraska I heard about a place called the Institute for Advanced Study opening in far away Princeton. I applied for admission and was accepted. For some years the School of Mathematics was the only School of the Institute and was housed with the mathematics department in Fine Hall at Princeton. Soon after I arrived the Director of the School of Mathematics took me aside and warned me that Princeton was not accustomed to women in its halls of learning and I should make myself as inconspicuous as possible. However, otherwise I found a very friendly atmosphere and spent a valuable and enjoyable year there. Had I not gone east, I would not have met Olga Tausky as early as I fortunately did.

At the end of that year there were, of course, still no jobs. Six men and I from the Institute and from Princeton University took a special qualifying exam to be taken on as substitutes for mathematics teachers on leave from New York City high schools. Our duties were to teach light schedules in the high schools to which we were assigned and to give jointly an alertness course, as it was called, for high school teachers. It qualified them for raises. At the end of the year I was asked to give an alertness course by myself the next year. There had been many requests for it. No prejudice here! However, that summer I was married and went to live in Massachusetts where my husband had a job as an assistant professor at Tufts College, as it was called then.

I kept my hand in somewhat by marking papers and substituting for him when he was away, and by helping him edit the mathematics section of Eshbach's *Handbook of Engineering Fundamentals*, second edition. I remember there was a question as to whether my name should appear on the list of contributors just as M. S. Barnes instead of Mabel S., but the first name did go in. Fortunately we were located where we could attend the Harvard Mathematics Colloquia.

In 1942 during World War II I was back in Princeton. My husband, on leave from Tufts College, was doing war work for the Bell Labs in New York and commuting. Somehow I encountered a Princeton physics professor who asked if I would read physics papers — they needed help desperately. Although I had had only a bare undergraduate physics major along with my mathematics major, I agreed — you can always study texts and mark papers, and they paid the handsome rate of \$1/hr. After a while the situation was really desperate — the physicists were off trying to make an atom bomb. The exigencies of war swept prejudice aside, and I was asked to teach some classes. With my sketchy background in physics I wouldn't have considered trying to teach it, but just at that time we were preparing to move to Red Bank, NJ, because my husband had been transferred to a different Bell Lab. There wasn't the remotest chance of my finding mathematical employment in Red Bank. I didn't even think of trying — but I did grow some beautiful tomatoes.

After the war, in 1946 my husband went back to Tufts to his job as chairman of the department of applied mathematics. By that time there was a heavy influx of war veterans. The afternoon before classes were to begin he came home and said, "Mabel, you'll be teaching in the morning." It seemed that no man could be found, the last lead having just failed. Nepotism and my being a woman were overlooked. Desperation again overcame prejudice. I was rehired for the next year; however, the next summer my husband accepted a job at UCLA, and we moved to California.

Note that in making moves it never once occurred to either my husband or me that the possibilities of my getting a job should be given any consideration at all.

I found that jobs for women in mathematics were in very short supply in California. Santa Monica City College would have hired me gladly, but I wasn't "qualified." I didn't have California junior college credentials. To remedy that deficiency I'd have to take some education courses at UCLA. My three years of teaching at a teachers' college might help some. I decided to pass this opportunity up. Then a little later when the moving van was at the door to move us into a house we had just had built, the phone rang. It was an offer of a job to teach one advanced calculus class at the University of Southern California. At that time I had hopelessly too much to do to accept.

In the summer of 1950 we were sitting with a friend from Caltech at a Mathematical Association luncheon. Across the table from our friend there was a young man who started to tell him that at Occidental College they were looking for a man with a Ph.D. in mathematics, preferably not from nearby Caltech — Oxy already had many Caltech men on its faculty — who was interested in undergraduate teaching. I nudged my husband and said in a low voice that I thought I was the man he was looking for. We approached him after the luncheon, and he said he would arrange for an interview with the dean. This vacancy had occurred because of a serious illness. I was somewhat dubiously hired as an Instructor by Special Appointment for one semester. (As an aside, that September there came to Occidental also a junior college transfer student, a track team shot putter,

attracted by the reputation Occidental had at that time in track. The shot putter's name was Ken Hoffman, now for many years at MIT and well known as the voice of mathematics in Washington.)

I was rehired for the second semester and afterward promoted fairly rapidly, although the administration at that time was not particularly friendly to women. There were very few on the faculty. I found Occidental a very congenial place and one that I enjoyed for 21 years.

My salary wasn't exactly handsome, and I was given the, at that time, perfectly reasonable and acceptable explanation that I had a husband to support me, while the men on the faculty had to support families. By the time I retired in 1971 that kind of argument had lost some of its weight and effect, and by that time there were quite a few women on the faculty at Occidental.

In the early '70s when my daughter was looking for a job in mathematics, times had really changed. In looking for a job it had become almost an advantage to be a woman.

## Vivienne Malone-Mayes

### I.

When I began to prepare this talk, I immediately recognized the difficulty of relating the cultural history of American black women in mathematics to the "Centennial Celebration" theme of this year's meeting of the American Mathematical Society. The first *white* woman to receive a Ph.D. in mathematics was Winifred Edgerton Merrill from Columbia University. Her degree was conferred in 1886 over a century ago. This certainly justifies recognition in this centennial year.

The first *black man* to earn a Ph.D. in mathematics was Elbert Cox at Cornell in 1925, thirty-nine years later. The first *black women* were in 1949, not yet 40 years ago. These were the late Marjorie Lee Browne from the University of Michigan, under G. Y. Rainich, and Evelyn Boyd Granville at Yale University under Einar Hille.

It was not until 1962 that Gloria Conyers Hewitt became the third black woman Ph.D. in mathematics in the United States. Her degree was from the University of Washington under Richard Pierce. [1]

The next Ph.D. was conferred on Thyrsa Frazier Svager under Paul Reichelderfer in 1965 from Ohio State University. Dr. Svager now is Vice-President of Academic Affairs at Central State University in Wilberforce, Ohio.

At the University of Texas under Don Edmondson, this author became the fifth black female Ph.D. in mathematics on June 4, 1966. One day later, Eleanor Green Dawley Jones, who first studied under Elbert Cox at Howard University, received her Ph.D. at Syracuse under James Reid.

Marjorie Lee Browne encouraged Geraldine Dawden who received her degree from Syracuse University the next year in 1967, also under Dr. Reid.

Etta Zuber Falconer completes the list of black females who had earned the Ph.D. in mathematics in the sixties. Her degree was conferred at Emory University in 1969 under Trevor Evans. Dr. Falconer is presently Chairman of the Natural Science Division at Spelman College in Atlanta.

This make a total of eight black females who had earned the Ph.D. by the end of the sixties. In an article in the 1981 *American Mathematical Monthly* [1], Patricia Kenschaft reported that she had found thirteen other black women who had earned doctorates in pure or applied mathematics in the United States by the end of 1980. Her article is an excellent source of biographical information on these pioneering black women.

The history of black women in mathematics based upon the parameter of Ph.D.'s therefore is only very recent history in comparison with the centennial of years since the first white female Ph.D. It should be noted that many of the dissertation advisors received criticism for sponsoring these black female doctoral candidates. Their courage must be acknowledged as an important factor in the careers of these mathematicians.

### II.

I would like to focus briefly on some of the social conditions affecting black education which were operative during the last forty years.

Whereas many white women were simply expected to be homemakers dependent upon a providing male, black girls had always been conditioned to work. Every girl expected to work hard in her life. In the fifties and sixties, education provided black women a hope that they could escape the low-paying jobs traditionally designated for them.

However, as Dr. Etta Zuber Falconer pointed out [2], the black female college students in the early fifties were not encouraged to prepare for academic careers. Since black colleges were so few in



number, it was unrealistic to expect a teaching appointment. Consequently, it made little sense to pursue advanced degrees. In those days, we were counselled to prepare for health professions, the ministry or public school teaching — the few careers which offered an opportunity for livelihood. The available teaching positions at small colleges offered little financial reward.

As a personal example, I recall my return to live in Waco, Texas, in 1954. I had a master's degree in mathematics from Fisk University supervised by Lee Lorch. But my salary at the small black college in Waco was \$100 per month *less* than public school teachers with the same credentials. In fact, public school teaching held more status than college teaching, unless you were at a state-supported segregated institution.

Since there were almost no existing career opportunities for black mathematicians, it was no small miracle that in the fifties at Fisk Lee Lorch was able to influence young black undergraduates of both sexes to pursue advanced degrees. A record of his success is recorded in the article "Lee Lorch at Fisk," published in the 1976 *American Mathematical Monthly* [3]. Quoted in this article, Dr. Eric Zuber Falconer speaks for us all in saying "Dr. Lorch encouraged [us] in the pursuit of a mathematical career at a time when it was unpopular for both blacks and women. He was well before his time in promoting the rights of all people. He refused to see a color line or sex line that limited ability, and for this reason, he has profoundly affected the development of many persons who would otherwise have carried out the low expectations of the times."

At the same time that he was encouraging students to pursue graduate studies, Dr. Lorch was equally vocal about job opportunities for mathematicians in government, business and industry. Thus, many of our Fisk classmates who did not earn Ph.D.'s still found career opportunities in areas other than teaching. Among them were Cornelia Haddox Edwards, Marjorie Scott Bethea and Sally Duvall Richmond. They are senior computer programmers with TRW Systems, Inc., the National Security Agency and Computer Sciences Corporation, respectively.

Fortunately, the civil rights movement of the sixties was simultaneous with the national emphasis on science education which led to an acute shortage of mathematicians. This shortage made it possible for these first black female mathematicians to find jobs in business and industry and teaching positions at both predominantly white and predominantly black institutions.

### III.

Many white graduates can fondly recall the excitement and collegial atmosphere of their graduate research days. However, it took a faith in scholarship almost beyond measure to endure the stress of earning a Ph.D. degree as a black, female graduate student.

The almost universal complaint from black women who earned Ph.D.'s in the sixties was their complete isolation from their classmates. There are a few exceptions. For instance, Gloria Conyers Hewitt told how her classmates formed a support system for her. But — whether as graduates or undergraduates, in northern schools or in southern schools — most of us experienced the same treatment that Dr. Elayne Arrington-Idowu related in the 1978 Association for Women in Mathematics panel in Atlanta. She said, "I was isolated, and it was me against all of them ... the worst effect of my undergraduate experiences was the lack of intellectual exchange with my peer group." [1]

I can personally vouch that my personal isolation at the University of Texas in Austin was absolute and complete, especially during the summer of 1961. At times I felt that I might as well have been taking a correspondence course.

For those who completed degree programs, and for many who quit along the way, the lack of interchange with fellow students was a profound hindrance to academic achievement. There are two sides to the explanation of this isolationism. On one hand, it seemed easy for the predominantly white and male graduates to associate with one another both socially and academically. With their large numbers, each of them could find *somebody* to relate to. Since they were not missing out on the collegial spirit, they did not notice that the blacks and females were missing out. On the other hand, since the blacks and females were so scarce and so different, it was difficult for them to find social and intellectual matches. Observing the "in-group" students fraternizing so easily only intensified the sense of isolation.

The isolation, however, was not limited to the student years. The black, female Ph.D.'s faced much the same isolation even after earning their degree and finding a job or university teaching appointment. Though many had 15-hour teaching loads, administrative duties, and isolation on the job, most of them nevertheless succeeded in publishing mathematical research or textbooks or otherwise advancing in their academic careers, as indicated previously in this paper.

This sense of isolation may possibly be one of the reasons why so few black mathematicians today — male and female — participate in the American Mathematical Society, the Mathematical Association of America, or the Association for Women in Mathematics.

IV.

In conclusion, at the time of this Centennial Celebration of the American Mathematical Society, black female mathematicians have *begun* to be accepted into the mainstream of business and academia. These are remarkable achievements attained only in the last forty years. It is my hope that, when the bicentennial celebration of the American Mathematical Society is held, all problems which accompany racism and sexism will long have been solved.

TABLE I. BLACK WOMEN PH.D'S IN MATHEMATICS IN THE UNITED STATES, 1949-1969

		<u>Doctorate</u>	<u>Undergraduate</u>
1949	Marjorie Lee Browne	University of Michigan	Howard University
	Evelyn Boyd Granville	Yale University	Smith College
1962	Gloria Conyers Hewitt	University of Washington	Fisk University
1965	Thyrza Frazier Svager	Ohio State University	Antioch University
1966	Vivienne Malone-Mayes	University of Texas	Fisk University
	Eleanor Green Dawley Jones	Syracuse University	Howard University
1967	Geraldine Dawden	Syracuse University	Hampton Institute
1969	Etta Zuber Falconer	Emory University	Fisk University

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2. Malone-Mayes, V. "Black and Female." *This Newsletter*. Vol. 5, No. 6(1975), pp. 4-6.
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**Olga Taussky-Todd**

Some of my life history is described in the Birkhäuser Boston book, *Mathematical People*. An article by Edith Luchins also appears in Grinstein and Campbell's *Women of Mathematics*. They describe my devotion to mathematics and also my struggle to stay with it. At any time a mathematician's life is not an easy one, and mine began at a particularly critical time in history.

I graduated from the university in Vienna, Austria, in 1930 and had then a variety of jobs connected with mathematical research, mostly unpaid or underpaid, at various institutions, with an assortment of bosses and pupils.

The fact that I studied and worked in several countries made me able to observe a number of facts about the "behavior" and "treatment" of women. Now we live with Women Lib and it has not only changed the opportunities for women, but also their behavior towards each other. Women are now "friends" of women colleagues. This was not always the case. Even the great and kind Emmy Noether was no exception. She was convinced that men had greater strength and that women ought not to attempt to work like men, that regular appointments ought to go to men so that they could support a family. Women ought to look for marriage.

I came to the USA for the first time in 1934, and this is where the story really ought to begin. I came to Bryn Mawr College where the department chairman was Mrs. Pell Wheeler. She had gone through hard times. Her first husband Pell became very ill, and she had to look for work. But she really made it. She was the first one to give the AMS Colloquium lecture series. However, at the age of about 50 her health seemed to break down (she was supposed to be really robust earlier). One day I discussed with her the problem of women in academic life and bemoaned the fact of their poor strength. She predicted that women will become more athletic in the future. Well, if she saw our young women at Caltech nowadays, dressed in short outfits on the coldest days, full of strength, she would see that her prediction has come true.

The next time I turned up at USA was after the war WW2 which we (my husband and myself) had spent in Great Britain, with a truly tough time. We gave up academic life and joined the British Civil Service, and I particularly had to leave my favorite subject. This second visit was by invitation

of the US National Bureau of Standards where we had hard and new work (exploitation of computers), but no more war. I think women were treated as well as the men there. We stayed there until 1957 when Caltech offered both of us very attractive positions. I myself was the first woman to teach in this real men's place, a fact which is not true any longer. So there is progress!

In 1958 I was invited to give *the* one hour lecture at an AMS meeting, the first woman since Emmy Noether in 1934. The lecture, titled "Integral Matrices," was published in the AMS *Bulletin* and is cited in the book by Curtis and Reiner. At such an occasion the chairman usually says a few kind words by way of introduction. I trained myself to say "thank you for your kind words." However, he only mentioned my name and Caltech and I almost thanked him for his "kind words."

Soon there will not be occasions for a woman to be "a first." I cannot help wondering what would happen nowadays if a woman chairman had to fill an opening and a woman and man of fairly identical qualifications applied for it. Difficult situations will, of course, still occur in many ways. Blame it all on Adam and Eve.

Addition:

Prediction for women in university departments:

universities will employ more women;

departments will employ more women;

however, in the same department some men colleagues will be more jealous of the achievements of women colleagues than of men colleagues and even persecute them if possible.

And women will always be different from men.

## Judy Green

Just before the AMS entered its second half-century the percentage of women receiving Ph.D.'s was beginning to descend from a peak of over 17% during the period 1931 to 1935. During the comparable period 50 years later, while the numbers of women receiving Ph.D.'s was ten times larger, this percentage was smaller, under 16%. However, since 1983 the percentage has been consistently at least 16%, and it has been over 17% in the last two years. It thus appears that as we enter the second century of the AMS the percentage of women receiving Ph.D.'s in mathematics is at least comparable to that of the early 1930s and is remaining fairly steady rather than declining.

During the 1960s, the decade prior to the founding of AWM, the American mathematical community experienced a dramatic growth. The number of Ph.D.'s being granted by schools in the United States was almost four times as large at the end of the decade as it had been at the beginning. The growth continued only a few more years, peaking in 1972, and after a decade of decline the total number of Ph.D.'s granted currently is roughly equal to that of 1965. For women, on the other hand, the growth was somewhat dramatic in the 1960s but did not decline and appears to have now leveled off. At the same time that the number of women mathematicians was dramatically increasing, the current wave of feminism was taking shape through the formation of new organizations and publications, as well as through such informal means as consciousness-raising groups.

AWM was founded at the 1971 Winter Mathematics Meetings in Atlantic City. At a meeting of MAG, the Mathematicians Action Group, a progressive political caucus within the mathematical community, Joanne Darken, then an instructor at Temple University, suggested that the women at the meeting remain afterwards to discuss the formation of a women's caucus. Against the advice of the male chair of the MAG meeting, a small group of women did remain, and the existence of AWM can be dated from that discussion. In fact, as there had been six men present at the formation of the AMS, we were six women present at the formation of the AWM.

The organizational structure of AWM sprang into existence rapidly. Mary Gray was the first chair; the first newsletter, which appeared in May 1971, announced a panel discussion on the role of women in mathematics sponsored by the MAA at the summer mathematics meetings. By January of 1973, AWM-sponsored events were listed on the schedules of programs of the combined meetings. In May of 1974 the Council of the AMS reversed its January vote and voted unanimously to recognize AWM by also listing it in the opening paragraphs of the meeting announcements in the *Notices*. In 1976 AWM was accepted as an affiliate member of CBMS, the Conference Board of the Mathematical Sciences, the umbrella organization of mathematical societies. In 1984, the MAA presented a citation "in honor of those who have furthered the progress of mathematics by enhancing significantly the status of women in mathematics;" the citation was accepted by Julia Robinson and Linda Rothschild, respectively the Presidents of the AMS and AWM.

An early priority of AWM was to increase the visibility of women among the leadership of the AMS and to promote the concerns of women within the Society and the Association. From the beginning AWM had a cordial relationship with the Association. The Association, which had a substantial contingent of women among its founding members, has a continuous history of women holding responsible positions. Women have been particularly visible in the governance of the sections, but many have served in the national leadership as Vice Presidents, Trustees, and Governors. The MAA inaugurated its first woman president, Dorothy Bernstein, in 1978 and will inaugurate its second woman president when Lida Barrett takes office in 1989.

At the time of the formation of AWM, the AMS had for many years conferred little responsibility or recognition upon women. Mina Rees had served on the Board of Trustees from 1955 to 1959 but was, in 1971, the only woman to have done so since 1923 when Anna J. Pell and Clara E. Smith served as two of the original thirty-one Trustees. In 1971 Mary Ellen Rudin began a term on the Council of the AMS as the first woman member in over forty years. Olga Taussky-Todd in 1959 and Cathleen Morawetz in 1969 were, at the time that the AWM was founded, the only women who had been invited to address any AMS meeting since Emmy Noether in 1934. In 1969 the Council of the AMS voted not to publish a letter to the *Notices* by Lee Lorch suggesting the formation of a committee of women mathematicians to study problems of discrimination.

AWM's relationship to the Society was inevitably somewhat confrontational at first. Mary Gray, with the support of MAG and other sympathetic mathematicians including many Blacks, successfully pressured the AMS, first to open Council meetings to all members of the Society, and then to adopt a procedure for nomination by petition. The leadership of the Society responded to the pressure by impaneling a Committee on Women in Mathematics and by nominating women to the Council with some regularity. There was initial resistance to the concept of nomination by petition and, even after the idea was accepted in principle, there were attempts to prescribe the research credentials of those who could be nominated as well as attempts to give the Council the right to override such nominations.

The adoption by the AMS of nomination by petition in 1972 led to the nomination and election of younger and/or more radical mathematicians, including Mary Gray and Lee Lorch. Mary Gray was later nominated by petition and was elected as the first woman Vice President of the Society since Charlotte Scott had served in that office in 1906. In recent years nomination by petition has fallen into relative disuse, but the representation of women within the leadership of the AMS remains significant. Starting in 1974, and until this year, there has been at least one woman on the Council serving as an editor of a Society publication. Since 1972 the number of women officers or members-at-large of the Council has been at least 3, and is currently 6. It is now routine for women to serve as Vice Presidents, and Julia Robinson served as President from 1983 to 1984. In addition, since 1976 one of the five Trustees has been a woman. In 1981, Cathleen Morawetz was the 54th Gibbs lecturer, the first to be a woman. However, the incidence of women as invited speakers at AMS meetings and AMS sponsored conferences remains extremely low.

From being focused in its early years almost exclusively on acting as a pressure group on the mathematical establishment, AWM has evolved into a mathematical organization in its own right. The AWM newsletter regularly includes biographical and historical articles on women and the mathematics they do. In January 1974 Louise Hay presented the first mathematics talk at an AWM meeting, the annual Emmy Noether Lectures began in 1980, and in 1982 the AWM sponsored its first symposium concerned with the accomplishments of a woman mathematician. The nine Emmy Noether lecturers to date — Jessie MacWilliams, Olga Taussky-Todd, Julia Robinson, Cathleen Morawetz, Mary Ellen Rudin, Jane Cronin Scanlon, Yvonne Choquet-Bruhat, Joan Birman, and Karen Uhlenbeck — in their expertise span a broad cross section of mathematics, in their education represent the traditions of several countries and several decades, and by their accomplishments testify to the ongoing contributions of women to mathematics.

**DUES! DUES! DUES!** If you have neglected to pay your dues by the October 1 deadline, please write your check *now*. Encourage your institution to join. Give a deserving student a gift membership. Consider becoming a contributing member. **DUES! DUES! DUES!**

## HONORS AND AWARDS

Congratulations to S. M. Rees of the University of Liverpool. She has been awarded a 1988 Junior Whitehead Prize by the London Mathematical Society for her work on ergodic theory and dynamical systems.

Dr. Roswitha März was elected in July, 1988 as Corresponding Member of the Academy of Sciences of the German Democratic Republic. She is Professor of Numerical Mathematics at Humboldt University (Berlin, GDR), a position to which she was appointed at an early age in 1980. This appears to have been the first time that a woman had ever been appointed to a full professorship in mathematics in the entire history of that venerable university. (This is the same university which compelled Weierstrass to tutor Sofia Kovalevskaia privately because women were not then permitted to take classes or receive degrees.)

Dr. Lee Lorch, Professor Emeritus, York University, has received a citation from the Division of Natural Sciences, Spelman College "for outstanding contributions to the education of black mathematicians and to the field of mathematics, for courageous support of human rights and dignity, for inspiration and knowledge shared with the Spelman Community." This award was presented to Dr. Lorch on January 29, 1988.

## BOOK REVIEW COLUMN

**Feminist Approaches to Science**, edited by Ruth Bleier, Athene Series, Pergamon Press, 1986, paper \$12.50, ISBN 0-08-032786-9.

Reviewed by Bonnie Shulman, University of Colorado.

Reprinted with permission from the *CSWP Gazette: A Newsletter of the Committee on the Status of Women in Physics of the American Physical Society*, Vol. 7, Issue 4, Dec. 1987, pp. 2-3.

In the provocative and wide-ranging book *Feminist Approaches to Science*, editor Ruth Bleier asks, "What is it about science — or about women — or about feminists — that explains the virtual absence of a feminist voice in the natural sciences, as an integral part of the sciences, with the single exception of primatology?"

The reader eager for a precise answer to this question may be disappointed. I was. Another question whose answer I sought but never really found, is exactly what *is* a feminist voice in the natural sciences? I am a graduate level mathematical physicist and a woman. I identify with feminist issues (almost everywhere) and have often been active in feminist politics. I also consider myself an integral part of the sciences. Does this make mine a feminist voice in the natural sciences? Is there a distinctly feminist mode of scientific thought (not necessarily feminine)?

*Feminist Approaches to Science* is a collection of essays by nine women and tries to see science through a "feminist prism." But I was sorry no writings by women physicists were included. Global issues that concern all women scientists are discussed (e.g., why so few women achieve prominence in science, the prevalence of male-gendered metaphors in scientific language, the implications of sex-differences research), and this makes the book worth reading. However, I think it is important to distinguish and even draw attention to the *differences* in our experiences and roles as women in various sciences.

In primatology (the discipline most often cited by the authors), there are many gender-related issues in the practice of the scientific discipline that women in the so-called "hard" sciences do not face. For example, in reconstructing the *meanings* of behaviors (especially of female primates), men and women scientists draw very different conclusions from the same data. Here one may identify and define a genuine "feminist science" in the sense that I think is meant, where gender is a valid category of analysis. But I do not agree that in all (or even most) cases gender is an "unavoidable category of analysis."

In fact, it can be a very divisive issue, especially when feminist science is touted as *better* science. Clearly many feminist values need to be integrated into the scientific community. (One author asks, "How do we justify working on research whose applications have been and threaten to be profoundly destructive of natural resources, human life, and the dignity and self-respect of racial, ethnic, or gender groups?") However, to see "feminist" as the antidote to "patriarchal," women as the

“fix” for what is wrong with men, is to think in the “same old ways” we are invited at every turn of the page to abandon. Is it true that all feminist values and “ways of knowing” are essentially good and will yield a “truer knowledge” of nature? The value of personal values in science is their fruitfulness in producing better scientific explanations, and the true test of a good theory has to be which explanation is best, which is better, not *right*, but rather least wrong.

The authors are astute in emphasizing the disastrous results of the separation of science from social reform and the subsequent institutionalization of science. However, the cure is not a reinstitutionalization along feminist lines. I think the analysis stops short when it fails to stress that it is precisely the collusion between science and state power (at least as deadly as that between church and state) that must be questioned and criticized. Power itself corrupts (absolutely), and I am not convinced that if women had it they'd use it any better.

How are one's scientific ideas related to one's politics? Primatology illustrates very well how the (sexist) biases of scientists can influence the direction, content, form, and results of the research being conducted. This is surely a valid and valuable insight of feminist analysis. But *any* biases (including feminist ones) create their own context. The best we can do is to recognize and articulate our biases (whenever possible) *as part of* our research.

The role of women in science is changing. It will be some time before we can answer the question as to how science might be different if as many women as men were scientists. I do not believe anything in science itself excludes women (I am my own favorite counterexample). Of course there is much in education, the “old boys” employment network, outmoded cultural values, etc., that prevents most women from ever considering technical courses of study.

Those of us who have somehow penetrated the filters must do our best to be the scientists we want to be *and* remain the women we are. That is how we can discover our value as women scientists.

Whatever contributions we make, they will not be simply *because* we are female and not male. Rather our struggles as women in the existing world will teach us all how to think, create, feel, and live as fuller beings. Human beings are rationally one, and women scientists can best prove this by doing well what scientists do and (aggressively at times) encouraging and supporting others to do the same.

**Women's Ways of Knowing: the development of self, voice, and mind** by Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule, Basic Books, '86, \$19.95, ISBN 0-465-09212-8.

Reviewer: Judy Roitman, University of Kansas

Suspicious title, isn't it? I was expecting a paean to intuition and a castigation of rationality. Instead I was pleasantly surprised to find a thoughtful and stimulating discussion of cognitive strategies. The book is based on a longitudinal naturalistic study of 135 women of various social classes who were in some sort of educational system, ranging from social service programs to help them cope with their daily lives, to elite colleges. It was conceived as a broadening of a similar study done on young men at Harvard — thus the emphasis on women, and the wider sample of social, economic, and racial groups.

There are three questions I asked myself, reading this book as a reviewer for this newsletter: is it good for women? is it good for mathematics? and: would I recommend it to another mathematician?

Is it good for women? Yes. It's a pleasure to read a serious study of the intellectual lives of women in which so many smart and passionate thinkers appear. Although there is certainly some oversimplification in the categories, the picture created is of varied and rich intellectual lives — a picture that seldom appears.

Is it good for mathematics? It isn't damaging. The authors mention that there are some feminist analyses of knowledge which damn science and mathematics, but they don't seem to approve. Some of their terminology seems a bit loaded (e.g., “separate” vs. “connected” knowing), but in their examples they make it clear that imagination and intuition are basic to scientific and mathematical work, and their most damning examples of intellectual alienation come — believe it or not — from English literature classes. However, the physics student who has a radical theory she doesn't dare show her professors for fear of being hooted down the hall seems unrealistic. (Were they disguising a participant by changing fields?) [Editorial comment: It doesn't seem unrealistic to me. - MKS] And far worse is the impression that their highest cognitive strategy can only find fulfillment in, essentially, social service fields.

Would I recommend this book to my colleagues? If they teach, yes. We simply do not pay enough attention to the cognitive strategies of our students; we don't even have the vocabulary to do

so. ("We" here is: nearly all teachers at any level.) *Women's Ways of Knowing* is one of the few books attempting to provide us with the vocabulary and with the understanding to see what our students are doing, and what exactly it is that we want them to do.

Some of their results are quite surprising and deserve mention here.

The most striking is the close relationship between attitudes to family and cognitive approach. Put too simply: ask a woman about her mother, and you can predict how she'll approach a calculus problem. Cognitive strategies are global and are psychologically grounded — we ignore this at our students' peril.

A second observation is well known but bears repeating to everyone from parents to graduate advisors: people do better when we believe in them.

A third, and striking, observation is the emotional difficulty of moving from one stage to the next, and how often this movement is precipitated by dramatic events. The most difficult movements are:

- (a) from dependence on others' knowledge, to a belief in your right to your own opinions;
- (b) from opinionated, quasi-mystical belief in your opinions, to the realization that there are standards of judgement that must be met;
- (c) from going through intellectual motions to get the approval of others, to internal motivation.

This intellectual movement has special consequences for students in math classes. Consider the changes we ask in a standard math curriculum: from the rote, algorithmic thinking that most students picked up at an early level, to more creative applications of algorithms; from essentially algorithmic methods to simple proofs; from simple proofs in which there is mostly logic and little intuition, to proofs in which intuition is nearly everything. And this is ignoring the interplay between pure and applied mathematics! Note that the (oversimplified) movement I have set forth as the mathematical pilgrim's progress in many ways parallels the movement set forth in the book under review. It is foolish to consider the intellectual tasks we set our students in isolation. When we ask why one student moves forward and another student hangs back, we can be helped by the evidence of this book.

A fourth important contribution is yet more evidence that techniques which we assume to work with white, male, middle-class American students may largely fail with other populations, on social and psychological grounds. For example, how many of us see verbal aggressiveness as a sign of intelligence? Thus the women in the study who had concluded that they had a right to their own opinions tended not to challenge the opinions of others, or even to voice their opinions, on the grounds that it was either impolite or hopeless to do so, while the Harvard men at the same stage in the Harvard study continually did intellectual battle with others, even though they never won. Who will be encouraged? Who will be ignored, or even belittled? Who will be pushed to find intellectual standards and who will be left on the outside? Similarly, when people in this stage were challenged to rise beyond it, the women often interpreted the challenge as devastating, thoroughly demoralizing criticism, denying their right to have their own voice, rather than as encouragement to strengthen and enrich their intellectual capacity.

No one is saying that all women react one way and all men another, all whites one way, all blacks another, and all Hispanics yet a third. But clearly we have the responsibility to be more sensitive to our students' responses, to find more ways of reacting with and encouraging them, to recognize that talent can lie hidden behind social disguises, and to acknowledge the unnecessary social biases in our own standards.

The fifth and most important point of this study is the simple fact that intellectual growth need not stop at any point in life. Some of the subjects found their cognitive strategies changing only in middle age, as the movement away from abusive husbands or the economic shock of divorce forced them into intellectual as well as personal independence. Intelligence is plastic and dynamic, not static and predetermined — yet another truth we tend not to act on.

In short: *Women's Ways of Knowing* is good for women, not bad for mathematics, useful for anyone who teaches — and also a good read.

Book Review Editor:

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## AWM EDUCATION COMMITTEE COLUMN

**The Changing Role of Women in Research and Development** by Herbert R. Northrup. Manpower and Human Resources Studies #11A, University of Pennsylvania, Philadelphia, 1988.  
Reviewer: Sally Lipsey, Chair, Education Committee

This study of women in science and engineering presents recent data on sex differences in education and employment. The following items are particularly relevant for AWM members.

There has been, according to Herbert Northrup, "a virtual revolution" in the number of women available for professional positions in science and engineering. Women are still in the minority, however, and still suffer salary differentials. They are likely to continue to do so as long as the current educational system prevails and as long as they "put their husbands' careers first," accepting responsibility as major homemaker and parent.

Although female scientists still earn less on the average than their male counterparts, salary differentials are smallest for mathematicians, engineers, and environmental scientists. For newcomers with a bachelor's degree, the differentials seem to be disappearing, but for those with Ph.D.'s, median salaries at the end of the first year are less for women than for men whether they are in teaching, research, business, industry or government. The salary sex differentials that exist for experienced female professionals have been ascribed to factors such as (1) "the greater number of women in non-industrial employment, where they are substantially less likely to be tenured full professors and departmental heads," (2) past discrimination which may continue to influence today's salaries, (3) relatively fewer women in management, (4) career decisions based on assumptions that certain opportunities do not exist, and (5) relative lack of mobility. (The data for mathematicians with 35 years of experience show an interesting anomaly: in 1986, the average salary of such females was higher than that of males.) Although men and women enter the mathematical sciences at about the same rate, roughly three times as many men as women are employed in the field.

The ability to compete successfully starts, of course, with an effective education. Women take introductory math courses in about the same proportion as men but are still taking advanced courses in a smaller proportion. However, advanced placement exams do show gains in two respects: (a) in 1976, women were 25% of those taking such exams, but in 1986, their numbers rose to 36%; (b) their relative scores are higher than formerly, but still about 0.2 points (out of 5) less than males, on the average. On SAT's, although males generally score substantially higher than females in math, it is interesting to note that, throughout the 1980's, high school girls who were contemplating an engineering career had SAT math scores consistently higher than males. In 1986, while females accounted for about half of all bachelor's degrees in math, they received only about one-third of master's degrees and less than one-fifth of all doctorates. Computer science had an even smaller representation of women.

Mr. Northrup is optimistic that sex salary differentials will decrease as the percentage of women Ph.D.'s increases, as women gain in experience, and accept a greater role in management. He believes also that women will continue to differ from men in selection of career, specialty within a career, and location.

P.S.: A recent *Wall Street Journal* article, "Studies Link Subtle Sex Bias in Schools with Women's Behavior in the Workplace," (Susan Epperson, 9/16/88) touches on themes of the Northrup research. The article discusses a number of educational studies which suggest that, under the current educational system, females do not suffer overt discrimination, but males do receive from teachers (who often think of themselves as totally unbiased) more attention, praise, criticism or constructive comments, and remedial help. Compared to men, as a result, women are more passive, have less self-esteem, and are less confident in a managerial role. One solution being offered is — single-sex schools!

## THERE THEY GO AGAIN ...

In the caption under a picture of Susan Montgomery in his book *I Have a Photographic Memory*, Paul Halmos says she "is a number theorist and according to some state laws she should really be called Mrs. Blattner." Montgomery, who retained her own name after her marriage in 1983, is a ring theorist. In fact, she gave an invited address on the automorphisms of rings at the 1984 Louisville meeting, where the photograph was taken. She has never been a number theorist.



## APS SYMPOSIUM

A symposium will be held at the January 1989 joint meeting of the American Physical Society, the American Association of Physics Teachers, and the American Association for the Advancement of Science in San Francisco. The symposium will be jointly sponsored by the Committee on the Status of Women in Physics, the APS Committee on Education, and the AAAS. The program for the symposium is as follows: Beverly Fearn Porter, American Institute of Physics, "Scientific Resources for the 1990's: Women, the Untapped Pool"; Vera Kistiakowsky, MIT, "Reflections on Women Physicists"; Jackie Eccles, U. Colorado (Psychology), "Social Influences on Girls' Interest in Mathematics and the Physical Sciences"; Mary Beth Ruskai, U. Lowell, "How Stereotypes about Science Affect the Participation of Women"; and Barbara A. Wilson, AT&T Bell Labs, "Choosing Physics as a Career: Experiments in Social Pressure". The meeting will be chaired by Ellen Zweibel, U. Colorado (CSWP chair). Questions may be directed to Amy Halsted, American Physical Society, 335 East 45th Street, New York, NY 10017.

## FEMMES ET MATHÉMATIQUES: Y-A-T-IL UNE INTERSECTION? (part 1 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.

For those of us who are committed to a career in mathematics, there can be no lack of awareness that we are operating in a domain defined by and for men. The mathematician's style of working, unlike some scientists', is seen as being alone and individual. Their output is described, both within and outside the discipline, as objective, logical, abstract and rational, for which the generic word "hard" is often used as a global descriptor. Hard here does not mean difficult but carries a sexual connotation with additional messages of masculinity, power and control. Certainly in the British system, to be successful at mathematics implies being less successful with words or in the so-called "creative" disciplines. In addition, there is an assumption of a clustering of interests between mathematics and the sciences, and more recently technology, which school systems often reinforce and which is juxtaposed with the humanities and the arts. Out of this develops notions of "hard" and "soft" areas of study with their inevitable gender-related extensions of appropriateness. In the Introduction to his recent book *Strategies of Educational Research*, Robert Burgess wrote "the term 'qualitative methods' has been used to cover approaches that are claimed to be 'soft' and 'non-rigorous' compared with the 'hard', objective, 'rigorous' approaches that are referred to as quantitative methods." (Falmer Press 1985, p. 1).

I wish to address these issues in two ways. First, by asking how reasonable is this view of mathematics and second, by reflecting upon the impact of such social stereotyping on the perceptions and choices of young people, girls and boys, in the classroom.

A quick tour through the history of mathematics provides an explanation for the derivation of the view of the discipline as rigorous, objective, and so on. However, from our current perspective that view is undermined. Three shifts can be detected over time in the understanding of mathematics itself. One is a shift from completeness to incompleteness, another from certainty to conjecture, and a third from absolutism to relativity.

The Platonist position in ancient Greece was that mathematical statements represented eternal truths which were complete descriptions, in both absolute terms and in terms of certainty. For example, Euclid offered his system of thought as a complete description of physical space after which no other was deemed necessary or required. The axioms on which the system was constructed were not seen as problematic but as self-evident foundations on which the system could rest with confidence. However, the development of non-Euclidean geometries after 1800 undermined certainty. A system of geometrical thought was now seen to be the result of a particular set of conjectures. Changing the perspective led to a new set of conjectures which resulted in the development of a

different mathematical model. In the present century, absolutism succumbed to Einsteinean relativity, and Gödel's Incompleteness Theorem dislodged completeness. After Gödel, mathematics has become introspective by using mathematical reasoning to explore mathematical reasoning. Proofs are now seen to be demonstrations which take place within fixed systems of propositions and are, consequently, relative to those systems. Objectivity, the star of the mathematical firmament, is "at best" seen to be relative and "at worst" abandoned altogether. In 1972, Kline wrote:

Mathematics is not a structure of steel resting on the bedrock of objective reality but gossamer floating with other speculations in the partially explored regions of the human mind. (Kline, M. *Mathematics in Western Culture*, Penguin 1972).

Luke Hodgkin in 1976 wrote:

We have important ways in which scientific knowledge changes character, even locally, with changing culture. This determining character of social institutions on the knowledge acquired is well-known among scientists: X was at Princeton, at Grenoble, at Warwick and so she sees a differential equation in a particular way, even has a particular notion of "proof." But this knowledge is not spread outside the restricted community of scientists, so that outsiders still believe in a universal agreement on an absolute "rightness" which is something they themselves have been taught to believe in — at school, and in mathematics in particular. (Hodgkin, "Politics and Physical Sciences" in *Radical Science Journal* 4, 1976.)

In addressing the second International Congress in Mathematics Education in 1972 René Thom said:

Any hope of giving mathematics a rigorously formal basis was irreparably shattered by Gödel's theorem. However, it does not seem as if mathematicians suffer greatly in their professional activity from this. Why? Because, in practice, a mathematician's thought is never a formalised one... The only real processes in mathematics are those of numerical and algebraic computation [but] even in a situation entirely concerned with calculation, the steps must be chosen from a large number of possibilities. One's choice is guided by the intuitive interpretation of the quantities involved. Thus the emphasis on axiomatics is not only a pedagogical aberration but also a truly mathematical one. (R. Thom, "Modern Mathematics: does it exist?" in *Developments in Mathematical Education*, Howson, G. (Ed.), Cambridge U.P. 1973.)

Is this the mathematics which is known and loved by countless teachers, less well-known and hated by even more countless students? Not only was the mathematics conceived, but also the pedagogical style through which it was learnt. The metaphor used by them to describe the learning of mathematics was that of "uncovering." In the famous dialogue between Socrates and the slave, Socrates was at pains to demonstrate that there was no such thing as teaching, only recollection by the learner of truths already known. Socrates' role was to help in the uncovering process by engaging the learner in dialogue through which the mathematics was elicited. If we are honest with ourselves, is this not the practice used in our classrooms today? A good teacher helps a pupil by judicious questioning and encouragement so that she recognises and reclaims the required mathematical knowledge. The outcome of this dialogue is the formal mathematics of our school curricula, the content of which is thus validated by the style of teaching. This model of teaching can be supported by one or both of two images. One is the filling of the empty vessel — the transfer of knowledge from the teacher to the pupil. The other is the peeling of the onion — the uncovering process already described. Some teachers use a combination, the first to transfer knowledge and skills, the second to help the unsuccessful pupil recapture the taught knowledge. The two are linked by the assumption that transfer of knowledge can and does take place so that when a pupil has difficulty, uncovering is the appropriate metaphor to describe what is needed. Consistent with this model of teaching is a heavy emphasis on rightness, to which Hodgkin referred, a rightness of both solution and method. Also consistent is assessment by examination of the body of knowledge and skills defined by the curriculum.

Recently a different metaphor, that of construction and exploration, has been used to challenge the underlying assumptions of transfer and uncovering. In exploring and constructing emphasis shifts from product to process, from single solution to alternatives. Pupils are no longer seen as empty vessels but are recognized as lively and profound thinkers engaged upon trying to make sense of the new, in the context of what is already understood. Content can no longer be subscribed in the same way since it is created through a method of personal enquiry which results from questions in the mind of the learner. In the classroom, therefore, the pupil is expected to engage in a process of constructing understanding. The teacher's role becomes one of providing the resources which are necessary to support and stimulate pupils while they work through their cognitive conflicts towards a resolution which is personal. More time is spent by the teacher in observing and supporting groups or individual pupils than in informing the class. The results of the observation and interaction are used to make decisions about the next appropriate activity for those pupils. This style of classroom places a high

value on the use of intuition, on the role of questions and the use of imagination to resolve those questions, on the creativity of the learners both in choosing their method and in communicating their results.

If we compare the formal teaching environment with the informal one just described, what are the differences? Formality highlights single methods and single solutions, it stresses correctness, it is content-driven and usually examination-oriented. Informality, by contrast, stresses multiplicities of questions, of approaches, of possible outcomes; appropriateness is more important than correctness since a "right" answer in one context might be inadequate in another; emphasis on the content of the curriculum shifts to incorporate the processes through which mathematics is recognized and derived. Assessment becomes more a matter of personal and group reflection and evaluation than of external examination.

In 1979, Davis and Anderson wrote: "The definition-theorem-proof approach has become the sole paradigm of mathematical instruction, experience and research. This is not the way mathematics is created, propagated or even understood." (Davis & Anderson, "Non-analytic aspects of mathematics and the implications for research in education," in *Society for Industrial and Applied Mathematics Review*, 1979.)

Thom, in the same address in 1972 from which I have already quoted, said: "The real problem which confronts mathematics teaching is not that of rigour but the problem of the development of 'meaning' and of the 'existence' of mathematical objects." (Thom, "Modern Mathematics: does it exist?" in *Developments in Mathematics Education*, Howson (Ed.) C.U.P., 1973.)

It is my contention that the approach to mathematics teaching which I have labelled "formal" rests on a view of mathematics and of mathematics teaching and learning which, as I have said, derives from the Greeks. It is an approach which has been overtaken by changes in the discipline and its pedagogy, changes which have been acknowledged in the quotations I have read. Yet, how many of us and how many of our pupils conceive of mathematics as "gossamer floating in the mind"? How often was mathematics presented to us as conjectural, how often do our pupils experience mathematics as a verb, a way of tackling a challenge with its own personal, social and cultural constraints rather than a noun, a formal and tightly argued piece of rigorous and elegant abstraction.

I wish to offer the argument that the genderization of mathematics does not only rest upon the social climate, nor upon the personal and social experiences of girls within the classroom, although it is clear that these influences are far from being trivial. I believe that the discipline itself and the style through which it is encountered is rendered masculine by the misguided stress which is laid on those very attributes of mathematics which are no longer acceptable to mathematicians, that is, completeness, certainty and absolutism. From these beliefs spring descriptions such as objective, rational and axiomatic which are used by mathematics teachers as well as by non-mathematicians to describe the subject and out of which develops a formal, abstract and non-applicable presentation of mathematics which justifiably alienates a majority of learners but, in particular, women. Alba Thompson, in 1984, wrote: "Teachers' beliefs, views and preferences about mathematics and its teaching, regardless of whether they are consciously or unconsciously held, play a significant, albeit subtle, role in shaping the teachers' characteristic patterns of instructional behavior. (Thompson, "The Relationship of Teachers' Conceptions of Mathematics and Mathematics Teaching to Instructional Practice," in *Educational Studies in Mathematics* 15, No. 1 (1987), pp. 105-127.) She presented the view of Jeanne, a mathematics teacher, of the nature of mathematics as "consistent, certain, and free of contradictions and ambiguities, accurate, precise and logical." Lynn, another teacher, described mathematics as "exact — free of ambiguity and conflicting interpretations, certain (guaranteeing right answers), predictable, absolute and fixed." Both teachers had conceptions of mathematics teaching which accepted the responsibility for controlling and directing all instructional activities. They saw the student's role as one of assimilation and reproduction. Only a third teacher, Kay, had a distinctively different view of mathematics. She saw the subject as continuously expanding its content and undergoing changes. She described mathematics as challenging, rigorous and abstract but asserted that its main purpose was in its applicability. Her teaching role she saw as needing to encourage guess and conjecture and to support pupils' attempts at reasoning rather than to present solutions or answers. Alba Thompson summed up by saying:

Much of the contrast in the teachers' instructional emphases may be explained by differences in their prevailing view of mathematics. For example, Jeanne viewed mathematics primarily as a coherent subject consisting of logically interrelated topics... Kay regarded mathematics primarily as a challenging subject whose essential processes were discovery and verification... Lynn indicated a view of mathematics as essentially prescriptive and deterministic. Jeanne and Lynn conceived of mathematics as a rather static body of knowledge. Both teachers presented the content as a finished product. Kay, in contrast, held a more

dynamic view of mathematics and believed that the best way for the students to learn it was to engage in its creative generative processes.

Of these three teachers, only Kay held a view of mathematics which was consistent with that of the mathematicians already quoted. Jeanne and Lynn had been educated into believing mathematics to be something it isn't — they used words such as complete, free of contradictions, absolute, unemotive — above all they saw mathematics as powerful and controlling. I believe that this mistaken image of mathematics reinforces the social messages and is reinforced by them, thus providing an explanation for the persistence of mathematics as a male domain.

It would appear that there is a private and public world of mathematics. The private world is where struggle, failure, incomprehension, intuition and creativity dominate. It has been beautifully described by Poincaré and Hadamard. The public world is where the results of the private struggle make their appearance in a formal, conventional abstract formulation from which all evidence of false trails, inadequate reasoning or misunderstandings have been eliminated. Unfortunately for our pupils, the majority are given access only to the public world — the pages of text books which present inert knowledge as if it has always been just so. Their struggle and failure to understand then becomes personalized — it is their inadequacy — rather than being part of the process that was inherent in the development of the mathematics originally. Nancy Nersessian wrote:

What finally struck me is that the concepts of science are inventions — *made* by us — so their meanings can be better understood by examining their actual construction. Scientific concept formation is a process, involving the struggle to articulate what we mean when we say, e.g., that something is a "field", and the key to understanding the concepts of science lies in examining the various phases of that process as it takes place in scientific practice. (Nersessian, *Faraday to Einstein: Constructing Meaning in Scientific Theories*, Martinus Nijhoff Pubs., p. xi.)

Our pedagogical procedures particularly in the teaching of mathematics and science deny these processes, deny the influence of the individual or the social context, and present young people with a pretend world of certainty, exactitude and objectivity.

But why do I assert that the pretend world is male? Perhaps it would be more accurate to say that the pretend world is associated with power and control and given our social history that is male because of guilt through association! This is not the place to chart social history, but it is clear that our society has developed according to an hierarchical model and that, whatever their inner doubts, those at a higher level in the hierarchy with power and influence over those beneath them, always wish to display their competency and authority to retain their position. "Rightness" thus achieves almost parents!) feel that they will be perceived as inadequate if they admit to not knowing. Their authority, and with it their influence, for some their power and with it their control, rest on a view of "expertness" which makes a formal classroom an inevitable outcome. If we examine the curricula and methodological changes which have taken place in our schools over, say, the last twenty-five years, the authoritative disciplines, mathematics and science, those with the greatest social power in our present technological age, are the ones which have been least innovative in their approach to process rather than product. We have had swings of fashion in the content of school mathematics, but these have been dictated by those outside schools and have not substantially altered the perception of the subject inside schools. In the U.K., we are presently experiencing a pedagogical shift from class-based mathematics teaching to individualized schemes which, theoretically, allow pupils to progress at their own pace. The authority of the text, however, remains sacrosanct, and consequently the content authority is undisturbed. In many cases, the teacher forsakes some power and control to an absent author although the "metaphysical commitment" of the classroom remains unchanged. Metaphysical commitments are defined by Kuhn as our beliefs about the nature of our world and its relations with us and with each other. We transmit these beliefs as part of the hidden curriculum, and, as Thompson's work has demonstrated, they affect the choice of curriculum and the means by which it is implemented. Thus, Kay, the teacher Thompson quoted who believed mathematics to be dynamic and creative, chose to create a classroom climate which was questioning and conjectural, whereas Lynn indicated that "[c]ertainty is an inherent quality of mathematical activity. The procedures and methods used in mathematics guarantee right answers" and so "[t]he main goal of mathematics instruction is to produce students who can perform the mathematical tasks specified in the curriculum, using standard procedures or methods."

I believe that only by moving mathematical pedagogy into the same world of conjecture, relativism and incompleteness that mathematics itself now occupies will we succeed in breaking the masculine image and creating the kind of classroom environment in which women can find

excitement, interest and success. I have no doubt of their ability in this respect. It has been too extensively demonstrated in other areas of the curriculum to need reassertion. I believe that women justifiably reject much of the mathematics that they encounter in school because it is irrelevant, and unrelated to the world of relativity in which they reside, it is impersonal and uncreative. It seems to me to be a supreme irony that pupils disengage from the subject known in schools as mathematics which itself is rejected by professional mathematicians. Were mathematics to be experienced as a searching, hesitant, intuitive area of study, open to interpretation and challenge, I feel confident that there would be a much greater identification of both sexes with its style and ideas. What is the basis for this confident assertion? Partly it results from looking at those aspects of the curriculum at which girls are successful and asking what they have in common. Partly, it comes from research in which deliberate attempts have been made to change pedagogical experience. Partly it is reinforced by the recent work of feminist psychologists and philosophers.

(to be continued)

## SCIENTIFIC EXCHANGES

The National Academy of Sciences (NAS) invites applications from American scientists who wish to make visits beginning during the period January 1, 1990 through December 31, 1990 to the U.S.S.R., Bulgaria, Czechoslovakia, the German Democratic Republic, Hungary, Poland, Romania, and Yugoslavia. Long-term research visits of 3 to 12 months duration are encouraged, particularly if contact with colleagues in the other country has already been established. The minimum length of visits is one month in one country.

Applicants must be U.S. citizens and have a doctoral degree or its equivalent by June 1989 in physics; chemistry; mathematics and computer sciences; earth, atmospheric, and oceanographic sciences; agricultural, forestry, fishery, and plant sciences; biological sciences; environmental sciences; engineering; archaeology and anthropology; geography; or psychology. Also included are science and technology policy and those aspects of the economic and social sciences that involve quantitative analysis as a primary consideration. Other scientific disciplines not explicitly mentioned will be considered on a case-by-case basis. Necessary expenses will be met by the NAS and the foreign academy, including reimbursement for long-term visitors for salary lost up to a predetermined maximum and expenses for accompanying family members for visits exceeding five months.

Requests for applications should reach the NAS not later than February 14, 1989. Applications must be postmarked by February 28, 1989. Address application requests to: National Academy of Sciences, Office of International Affairs, Soviet and East European Affairs (HA-166), 2101 Constitution Avenue, NW, Washington, DC 20418. Telephone: (202) 334-2644.

## OF POSSIBLE INTEREST

An article entitled "Confronting the Myths About Math" by Pat Kenschaft appeared in the Summer 1988 issue of *Journal of Career Planning & Employment*. The article begins with the results of a survey of Montclair State College graduates in the mathematical sciences about their employment, showing the wide variety of jobs available to the bachelor's degree holder. Then a number of myths such as "Computers and calculators are replacing mathematicians" and "An overwhelming majority of math majors are male" are demythologized. I'm putting the article in my propaganda file. It would be good for the profession if more such articles were to appear.

The updated *Bibliography of Resources for Mathematics Equity and Computer Equity*, compiled by Judith E. Jacobs and published by Women & Mathematics Education, is available at \$3/copy from WME, c/o SummerMath, Mt. Holyoke College, 302 Shattuck Hall, South Hadley, MA 01075. Each member will receive a free copy; annual membership is \$10/year.

The National Women's History Project distributes many multicultural women's history materials. Two new posters are "Celebrating Black Women's History" and "Heritage of Strength and Vision." "A Woman's Place" is a 25-minute color video showing that women have a long history of involvement and activism in most aspects of United States life. For a catalog, send \$1 to National Women's History Project, P.O. Box 3716, Santa Rosa, CA 95402. Posters are \$5 plus \$2 for shipping.

The National Association for Science, Technology and Society will hold the Fourth National Technological Literacy Conference in the Washington, DC area from February 3-5, 1989. Write Franz A. Foltz, TLC Conference Manager, 117 Willard Building, University Park, PA 16802 for more information.

Women's Studies: Greenwood Press, Inc., 88 Post Road West, Box 5007, Westport, CT 06881. Rowman & Littlefield Publishers, Inc., Barnes & Noble Books, 81 Adams Drive, Totowa, NJ 07512. Rutgers University Press, 109 Church St., New Brunswick, NJ 08901.

DEADLINES: Nov. 24 for Jan.-Feb., Jan. 24 for Mar.-Apr., Mar. 24 for May-June  
AD DEADLINES: Dec. 5 for Jan.-Feb., Feb. 5 for Mar.-Apr., Apr. 5 for May-June  
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: gargoyl!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 \$10.00 and must be prepaid. The vacancies listed below are in alphabetical order. All institutions advertising below are Affirmative Action/Equal Opportunity Employers.

**BALL STATE UNIVERSITY.** Seeks application for a tenure-track position in mathematics education to begin August 1989. Appointment will be at the assistant or assoc. prof. level dependent upon qualifications. Salary negotiable. Responsibilities: Teach undergraduate and graduate courses in math. education and undergraduate courses in mathematics; engage in scholarly activity appropriate for mathematics education; advise undergrad and grad students in math ed; participate in outreach activities, inc. service in state and regional prof org. Min Qualifications: Ph.D. or Ed.D. in mathematics, inc. grad coursework; precollege teaching. Preferred qualifications: Evidence of scholarly productivity, successful college teaching exp. For consideration above the asst. prof level, a record of scholarly productivity in math ed is required. Review of apps begins immediately and continues until position is filled. Send current vita and 3 letters of recommendation to: Dr. Bernadette H. Perham, Chairperson, Mathematics Education Search Committee, Dept. of Mathematical Sciences, Ball State University, Muncie, IN 473067.

**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. Candidate 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 be 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.

**BRANDIES UNIVERSITY.** Department of Mathematics, Waltham, MA 02254, Michael Harris, Hiring Committee Chair. Pending University funding, we anticipate having several faculty openings in pure mathematics both at the visiting and assistant professorship levels beginning September 1989. Teaching load six hours per week. Ph.D and demonstrated excellence in teaching and research required. We will begin reviewing applications during December, so it is important to have curriculum vitae and letters of recommendation sent early.

**CALIFORNIA POLYTECHNIC STATE UNIVERSITY.** Mathematics Dept., San Luis Obispo, CA 93407. Dr. Thomas E. Hale, Chair. Visiting Professor (Lecturer), Full-time, Mathematics Dept. Salary commensurate with qualifications and experience. Available (pending funding) for one, two, or three quarters of the 1989-1990 academic year. Persons planning a sabbatical leave are encouraged to apply. Doctorage in mathematics, evidence of teaching and a strong research record are required. Duties include teaching, research, and possibly conducting a faculty seminar. Teaching experience at a career-oriented university, or relevant professional experience, desirable. Closing date: Feb. 10, 1989.

**CALIFORNIA STATE UNIVERSITY, FULLERTON.** Math Dept. has a tenure track position at the assistant or Associate Professor level for the Fall of 1989. Outstanding teaching qualifications and commitment in continued research are required. Rank and salary will be determined by the experience and qualifications of the candidate. Send resume and three letters of reference by February 10, 1989 to the Chair of the Selection Committee, Department of Mathematics, CSU, Fullerton, CA 92634. California State University hires only individuals lawfully authorized to work in the United State.

**CALIFORNIA STATE UNIVERSITY, LONG BEACH.** Seven tenure track positions beginning Fall, 1989: Algebra or Analysis (3 positions); Applied Math with Numerical Analysis, applied PDE or applied Probability preferred (2 positions); Statistics with Actuarial Math (1 position); Math Education (1 position). All positions require completed Ph.D., evidence of excellent teaching, strong research record or potential. Asst. or Assoc. Prof. preferred; applicants with distinguished records in teaching and research may be considered for Professor. Must be US citizen or permanent resident prior to offer of appointment. Further details of duties, salary range, and degree requirements provided on request. Positions open until filled, but selection begins from applicants complete files (resume, transcript, 3 reference letters) 12-01-88. Apply to C. W. Austin, Chair, Dept. of Mathematics, CSU, Long Beach, CA 90840.

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.

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.

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.

COLBY COLLEGE. Mathematics Department, Colby College, Waterville, ME 04901. Colby College invites nominations and applications for the Carter Professor of Mathematics and Chair of the Mathematics Department, effective Sept. 1, 1989. Ph.D. in mathematical science required. Desirable qualifications include a distinguished record as a teacher and scholar; demonstrated departmental and collegial leadership, including ability to nurture faculty development and research programs; commitment to liberal arts and undergraduate math education. Send applications (letter of application and resume) and nominations to: H. T. Hayslett, Jr., Chair, Mathematics Department, by Dec. 1, 1988.

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, SC 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.

EARLHAM COLLEGE. Dept. of Mathematics, Earlham #93, Richmond, IN 47374. Assistant or Associate Professorship in September, 1989. Excellence in teaching undergraduates essential. Ph. D. preferred; interested ABDs should apply. Initial contract two years. Send vita, an indication of teaching interests, and names of three references by 1/1/89 to Harold Hanes.

EASTERN MICHIGAN UNIVERSITY. Dept. of Mathematics, Ypsilanti, MI 48197, Don R. Lick, Head. Two tenure track positions in mathematics education, one at Asst. or Assoc. Professor level and the other for all ranks. Teaching the content and methods courses, at the undergraduate and graduate levels, which support the department's mathematics education programs and the university certificate programs. Ph.D. or Ed.D. in mathematical education required as well as a substantial amount of graduate level mathematics beyond an earned undergraduate major in mathematics. Must hold a teaching certificate and be able to demonstrate a fine record of successful teaching. Excellent benefits with salary and rank commensurate with experience. Send detailed vita and three letters of reference to Don R. Lick not later than January 15, 1989.

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.

FLORIDA STATE UNIVERSITY. Mathematics Department, Tallahassee, FL 32306 3027. We are anticipating filling two tenure-track assistant professorships, with appointments beginning August 1989. Well qualified candidates in all areas of pure and applied mathematics are encouraged to apply. Candidates should have excellent research programs and excellent teaching ability. Salary is competitive. Please send resume and arrange to have three letters of recommendation sent to Ralph D. McWilliams, Chairman. Application deadline is January 13, 1989.

FROSTBURG STATE UNIVERSITY. Dept. of Math. Two tenure track Instructor or Asst. Prof positions beginning Fall 1989. Salary range: \$20,000-\$39,000. Rank and salary commensurate with qualifications. Master's degree in Mathematics or related field required, along with strong commitment to undergraduate teaching. Teaching experience and quality teaching will be of prime concern in reviewing candidates. Doctorate in Mathematics or Mathematics education preferred and background involving experience with applications of Mathematics welcome. Send letter of application, resume, transcripts, and 3 letters of recommendation not later than 2/3/89 to: Mr. C. Douglas Schmidt, Director Personnel Services, Frostburg State University, Frostburg, MD 21532.

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. Goucher is a select, private, coeducational, liberal arts college located eight miles north of Baltimore and is convenient to Washington, DC. The selection process will begin Jan., 1989. Goucher is an EOE. 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.

GRAND VALLEY STATE UNIVERSITY. Mathematics & Computer Science Department, Allendale, Michigan 49401. Assistant Professor (tenure track). Prefer Ph.D. (Candidates considered) with emphasis in statistics, mathematics, or mathematics education. AT GVSU emphasis is placed on effective teaching and professional development, with reduced teaching loads and/or grants available for research and professional development. Interviews will begin Dec. 1 and will continue until position is filled. Send application with resume to: Chair, Math Search Committee.

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 UNIVERSITY-PURDUE UNIV AT INDPLS. The Dept. of Mathematical Sciences is seeking applicants for several tenure-track positions beginning August, 1989. An earned doctorate and an excellent research record or potential are required. Strong applicants in all areas of pure and applied mathematics will be considered. IUPUI is a comprehensive urban university with over 24,000 students. The department offers B.S., M.S., and Ph.D. degrees from Purdue University. The university offers excellent fringe benefits and competitive salaries. Send resume and three letters of recommendation to Professor C. D. Aliprantis, Acting Chairman, Dept. of Mathematical Sciences, IUPUI, 1125 East 38th St., P.O. Box 647, Indianapolis, IN 46223. Closing date: Jan. 15, 1989. Late applications will be considered until positions are filled.

INDIANA UNIVERSITY AT SOUTH BEND. The Department 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.

INSTITUTE OF REAL ESTATE MANAGEMENT. Editor needed to originate materials dealing with comprehensive analysis of real estate investments. Teaching experience, strong academic background in economics, statistics, or math and excellent writing skills required. Experience in developing college-level textbooks, instructor manuals or corporate training programs preferred. Competitive salary, downtown Chicago location, good benefits. Respond with salary history to: Mary E. Herrmann, Human Resources Coord., Inst. of Real Estate Mgmt, 430 N. Michigan Ave., Chicago, IL 60611.

KENYON COLLEGE. Mathematics Department, Gambier, OH 43022. Two tenure-track positions starting 89-90. One Asst. Prof. or beginning Assoc. Prof., other Asst. Prof. Ph.D required for Assoc., highly desirable Asst. Must have broad background in mathematics. For one position, preference for candidate in stats or prob. Strong commitment to undergraduate teaching and scholarship is required. Teach 3 courses per sem. For full information contact Stephen Slack at the above address or call (614)427-5267. First screening of dossiers December 15, 1988; apps accepted until positions are filled.

LOYOLA MARYMOUNT UNIVERSITY. Dept. of Math, 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, IL 60626.

LYCOMING COLLEGE. Dept. of Math Sciences, Williamsport, PA 17701. David Haley, Chair, (717)321-4289. Two entry level tenure track positions, beginning August, 1989, in seven member department offering majors in mathematics (including secondary education certification) and computer science. Expertise sought primarily in mathematics education and computer science, secondarily in applied areas including statistics. Requirements: the doctorate and a strong commitment to undergraduate teaching excellence. Send resume, academic transcripts, and 3 letters of recommendation with at least one addressing teaching. Applications accepted until positions filled. Will be interviewing at the AMS/MAA January Meetings.

MIAMI UNIVERSITY. The Department of Mathematics and Statistics anticipates a tenure track assistant professorship beginning August, 1989. Duties include teaching 8-9 hours per semester, continuing scholarship, and service. Applicants should have a Ph.D in pure or applied mathematics by 8/89. Please send vita, graduate transcript and three reference letters to John Skillings, Dept. of Mathematics and Statistics, Miami University, Oxford, Ohio 45056 by Feb. 1, 1989.



MICHIGAN STATE UNIVERSITY. 2 Postdoctoral fellowships in Mathematics. Appt is for 2 years. Duties: teaching one 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 doctorate less than 2 years. 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 prior 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.

MICHIGAN TECHNOLOGICAL UNIVERSITY. The Department of Mathematics Sciences 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. 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 required. 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. Three tenure-track asst. prof. positions are also expected starting Set. 1989. Applications in all areas of math are invited. Candidates in computational math or statistics particularly encouraged to apply. Commitment to research and excellent teaching required. To apply: send a curriculum vitae and arrange to have 3 letters or recommendation sent to Recruitment Committee at the above address.

MILLERSVILLE UNIVERSITY. Applications are invited for an expected full time tenure-track position in secondary mathematics education beginning September, 1989. Candidates must hold a doctoral degree in mathematics education or mathematics with experience in math education and have a strong commitment to teaching. Appointment at the Assistant Professor level is expected. Preference will be given to candidates with experience teaching mathematics at the secondary school level. Teaching load is 24 semester hours per year. Primary course responsibilities for this position will be within the undergraduate and graduate mathematics education programs. Teaching other undergraduate mathematics courses is also expected. The department consists of 26 full-time faculty serving app. 75 mathematics majors (of whom more than 100 are in secondary education) and 200 computer science majors. Mathematical specialties among the faculty include mathematics education, statistics, tomography, algebraic topology, graph theory and combinatorics, real and complex analysis, algebra, and differential equations. The department offers both B.S. and M.Ed. degrees in Mathematics Education. Send vita, transcripts, and three letters of recommendation (at least two of which attest to your teaching effectiveness) to: Dr. Charles G. Denlinger, Search Committee Chairman, AWM 12, Dept. of Math & Computer Science, Millersville University, Millersville, PA 17551. Interviews will begin about Feb. 1, 1989.

MILLS COLLEGE. Seeking outstanding candidates for a tenure-track position commencing Fall 1989 as Assistant Professor of Computer Science and Director on Interdisciplinary Computer Science Masters Degree Program. Candidates must submit evidence of superior teaching and research abilities, and demonstrate a commitment to become involved in highly innovative and energetic department. Rank and salary will depend on experience and qualifications. The initial contract will be for three years, subject to final administrative approval. Send vita and direct 3 letters of reference to: Professor Diane McEntyre, Chair of ICS Search Committee, Mills College, Oakland, CA 94613. Deadline for application: Jan. 15, 1989.

NEW MEXICO STATE UNIVERSITY. Visiting positions and possible tenure-track, assistant professor positions in mathematics and statistics, including numerical analysis. Start Aug. 21, 1989. Salary competitive. Ph.D. (or equivalent) and strong commitment to teaching and research essential. Applications are kept on file through hiring period and positions filled as openings occur. Send vita and arrange for three reference letters to be sent to Carol L. Walker, Head, Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003.

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. The dept. has 25 full-time and 14 part-time faculty members and 288 majors. NKU is located 7 miles from downtown Cincinnati, OH. 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.

OFFICE OF NAVAL RESEARCH, ARLINGTON, VA. A civil service position in mathematical sciences is available. Salary range is \$39,501 to \$71,377 depending on qualifications. Responsibilities are to plan and manage research and development programs in discrete mathematics with particular emphasis on combinatorics and graph theory. Applicants must have a Ph.D. or equivalent in mathematics and one year of appropriate professional experience or an equivalent combination of education and experience. Submit a Standard Form 171 and a list of publications to be received by December 16, 1988 to Office of the Chief of Naval Research, Civilian Personnel Division, Code 0124 2P, Attn: Announcement #88-86 (AWM), 800 North Quincy Street, Arlington, VA 22217-5000. For further information and supplemental forms call (202)696-4705.

THE OHIO STATE UNIVERSITY. The Department of Mathematics of The Ohio State University hope to fill several positions, both visiting and permanent, effective Autumn Quarter 1989. Candidates in all accomplishments or exceptional research promise, and evidence of good teaching ability, will be expected of successful applicants. Please send credentials and have three letters of recommendation sent to Professor Joseph Ferrar, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of resumes will begin immediately.

THE OHIO STATE UNIVERSITY. Applications are invited for the position of research instructor in mathematics for the academic year 1989-1990. Candidates should hold a Ph.D. (or equivalent) in mathematics and show strong research promise. Please send credentials and have three letters of recommendation sent to Professor Joseph Ferrar, Department of Mathematics, The Ohio State University, 231 W. 18th Avenue, Columbus, Ohio 43210. Review of resumes will begin immediately.

OREGON STATE UNIVERSITY. The Andreotti Assistant Professor position in mathematics will become available September 19 89. Salary depends on qualifications. Closing date January 20, 1989. Write to: Professor Bent Peterson, Chair, Andreotti Professorship Selection Committee, Department of Mathematics, Oregon State University, Corvallis, OR 97331. OSU has a policy of being responsive to the needs of dual-career couples.

OREGON STATE UNIVERSITY. Assistant Professor position in Algebra (Number Theory), Numerical Analysis, or Geometric-Topology will become available September 1989. Salary depends on qualifications. Closing date January 20, 1989. Write to: Professor Bent Peterson, Chair, Staff Selection Committee, Department of Mathematics, Oregon State University, Corvallis, OR 97331.

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.

QUEENS UNIVERSITY, KINGSTON, ONTARIO. Applications are invited for a tenure track position in discrete mathematics beginning July 1989. The successful applicant must have and maintain a solid research record in such areas as graph theory, enumeration, and combinatorial designs. Those interested are requested to arrange that a curriculum vitae and letters of recommendation from three or more referees be sent to: Professor L. L. Campbell, Head, Dept. of Mathematics and Statistics, Queen's University, Kingston, Ontario, K7L 3N6. by Oct. 31, 1988. At least one letter should comment on the candidate's teaching ability. In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents.

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.

ST. MICHAEL'S COLLEGE. Applications being invited for a tenure-track position at the Asst. Prof. level to begin 9/1/89. Candidates should have the Ph.D. in Mathematics (by Fall 1989), and a strong commitment to undergraduate teaching as well as to scholarly activity. To assure full consideration, applications should be received by Jan. 15, 1989. Please send resume, transcript, and three letters or recommendation to Personnel Office; Saint Michael's College, Winooski, VT 05404.

SAN FRANCISCO STATE UNIVERSITY. Dept. of Mathematics, 1600 Holloway Ave., San Francisco, CA 94132. One tenure track position in Mathematical Statistics. Required: Ph.D. and demonstrated competence in teaching and research. U.S. citizen or permanent resident. Current salary range from \$27,600-\$38,100. Closing date: Jan. 15, 1989. Send vita, transcripts, and 3 letters of recommendation to Newman Fisher, Chair.

SMITH COLLEGE. Mathematics Department seeks to fill tenure-track position at the Assistant Professor level beginning September, 1989. All fields welcome but statisticians are particularly urged to apply. Applications must include vitae, at least three letters or recommendation, and should offer evidence of potential outstanding teaching and scholarship and a strong interest in educational at liberal arts colleges. Send application to Kathy Bartus, Department Secretary, Mathematics Department, Smith College, Northampton, MA 01063, by January 18, 1989.

SOUTHEASTERN MASSACHUSETTS UNIVERSITY. Tenure-track or Full-time Visiting Lecturer position in the Department of Mathematics beginning September, 1989. Earned doctorate and excellence in teaching required. Research potential/experience is expected. The selected candidate will join an established program with traditional and computer-oriented degrees and will have the opportunity to participate in the development of mathematics courses for growing undergraduate and graduate programs in the Department of Mathematics and in the Department of Computer Sciences. Application deadline: January 15, 1989. Applications, including resume, transcript, and three letters of reference should be sent to: Rufus A. Winsor, Chairperson, Department of Mathematics, Southeastern Massachusetts University, North Dartmouth, MA 02747.

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE. Applications are invited from qualified candidates for a tenure-track position at the Assistant Professor level beginning on Aug. 16, 1989. Ph.D. in mathematics and a strong background in probability and stochastic processes required. Selection will be based on the potential and demonstration of excellence in research and teaching. Applicants are asked to send letter of application, vita, and three letters of recommendation to: Probability Position; c/o Ronald Kirk, Chairman, Mathematics Department, Southern Illinois University, Carbondale, IL 62901. The closing date for applications is Jan. 10, 1989 or until the position is filled.

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE. Applications are invited from qualified candidates for a tenure-track position at the Assistant Professor level beginning on Aug. 16, 1989. Ph.D. in mathematics required. Preference given to apps with strong background in analysis, but other areas will be considered. Selection will be based on the potential and demonstration of excellence in research and teaching. Applicants are asked to send letter of application, vita, and three letters of recommendation to: Analysis Position; c/o Ronald Kirk, Chairman, Mathematics Department, Southern Illinois University, Carbondale, IL 62901. The closing date for applications is Jan. 10, 1989 or until the position is filled.

SUNY-STONY BROOK. State University of New York at Stony Brook, Department of Mathematics and Statistics, Stony Brook, NY 11794-3600 anticipates a position for a tenure track or visiting Associate Professor starting Spring Semester, 1989. A successful candidate will demonstrate excellence in one or more of the following areas: computational fluid dynamics and mathematical modeling of petroleum reservoirs, hyperbolic conservation laws and wave interactions, scientific computing and fluid instabilities. Please send a resume and statement of research and career goals to the Chairman, Department of Applied Mathematics and Statistics at the above address. Also arrange for three letters of recommendation to be sent.

STATE UNIVERSITY OF NEW YORK AT BUFFALO. The Department of Mathematics anticipates the appointment of at least one tenure track faculty member beginning September 1, 1989. Salary will be competitive. Outstanding applicants in all fields of mathematics are encouraged to apply. We seek applicants with excellent research accomplishments/potential and a strong commitment to teaching. Applicants should send any supporting information and have four letters of recommendation sent to: Dr. Nicholas Goodman, Search Committee Chairman, Department of Mathematics, SUNY/Buffalo, 106, Diefendorf Hall, Buffalo, NY 14214. The deadline for applications is Dec. 1, 1988. Late applications will be considered until positions are filled.

SYRACUSE UNIVERSITY. Dept. of Mathematics, Box 1, Syracuse, NY 13244-1150. We anticipate positions available Fall 1989. Candidates should have outstanding research ability and evidence of excellence in teaching. Apps. are invited in any area of mathematics and in math ed and statistics. Send letter of app and vita with a list of publications, and have 3 letters of reference sent to: Daniel Waterman, Chair.

UNIVERSITY OF ALABAMA. The department expects to fill from two to five tenure-track positions at the rank of Assistant Professor, to begin August 16, 1989. Areas of special interest are: algebra, analysis, continuous mechanics, computational mathematics, differential equations, differential geometry, optimization, stochastic modeling, and topology. Applicants should have or reasonably expect to have by August 16, 1989 a Ph.D. or the equivalent. Excellence in both teaching and research is required. We also invite applications for visiting positions. Send curriculum vitae, reprints and or pre/prints, and at least three letters of recommendation to: Search Committee, Dept. of Mathematics, The University of Alabama, Box 870350, Tuscaloosa, AL 35487-0350.

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, BERKELEY. Pending final budgetary approval, we invite applications for a faculty position at any tenured or tenure-track rank, to begin July 1, 1989. Will consider strong candidates in any area of theoretical and applied statistics, computer-intensive statistics, probability and applied probability theory. Interdisciplinary interests encouraged and joint appointments possible. Send inquiries and applications including a resume and three references by Jan. 30, 1989 to: P. W. Millar, Personnel Committee, Dept. of Statistics, UC-Berkeley, Berkeley, CA 94720.

UNIVERSITY OF CALIFORNIA, BERKELEY. Dept. of Mathematics, UC-Berkeley, Berkeley, CA 94720. (1) We invite apps for one or more positions eff July 1, 1989, at the tenure track asst. prof level, subj. to budgetary approval, in the areas of algebra, analysis, app math, foundations, or geometry and topology. Apps are expected to have demonstrated outstanding research potential, normally inc. major contributions beyond the doctoral dissertation. Send by 1/15/89 a curriculum vitae, list of pubs, a few selected reprints or preprints. Ask 3 people to send letters of recommendation to Marc A. Rieffel, Vice Chair for Faculty Affairs, at the above address. (2) One or more positions effective July 1, 1989 at tenure level (Assoc. or Full Prof.), subj to budgetary approval, in areas of algebra, analysis, app math, foundations, or geometry and topology. Demonstrated leadership in research is expected. Send by 1/15/89 a vitae, list of pubs, a few selected reprints or preprints, and the names of 3 references to Marc A. Rieffel at the above address. (3) Special 2-year (non-tenure-track) positions effective July 1, 1989. Apps should have a recent Ph.D. in the areas of algebra, analysis, app math, foundations, or geometry and topology, and should have demonstrated superior research potential. Send by 1/15/89 a vitae, and reprints, preprints and/or a dissertation abstract. Ask 3 people to send letters of recommendation to Marc A. Rieffel at the above address. (4) Several temporary positions beginning Fall 1989 are anticipated for new and recent Ph.Ds of any age, in the areas of algebra, analysis, app math, foundations, or geometry and topology. The terms of these appts. range from 1 to 3 years. Apps. for NSF or other postdoctoral fellowships are encouraged to apply for these positions: combined teaching/research appts. may be made up to 3 years. Mathematicians whose research interests are close to those of regular department members will be given some preference. Send by 1/15/89 a resume, and reprints, preprints, and/or dissertation abstract. Ask 3 people to send letters of reference to Marc A. Rieffel to the above address.

UNIVERSITY OF CALIFORNIA, DAVIS. Applications are invited for 3 or more anticipated tenure track positions in the Dept. of Math, effective 7/1/89. Appointments will be made at rank and salary commensurate with qualifications. Qualifications: Ph.D and outstanding record or great promise in teaching and mathematical research. Particularly interested in distinguished record in Applied Analysis, Mathematical Physics, or Mathematical Biology, but outstanding candidates in other fields given full consideration. Deadline: 1/16/89. An application consists of a curriculum vitae, list of publications, and at least 3 letters of reference sent to: Chair of Search Committee, Dept. of Math, UC-Davis, Davis CA 95616.

UNIVERSITY OF CALIFORNIA, LOS ANGELES. Six to eight regular positions in pure and applied mathematics. Specific fields of interest include algebra/number theory (including algebraic geometry), analysis, applied and computational mathematics, differential equations, dynamical systems, game theory, logic, mathematical computer science, mathematical physics, probability and statistics. Very strong promise in research and teaching required. Positions initially budgeted at the assistant professor level. Sufficiently outstanding candidates at higher levels will also be considered. Teaching load: Averaging 1.5 courses per quarter, or 4.5 quarter courses per year. To apply, write Alfred W. Hales, Chair, Dept. of Mathematics, UCLA, Los Angeles, CA 90024-1555.

UNIVERSITY OF CALIFORNIA, LOS ANGELES. TEMPORARY POSITIONS: (1) One or two E. R. Hedrick Assistant Professorships. Applicants must show very strong promise in research and teaching. Salary \$36,000. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by Jan. 1, 1989. (2) Two or three Research Assistant Professorships in Computational and Applied Mathematics. Applicants must show very strong promise in research and teaching. Salary \$36,000. Three year appointment. Teaching load: four quarter courses per year, which may include one advanced course in the candidate's field. Preference will be given to applications completed by Jan. 1, 1989. (3) One or two Assistant Professorships in the Program in Computing (PIC). Applicants must show very strong promise in teaching and research, preferably in the general area of Logic, Language, and Computation. Teaching load: four quarter programming courses and an advanced quarter course of the candidate's choice per year. Two year appointment, renewable once or twice. Salary range: \$36,000-\$42,000. Preference will be given to applications completed by Jan. 1, 1989. (4) One or two Lectureships in the Program in Computing (PIC). Applicants must show very strong promise in the teaching of programming. Teaching load: five quarter programming courses per year. One year appointment, renewable up to four times. Salary depends on experience, begins at \$30,300. (5) Subject to administrative approval, a few adjunct assistant professorships. Two year appointments. Strong research and teaching background required. Salary \$31,500-\$35,400 per year. Teaching load: five quarter courses per year. (6) Several positions for visitors and lecturers. To apply, write to Alfred W. Hales, Chair, Dept. of Mathematics, UCLA, Los Angeles, CA 90024-1555.

UNIVERSITY OF CALIFORNIA, SAN DIEGO. Dept. of Mathematics, C-012, La Jolla, CA 92093. The following positions expected to be available in Fall 1989 subject to admin approval. 4 Asst. Professorships in any field of mathematics (or related area) and 2 or possibly more professorships (at any level) primarily in the areas: algebraic geometry and discrete mathematics. Qualifications: (Asst. Prof. tenure track) Ph.D. in Mathematics or related field, demonstrated research potential, and demonstrated teaching exp at the undergrad level. To apply submit placement file inc at least 3 letters of reference, vitae, and publications to "Faculty Appointments Committee" at the above address. Qualifications: (Assoc. Prof level and above, tenured) Ph.D. in Mathematics or related field, demonstrated research potential, and demonstrated teaching exp at the undergrad and grad level. To apply submit placement file inc at least 3 letters of reference, vitae, and publications to "Faculty Appointments Committee" at the above address. Apps received by 1/6/89 will be given full consideration. Salary and level of appt. based on qualifications and UC pay scale. Immigration status of non-U.S. citizens should be stated on curriculum vitae.

UNIVERSITY OF CALIFORNIA, SAN DIEGO invites applications for the S.E. Warchawski Assistant Professorship, a special 2-year position. The 9-month salary is \$38,000. Candidates (of any age) should possess a recent Ph.D. (received no earlier than 1986) in mathematics or expect to receive one prior to July 1989. All areas of specialization will be considered. Selection based primarily on demonstrated research achievement. Teaching exp desirable. To apply submit placement file inc at least 3 letters of reference, vitae, and publications to "Faculty Appointments Committee" at the above address. Apps received by 1/6/89 will be given full consideration. All supporting material must be received by 1/13/89.

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 CALIFORNIA, SANTA CRUZ. Math Dept. recruiting for one position either in linear analysis, geometry, topology, or algebra. Teaching load: 4 courses. Rank: Asst. Prof. (possibly Assoc.) Min Qualifications: Ph.D. in mathematics with strong research and teaching credentials. Salary: \$31,500-37,200. Effective: July 1, 1989. Apps should send vitae, 4 letters of recommendation, and info about research and teaching experience to: Recruitment Committee at the above address. Closing date: 12/31/88. Please refer to #129-889 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. A tenure track position beginning Fall 1989. Asst. Prof. level preferred, other levels considered for exceptionally strong cases. Candidates whose specialty is in differential geometry or in number theory encouraged to apply. Exceptionally strong applicants in other areas of math that compliment the interests of our current faculty will also be considered. Applicants should be completed by 12/31/88. Send resume and 4 letters of reference.

UNIVERSITY OF FLORIDA. Department of Mathematics, 201 Walker Hall, Gainesville, FL 32611. David A. Drake, Chair. The Department is in its third year of a five-year program to fill over 20 new tenure-track positions with mathematicians of exceptional caliber. Candidates should have distinguished research records and a strong commitment to teaching. Outstanding candidates in all areas of applied and pure mathematics and at all academic ranks (junior candidates are especially welcome) are encouraged to apply for 5 or 6 positions to begin in the fall semester, 1989. One of the 6 positions is reserved for a senior candidate in partial differential equations. Other areas of interest include, but are not limited to, arithmetic geometry, number theory and dynamical systems. Send resume, including a list of publications and at least three letters of recommendation to the Chair by 12/31/88.

UNIVERSITY OF HAWAII. Applications are invited for two anticipated positions beginning Fall, 1989, one tenure-track and one temporary (one year). Rank open. Duties include mathematical research and teaching 6 credit hours per semester. Minimum qualifications include Ph.D., commitment to research and teaching, and achievement appropriate to rank. Research interests complementing those of the Department are desirable. Normal salary range as of 10/88 is from \$25,368 (minimum for assistant professor) to \$57,804 (maximum for full professor). To apply, write to Professor Ronald Brown, Chairman, Department of Mathematics, 2565 The Mall, Keller 401A, Honolulu, HI 96882. Have three references send confidential letters directly to the chairman. DEADLINE FOR APPLICATION: 1/23/88.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN. New (1989) and recent Ph.D.'s are invited to apply for one or more anticipated tenure-track positions at the assistant professor level (subject to administrative approval) and several full-or part-time visiting positions. Appointments commence August 1989: competitive salary and teaching load. Candidates should send letter of application, vita, and publication list and arrange to have three letters of reference sent directly to: C. Ward Henson, Chair, Department of Mathematics, University of Illinois at Urbana-Champaign, 1409 West Green Street, Urbana, Illinois 61801. Tel. (217)-333-3352. In order to ensure full consideration, application materials must be received by Jan. 2, 1989. Candidates are expected to present evidence of potential excellence in research and teaching. Interviews may be conducted prior to closing date, but all applications received by the closing date will receive full consideration.

UNIVERSITY OF KANSAS. Applications are invited for tenure track and temporary positions at all levels commencing August 16, 1989 or as negotiated. Field is unrestricted but preference will be given to numerical analysis and prob/stat, and to areas meshing well with the dept.'s needs. Require Ph.D. or Ph.D. dissertation accepted only formalities to be completed. Application, detailed resume with description of research, and 3 letters of recommendation should be sent to C. J. Himmelberg, Chair, Dept. of Mathematics, University of Kansas, Lawrence, KS 66045-2142. Deadlines: 12/1/89 for first consideration, then monthly until 10/1/89.

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 MICHIGAN. Department of Mathematics, Ann Arbor, MI 48109-1003, Professor D. J. Lewis, Chairman. Five or more tenured positions or senior assistant professor tenure track positions. Areas not specific, but a slight preference for individuals in areas that would significantly broaden and strengthen areas presently represented. Exceptional research and teaching background required. Applications considered on a continuing basis. Salary negotiable. Starting date: September 1989.

UNIVERSITY OF MICHIGAN. Department of Mathematics, Ann Arbor, MI 48109-1003, Professor D. J. Lewis, Chairman. Expect to have 2 T. H. Hildebrandt Research Assistant Professorships. 3-year appointment, reduced teaching load. Preference given to persons of any age having the Ph.D. degree less than 2 years. Also expect to have several 3-year terminal assistant professorships. Area not specific. Seek individuals with strong research program and serious commitment to teaching. Application deadline: 6 January 1989. Salary competitive. Possibility for additional income in summer. Starting date: September 1989.

UNIVERSITY OF MICHIGAN - FLINT. A possibility of a tenure track assistant professorship in Mathematics commencing Sept. 1, 1989. Ph.D. in Mathematics required. Department of ten with interests in algebra, algebraic geometry, classical and complex analysis, number theory, approximation theory and logic. UM-Flint is an urban regional campus of the University of Michigan. Enrollment is app. 6000. Send vita and three letters of recommendation prior to Jan 23, 1989 to: Dr. K. E. Schilling, Dept. of Mathematics, UM-Flint, Flint, MI 48503. (313)762-3314. Late applications considered until the position is filled.

UNIVERSITY OF MINNESOTA, DULUTH. Dept. of Mathematics & Statistics, MG 108, 10 University Drive, Duluth, MN 55812. H. Stech, Search Committee Chair. Applied/Computational Mathematics. Tenure-track Assistant Prof. and tenure-track or tenured Associate Prof. Start 9/1/89. Teach 2 courses/yr. at graduate and undergraduate level; assist in master's program in applied and comp math; do research. Req: Ph.D. in applied math or related field by 9/1/89. Des: 5 years professional experience, appropriate research area, effective teaching & advising experience, publications, industrial or governmental experience in math. Salary competitive. Send resume, 3 letters of recommendation, and transcripts (if degree received within past 5 years) to Harlan Stech by 9/1/89. 9218-726-8272).

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 supp. 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 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, 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 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. 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 NORTH CAROLINA AT CHAPEL HILL. Dept. of Mathematics, Chapel Hill, NC 27514. Applications are invited for a senior level tenured appointment in the general area of applied and computational mathematics, effective Fall 1989. Rank and salary depend on qualifications. A Ph.D. and demonstrated excellence in research and teaching are required. Applications will be accepted until the position is filled; however, applications received by Jan. 15, 1989, are assured of full consideration. Send 4 letters of recommendation, vitae, and abstracts of current research to Search Committee, Pat Levin, Mathematics Dept., Box 3250 Phillips Hall, UNC at Chapel Hill, Chapel Hill, NC 27599.

UNIVERSITY OF NORTHERN IOWA. The Mathematics and Computer Science Dept. invites applications for two new tenure-track positions at the Assistant or Associate Professor level from individuals with a strong commitment to undergraduate teaching, including a major responsibility for general education courses. Qualifications include doctorate (one person in an area of statistics, the other person's area is open), demonstrated success in collegiate teaching, and scholarly performance or promise. To be assured of full consideration, applications must be received by Feb. 17. For complete announcement, contact Dr. David Duncan, Head, Dept. of Mathematics and Computer Science, University of Northern Iowa, Cedar Falls, Iowa 50614. Immigration of non-U.S. citizens must be stated in application.

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 PENNSYLVANIA. We anticipate that commencing July 1, 1989, there may be one or more tenure positions available in the following areas: algebra, analysis, geometry/topology, discrete mathematics, and logic. These positions are for candidates with outstanding internationally recognized research achievements who are successful teachers of undergraduate and graduate students. Rank and salary will depend on experience. Write to Personnel Committee, Dept. of Mathematics, University of Pennsylvania, Philadelphia, PA 19104-6395.

UNIVERSITY OF PITTSBURGH. Department of Mathematics and Statistics invites applications for the following positions: (1) Specialist in partial differential equations or applied mathematics, including scientific computation. Rank open. (2) Two positions, one at senior level, in pure mathematics other than differential equations. Applicants should have outstanding research accomplishment or potential. Excellence in teaching is also required. Positions are contingent upon available funding.

UNIVERSITY OF ROCHESTER. Several tenure track positions at all levels available beginning 9/89. Applicants showing significant research accomplishments or exceptional research promise, as well as evidence of a commitment to excellent teaching are invited to apply. Initial tenure track appt. is 4 years. No restriction to field. In addition to a curriculum vitae, candidates should send a summary of research plans, available reprints or preprints, and have at least 3 reference letters sent to: Samuel Gitler, Chair, Mathematics Dept., University of Rochester, Rochester, NY 14627.

UNIVERSITY OF TENNESSEE, KNOXVILLE. Tenure track position at the asst. prof level. Especially interested in function theory, several complex variable, and harmonic analysis. Review of apps. begins 12/1/88 and continues until position is filled. Contact: Kenneth Stephenson 615-974-2461 or 2462.

UNIVERSITY OF TENNESSEE, KNOXVILLE. Tenure track positions available. Any academic rank who would compliment existing faculty. Specific areas of interest: numerical differential equations, numerical linear algebra, optimization. Outstanding record (or potential for candidates for junior positions) in research and teaching expected. review of apps begins 11/15/88 and will continue until positions are filled. Contact: Steve Serbin 615-974-4268 or 974-2461.

UNIVERSITY OF TENNESSEE, KNOXVILLE. Tenure track position at asst. or assoc. professor level. Pref for individual whose primary interest is in area of inference and who can add to current strengths in probability, stochastic processes, and other related areas. Review of apps begins 12/1/88 and will continue until position is filled. Contact Balram Rajput, 615-974-2461 or 2462.

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 WASHINGTON, SEATTLE. Department of Mathematics, Seattle, WA 98195. (1) Several tenure track positions starting Autumn 1989. We seek candidates with strong teaching and research records. Appts. will be generally at the Asst. Prof. level, although in exceptional cases a more senior appt. is possible. (2) Several 3-year appts. starting Autumn 1989 for recent Ph.D.s of any age, with strong research and teaching potential. All apts. carry competitive salaries, and standard benefits. Please send curriculum vitae, list of publications, and four letters of recommendation to: Chairman, Appointments Committee.

UNIVERSITY OF WISCONSIN-MADISON. Soliciting applications for the following positions beginning Fall 1989: (1) Tenure track positions. Appts. will be made at the Asst. Prof. level unless qualifications and experience require appt. to higher rank. (2) Van Vleck Assistant Professorships. Applications invited from mathematicians (of any age) who are recent recipients of a doctorate. Ordinarily only those applicants who have received their degree since 1986 and prior to Sept. 1989 will be considered. Pref. given to candidates whose research interests are compatible with research goals of the dept. Should have a strong commitment to good teaching and exhibit outstanding potential for mathematical research. The salary will be dependent on experience and will be at least \$30,500 per academic year. Appointments are for a specified term of 3 years. The usual teaching load is 2 courses per sem, with at least one in the applicant's specialty every other year. High probability of additional income through research or teaching during summers between consecutive years of appt. App. forms available: Hiring Committee, Dept. of Mathematics, 480 Lincoln Dr., Madison, WI 53706. Supporting materials should include a vita, a one to three page abstract of the candidate's dissertation, and 3 or 4 letters of recommendation, at least one of which discusses the candidate's exp and capabilities as a teacher in detail. Apps accepted until positions filled; however, to ensure full consideration, the application and all supporting materials should be received by 12/31/89.

UNIVERSITY OF WISCONSIN-MILWAUKEE. Dept. of Mathematical Sciences, P.O. Box 413, Milwaukee, WI 53201. Apps. are invited for several anticipated tenure track asst. professorships beginning Fall 1989. We especially seek candidates in: applied science, 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 sem. Please send credentials and at least 3 letters of recommendation by 1/27/89 to Search Committee at the above address.

VALPARAISO. Dept. of Mathematics and Computer Science, Valparaiso, IN 46383. If you are interested in contributing to a growing and dynamic undergrad math program, you are invited to apply for a possible tenure track position. Qualifications desired: Ph.D. in math with expertise in Analysis or Operations research and/or Math Modeling or Secondary ed. Background in Computer Science helpful. Closing date: 1/31/89. Valparaiso is a private university in the Lutheran tradition. Send letter of app and resume to William Marion, Chairperson.

VANDERBILT. Assistant Professor (Ph.D. required) with two year appointment beginning Fall, 1989. This is not a tenure track appointment but is intended for a person with demonstrated research potential who would like to spend time in a department with a vigorous research atmosphere. We are especially interested in someone who works in one of the areas of departmental strengths which include universal algebra, differential equations, approximation theory, operator theory, applied mathematics, graph theory, and topology. Have vita and four letters of recommendation (including one about teaching) sent to Professor Glenn Webb, Chair, Vanderbilt University, Dept. of Mathematics, Nashville, TN 37235.

WASHINGTON STATE UNIVERSITY. Assistant Professor (outstanding senior considered): Academic year, tenure track, one-half time Math Dept., one-half time Statistics Program. Duties include teaching, research, and some consulting. Ph.D. in statistics or interests in statistical computing, response surface design, quality control or area of engineering application. Vita and 3 letters of reference sent to Prof. Michael Jacroix, Chair, Statistics Search Committee, Dept. of Math, Washington State University, Pullman, WA 99164-2930. Closing date: Jan. 15, 1989.

WASHINGTON UNIVERSITY IN ST. LOUIS. Position open beginning Fall 1989. Rank and salary depend on qualifications. Candidates should have outstanding research ability in a field represented in the Department, evidence of excellence in teaching. Send a letter of application and vita, and have three letters of reference sent to: Robert H. McDowall, Chair, Dept. of Mathematics, Campus Box 1146, One Brookings Way, St. Louis, MO 63130-4899. Applications received before Jan. 15, 1989, will receive full consideration.

ASSOCIATION FOR WOMEN IN MATHEMATICS  
Box 178 Wellesley College, Wellesley, MA 02181  
617-235-0320 x. 2643

MEMBERSHIP FORM

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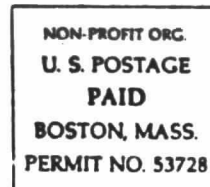
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Association for Women in Mathematics  
Box 178 Wellesley College  
Wellesley, MA 02181



November-December 1988

Marie A. Vitulli  
Univ of Oregon  
Dept of Math  
Eugene

OR 97403