File

Association for Women in Mathematics

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If you are a member of AMS/MAA and are not attending the annual meeting in Biloxi because Mississippi has not yet ratified the ERA, please write to the organization(s) and make your feelings known.

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LETTER FROM THE PRESIDENT

AMS elections. This year there is a write-in campaign to elect Alice Schafer as AMS secretary. If you have not yet sent in your ballots, I urge you to vote for Alice T. Schafer, Wellesley College. The other candidates supported by the AWM are Chandler Davis, Judy Green, and Lida K. Barrett.

Helsinki. At 8 p.m. on August 18, at the International Congress of Mathematicians in Helsinki, Finland, an AWM meeting was held which was attended by about 500 people. The following resolution of sentiment, presented by Lenore Blum, was passed overwhelmingly (only three dissenting votes):

> We note the absence of women from the list of invited speakers at the 1978 ICM, from the IMU general assembly, and from the IMU committees, despite the large number of internationally distinguished women mathematicians. We urge that this situation be rectified by the 1982 ICM.

I am sending this resolution to the president, president-elect, and secretary of the International Mathematical Union, to the AMS Notices, and to the presidents of the various American mathematical societies, along with my personal feelings of dismay that such a situation is still possible.

Another issue which surfaced at Helsinki, and which also might apply to summer AMS/MAA meetings, is the question of daycare. Daycare at the ICM had to be individually arranged and was quite expensive. This is an obvious hardship to the many families who bring their children to summer meetings. I would appreciate knowing your past experiences and present needs on this matter.

Science education legislation. As of this writing, the House of Representatives bill H.B. 13778 is before the House with no mention of transferring NSF science education programs to the proposed Department of Education. However its counterpart, S. 991, is before the Senate with such a transfer of funds proposed. Both bills are expected to pass, although possibly not before the October recess, and there is no way of knowing what the compromise will be. If you are interested in this matter, Senator Edward Kennedy's office is the one to contact. For many reasons, not the least of which is the miniscule proportion of funds such programs would receive from a giant Department of Education, keeping these programs in the NSF seems highly desirable. The NSF has a pretty good track record, in particular, in funding programs to encourage women and minorities in science.

NIH suit. Back in 1972, when the AWM was still a baby, we became a plaintiff, along with 10 individuals and six organizations in a suit against the officers of the National Institutes of Health, including Elliot Richardson, who was then the Secretary of HEW. The suit essentially charges the NIH with having too few women on its advisory committees and then, when an affirmative action plan was announced, breaking the rules of its own plan.

It should be noted that many of these advisory groups have lay members, so the pool of qualified women can be quite large. Sample fact from the suit: only two women were included in the six groups - 97 people all told - concerned primarily with breast cancer.

Helen Hunt Jones is the lawyer for the suit. When the AWM became a plaintiff it was with the understanding that as an organization we have no money; but individual donations toward the expenses of the suit are welcome. They can be sent to Cotton, Watt, Jones, King and Bowlus, Suite 4750-One IBM Plaza, 330 North Wabash Avenue, Chicago, Illinois 60611.

The suit is still pending in the U. S. District Court in Washington, D. C.

Another suit. Missouri, Nevada, and the Louisiana Action Committee for Tourism, Inc. are each separately suing NOW over the economic boycott of non-ERA states. Since the AWM is listed as a boycotting organization, we were sent a questionnaire by the lawyers for the defendants. The most illuminating question asked if "NOW or any other organization" offered to "do something to benefit your organization" if a pro-boycott resolution was passed. The answer, of course, is no.

Speaking of boycotts. Officially there is no AWM meeting at the joint mathematical meetings in Biloxi, Miss. this coming January. There will be an AWM presence, however: an AWM table; the wearing of green armbands; and a panel. The armbands will be worn by any individuals attending the joint meetings who wish to demonstrate support of the ERA. Bettye Anne Case of Tallahassee Community College and Evelyn Sylvia of the University of California at Davis are in charge of the armbands.

The panel is at 4 p.m. on Saturday, January 27 - scheduled so that afterwards there will be time for us to get together informally. The panel topic is the ERA and the mathematical community. We will discuss legal issues of the ERA and of affirmative action; the situation of women in the mathematical community; and the politics of the ERA. Speakers include J. R. Quine and Mary Gray; I will be moderating.

Judy Roitman
Department of Mathematics
University of Kansas
Lawrence, KS 66045

WELCOME TO JUDY ROITMAN

from Lenore Blum, Past President

Judy Roitman needs little introduction to the AWM membership. She has been active in the AWM since the beginning--as West Coast Representative on the Executive Committee, as Editor of and frequent contributor to the Newsletter, as AWM vicepresident, as panelist, as spokeswoman on many occasions...

For me, this welcome to Judy as new AWM president takes on a very special and personal meaning. Over the years, our friendship has grown with, indeed has been intertwined with, our involvement in and the development of the AWM.

Judy and I first met at Berkeley in the late 60's when she was a grad student and I was on the staff. Perhaps it was due to our roles, but perhaps even more to my own ambivalence at the time about the wisdom of alliances with other women in mathematics (after all, wasn't an important measure of success being considered "one of the boys"), that we didn't get to know each other until the spring of 1971 when Judy organized the first meetings of women in the Berkeley Math Department, and I organized the first colloquium on "Women in Mathematics". My own turnabout came with the realization - dramatically brought home to me - of the intrinsic instability and precariousness of the position on the pedestal. From Judy, I learned first hand the real meaning and

enormous value of a mutual support system. In large part it has been her constant encouragement and support and respect that gave me the courage to speak out, first at Berkeley, then later more nationally, on issues of women in mathematics - and to explore new areas professionally, particularly with regard to education. And this has also been the impact of the AWM. In her report "Do It Yourself" in the November-December, 1977 Newsletter on the "Women in Science" meeting in Washington, Judy writes "...I really got to appreciate the AWM. Our members are getting an enormous amount done. And perhaps my disappointment at the (W.I.S.) meeting was comparing it to most AWM meetings. We are both more sympathetic to each other and more open about our differences..."

I have always been in awe of Judy's energy and speed and capacity for getting things done, and I am truly looking forward to AWM's continued growth and development in the coming years under her leadership.

AWM MEETING AT THE ICM

by Bhama Srinivasan, Clark University, Moderator

The AWM held a meeting on August 18, 1978 at the International Congress of Mathematicians in Helsinki, Finland. The meeting had been scheduled to take place in a small lecture hall, but we had to move to a bigger room when we found that we had an audience of about 500 (including many men). I opened the meeting by introducing Mary Gray to the audience as the founder and first President of the AWM. Then we had a panel discussion in which the following mathematicians took part: Hel Braun, University of Hamburg, BRD; Marjatta Naatanen, University of Helsinki, Finland; Yvette Amice, University of Paris VII, France; Mary Kearsley, St. Ann's College, Oxford, UK; Judy Green, Rutgers University, USA; Lenore Blum, Mills College, USA; and Helen Kosachevskya, Donetsk, USSR. Lenore Blum, third President of AWM, gave a brief survey of the work that AWM is doing. Hel Braun and Yvette Amice talked about opportunities for women mathematicians in their respective countries and gave statistical data on the percentage of women at various ranks. Marjatta Naatanen stressed the fact that Finland is a small country and the total number of mathematicians is very small, and that perhaps because of this women seemed to be doing well at least at lower levels. Mary Kearsley talked about the effects of recent anti-discrimination laws passed in the UK; she was afraid that some of these were counter-productive and had led to situations where employers were afraid to hire women as they would be forced to give maternity leave, etc. Judy Green talked about American women mathematicians in the early part of this century who studied in Germany and were encouraged by various male mathematicians in Germany, notably Klein. Finally Helen Kosachevskya talked about the very favorable position that women had in her department at Donetsk, where there are ten men and eight women on the faculty. The panel was followed by questions and comments from the audience. It was clear that there was a sentiment that strong steps should be taken in all countries to encourage girls to study mathematics at all levels, starting from elementary school.

Lenore Blum introduced a resolution which was then amended by Lee Lorch to read as follows: "We note the absence of women from the list of invited speakers at the 1978 ICM, from the IMU General Assembly and from the IMU committees, despite the large number of internationally distinguished women mathematicians. We urge that this situation be rectified at the ICM meeting in 1982." After some comments from the audience the resolution was put to a vote and passed with only 3 dissenting votes. Copies of the resolution were sent to the President, President-Elect, and Secretary-General of the IMU. A report of the meeting, containing the resolution, was published in the ICM Daily Bulletin of August 21, 1978 so that it abtained a great deal of publicity among the mathematical community at the Congress.

Due to lack of time, papers by Nirmala Parkash of Indraprastha College, New Delhi, India and Pierre Samuel of the University of Paris-Sud, France, who were invited to be

members of the panel but were unable to attend the Congress, were not read at the meeting. They will be published in a future issue of this Newsletter.

I thank Alice Schafer, second President of AWM, who worked hard to organize the panel but was unable to attend the meeting. I also thank all the panel members for their contributions to the discussion.

Ed. note: An article with pictures of most of the panelists appeared in the Finnish paper Uusi Suomi on August 23.

MAA BROCHURES OF INTEREST TO AWM: part 1 of 2

by Henry L. Alder, President, MAA

Introduction

The MAA during the past year and a half has engaged in an intensive effort to prepare and make widely available information and brochures designed to assure adequate mathematical preparation in high school for entering college students. This effort was stimulated in March by the widely publicized decline in the mathematical competency of entering college freshmen as indicated, for example, by the drop in SAT scores over a period of fourteen years. As result of this decline the MAA and NCTM in July 1976 jointly appointed a Committee on the Reported Decline in the Mathematical Preparation of Students for Collegiate Mathematics. This Committee consisted of three high school teachers (David R. Johnson, Chairman of Nicolet High School in Milwaukee, Wisconsin; Katherine P. Layton, Chairman of Beverly Hills High School; and Ron McCully, Mathematics Supervisor in Phoenix, Arizona), one two-year college teacher of mathematics (Betty J. Hinman, Assistant Chairman of the Department of Mathematics at the Downtown Campus of the University of Houston), and three four-year college or university teachers of mathematics(Gerald L. Alexanderson, Chairman of the Department of Mathematics at the University of Santa Clara, who also served as Chairman of the Committee; Robert B. Meacham of Eckard College in St. Petersburg, Florida; and Henry L. Alder of the University of California, Davis).

As a first step, the Committee decided to obtain a lot of information on the widely reported decline in SAT scores over the last fourteen years. In this work, the Committee was greatly aided by Katherine Layton who also served as a member of the Advisory Panel on the SAT Score Decline appointed in October 1975 by the College Entrance Examination Board and chaired by Willard Wirtz, the former Secretary of Labor.

Since the Advisory Panel on the SAT Score Decline was charged with the responsibility to look into the causes of the decline, the joint MAA-NCTM Committee felt that it would be a duplication of effort to do the same,and, therefore did not pursue this. The Advisory Panel has in the meantime, namely, on August 23, 1977, published its report, entitled "On Further Examination," which has been given a great deal of publicity.

The Committee instead tried to determine how college and university mathematics faculty actually perceive the abilities of recent entering freshmen. Some evidence on this was available, at least for midwestern colleges, in the report of Professor Andrew Sterrett in the February 1976 issue of the TWO-YEAR COLLEGE MATHEMATICS JOURNAL.

Professor Sterrett had sent a questionnaire to mathematics department chairmen of 67 four-year colleges and universities in the midwest. Returns were obtained from 35 colleges with enrollment from 500 to 3000 and from nine universities.

In response to a question about the preparation of students, sixteen chairmen reported that students are less well prepared now than they were ten years ago, ten thought students are better prepared, and nine thought that there is no appreciable change.

An open-ended question was asked of chairmen: What topics from pre-calculus mathematics are not sufficiently well understood by students when they begin their calculus courses? Almost half of the responses included trigonometry. Lack of ability to perform important algebraic manipulations was a close second with several specific

algebraic topics mentioned on numerous occasions: inequalities (9), absolute values (6), and graphing (6).

Coincidentally, a Survey of the Conference Board of the Mathematical Sciences was to appear during the period the Committee was working. This Survey also indicated that a decline in preparation has been observed by college and university instructors and stated that "a heavy majority of mathematical science department heads report that mathematical training of undergraduate students has declined recently, and that they attribute the decline to poorer secondary school preparation and generally weaker motivation to study mathematics." The report goes on: "over 75% of the respondents reported a recent decline of students' training and ability. The most common explanations were poorer secondary school preparation, lower college admission standards, and student lack of interest in or motivation to study mathematics."

Everyone is aware, I am sure, of the increase nationwide in the number of remedial courses offered. The same CBMS survey also gives data on the increase in the number of students now taking remedial mathematics courses in colleges, particularly in the two-year colleges. The number of students taking arithmetic courses in two-year colleges has increased 86% since 1970 while overall enrollment increased by only 60%.

The Committee was also interested in learning how the SAT score decline is viewed by elementary and secondary school teachers. Meetings with teachers were arranged by members of the Committee: two in the Santa Clara Valley in California, one in the Davis, California, area, one in Houston and one in St. Petersburg, Florida. A questionnaire was sent to teachers in the Los Angeles and Milwaukee areas and, in addition, when the Committee met in San Francisco, it invited a group of teachers in that area to its meeting. Teachers from large metropolitan areas were consulted, as well as teachers from suburban and rural areas. Many were secondary school teachers, some were elementary school teachers, some were supervisors and some have been prominent in school curriculum revision and in textbook writing, for example, Sarah Herriot, Floyd Downs, and Calvin Crabill.

The teachers were asked the following questions:

1) What do you perceive to be the primary causes for the decline in SAT scores in mathematics?
2) What kind of curriculum do you teach at present in mathematics?
3) What textbooks do you use in your courses in mathematics?
4) What changes, if any, would you recommend in the mathematics curriculum to improve the preparation of students for collegiate mathematics?
5) What do you believe to be the proper role of hand computers in the mathematics curriculum?
6) Do you believe more homework should be given in mathematics than is now given in your school or should there be less or about the same as given now?
7) Do you believe that changes should be made in the mathematical preparation of prospective elementary and/or secondary teachers of mathematics and, if so, what changes do you recommend?
8) Should anything be done to improve the mathematical background of practicing elementary and/or secondary teachers, and, if so, what?
9) What would you like our Committee to recommend to improve the preparation of students for collegiate mathematics?

The remarkable thing about our meetings with teachers was the uniformity of the opinions expressed by the teachers. A number of themes were common to many of the discussions.

Most teachers we talked to agreed that a decline has occurred. I recall one question: "Do you feel the exams that you are giving are as hard as before?" The teachers laughed. One said: "We look up old exams - we don't dare give those exams." Another said: "We get the same feeling. Did I really give exams that hard three years ago? Did I really cover that much material three years ago?" It was conceded by those present that the students are not as capable or as motivated today and examinations and courses have been watered down.

The following is a short list of possible causes for the decline that we heard from the teachers. Of course, everyone can conjecture what the causes might be. The Committee is not claiming that any of the following are the causes but they all are comments from the teachers we talked to. As the reader will gather from the first few on the list, we might have heard other causes had we talked extensively with parents! Possible causes given were:

1) Parents have failed to support teachers and the schools.
2) Students are not encouraged in the home to do homework and there's little point in assigning homework anymore because the students will not do it.
3) Students won't do rigorous work and won't spend time on a problem if the problem is hard.
4) Students don't work hard because many are not interested in going to college anymore. Among those who are, there's no longer much concern because it is easy to get into college now. Colleges need students.
5) Students no longer have to go to college to avoid the draft.
6) Work-study programs take students away from college preparatory academic programs.
7) Television has brought about a deemphasis on written communication so the students can't read well and cannot learn as well from texts as they did in the past.
8) Grade inflation has convinced students they no longer need to work hard for good grades.
9) Economic conditions force students to be more job-oriented, less interested in academic courses.
10) In some schools students take eight classes a day and that's too many.
11) Students commonly cut class and there is nothing that can be done about it since there is no help given by the parents.
12) With the decline in the space program there is less interest in science and mathematics.
13) Curriculum changes in the schools have emphasized "relevant" high-interest areas, less science and mathematics.
14) There is little emphasis in the curriculum on formulas, tables or skill in calculation since there is a widespread feeling that hand calculators or computers will do it all.
15) Colleges and universities are admitting students with less and less mathematics and offering high school courses in college. Why should students take the courses in high school when, if they need the courses, they can take the courses in college and get college credit for them?
16) Students wanting to get into prestige schools avoid extra mathematics courses because it's safer to take easier courses and get higher grades.
17) There has been too much theory, too little practice in the curriculum.
18) There has been too much vocabulary, not enough emphasis on problem solving.
19) There has been a deemphasis of word problems.
20) Textbooks have required a reading level too high for the students.
21) Too many topics have been crowded into the high school curriculum forcing the teacher to cover lightly some important topics and to omit other valuable, basic topics.
22) Some teachers do not prepare adequately or they are themselves inadequately trained.
23) Programs for the retraining of teachers are inadequate. In particular, not enough appropriate subject matter courses are available in the colleges and universities.

And finally we come to one of the comments that brought about the quickest, most enthusiastic expressions of agreement from other teachers: students get poor advice from guidance counselors. Students are told, according to these teachers, not to continue mathematics courses because they're hard and might pull down one's grade average.

There were other causes suggested but this list gives some of the reasons most often heard. Many of these same reasons have been put forth to explain the SAT score decline. It is not easy to see what one might suggest to overcome all of these problems in the schools and in the home. The Committee liked one of the suggestions made when we asked what our Committee could do about the decline. It was: "Change society!" Maybe that's exactly what needs to be done, but the Committee did not feel up to the task. We did

feel that we had to try something, however, because the teachers we talked with consistently expressed feelings of concern and, indeed, urgency. One, I recall, said: "If you think your college students are bad now wait until you get this crop!"

The Committee made two recommendations which will be reported on in the next issue of the Newsletter.

WIDE DISTRIBUTION IN CALIFORNIA OF "THE MATH IN HIGH SCHOOL" BROCHURE

by Jane Day, Chair, Math Dept., College of Notre Dame, Belmont CA 94002
Member, Executive Committee, Northern California Section of MAA

The Northern California Section of the MAA has reprinted the excellent pamphlet "The Math in High School you'll Need for College" and will distribute these in bulk to high schools in the Section.. The California Math Council, CMC Community Colleges, and the Southern California Section of MAA have also contributed toward the printing cost. Joe Hoffman, Director of the Math Unit of the State Department of Education, will do an initial mailing in September 1978. Hoffman's letter will go to each math chairperson in a public high school and will ask that person to contact the head counselor and PTA President to decide together the best way to distribute the pamphlets to youth and parents in their school. Then they can write to me for the number of copies they need, and I'll distribute them as long as they last.

Changing the subject, but not much: there is another MAA/NCTM pamphlet which needs wide distribution to high school math teachers: "Recommendations for the Preparation of high school students for College Mathematics Courses". This specifies what topics in algebra, trigonometry and analytic geometry are needed. This is especially helpful for designing a fourth-year math course to follow Algebra II, as there is considerable variance in the topics included in books available for such a course.

Both these pamphlets can be obtained in limited quantities from MAA, 1529 18th St. M N.W., Washington, D.C. 20036.

WOMEN SCIENTISTS ROSTER

Last year the National Science Foundation supported a pilot Visiting Women Scientists Program in which 40 women scientists visited 110 high schools across the country. Based on the success of the pilot program, a number of schools have requested lists of women scientists who might be willing to meet with their students. Women scientists who wish to be included in a roster to be released to schools should send the following information to Ms. Carol Place, Research Triangle Institute, Box 12194, Research Triangle Park, North Carolina 22709 by January 31, 1979:

1) name; 2) mailing address; 3) telephone number;
4) type of science (biological, physical, engineering, mathematics, social science);
5) specific science field (e.g., bacteriology, mechanical engineering);
6) highest degree earned;
7) type of employment (academic, non-profit organization, profit-making organization, government);
8) race or ethnic background.

Respondents should omit any information they do not wish to have released.

ANNA JOHNSON PELL WHEELER, 1883-1966: part 2 of 2

by Louise S. Grinstein, Kingsborough Community College, and Paul J. Campbell, Beloit College

Research: Linear algebra and integral equations

Anna Pell Wheeler's work [1-11] centers around linear algebra of infinitely many variables. Her interest in it derived from its applications to differential and integral equations; but, although her training had been mainly in analysis, she also pursued algebraic results for their own sake. She began her career when functional analysis was beginning to be developed. In its spirit, she investigated functional equations of various kinds.

Her Ph.D. thesis is divided into two parts [3,4]: the first develops the theory of biorthogonal systems of functions, independent of its connection with differential and integral equations; the second applies the theory to integral equations, a red-hot field at the time.

If $\{u_i\}$ and $\{v_i\}$ are subsets of L^2, the class of Lebesgue square integrable functions on an interval $[a,b]$, then $\{u_i\}$ and $\{v_i\}$ form a biorthogonal system iff $\int u_i v_j = 1$ if $i = j$ and 0 otherwise, where the integration is from a to b. Each of $\{u_i\},\{v_i\}$ is referred to as an adjoint system of the other. Biorthogonal systems were introduced by R. Murphy in 1833; E. Schmidt in 1905, and G. D. Birkhoff in 1908, showed that they arise as the solutions of naturally associated ("adjoint") pairs of integral, respectively differential, equations.

In [3] Anna gives necessary and sufficient conditions for associating an adjoint system with a system of linearly independent functions, gives conditions for a generalized principal axis theorem $\int fg = \sum fv_i \int u_i g$ to hold, and classifies biorthogonal systems into equivalence classes. The second result proves important in [4], where it affords an expansion theorem for functions in terms of solutions to an integral equation. The important feature of the equivalence classes is a one-to-one correspondence with linear operators $T: L^2 \to L^2$ satisfying $\int f_1 T(f_2) = \int f_2 T(f_1)$ and $\int f T(f) = 0$, with $T(u_i) = v_i$. Each T in turn corresponds to a positive definite limited quadratic form in infinitely many variables, so that the functional equation $f = \lambda T(f)$ has a solution exactly when the quadratic form corresponding to T has an eigenvalue.

The reason the operators T interested Anna is that certain ones have a direct bearing on integral equations. Anna is concerned with the linear integral (or Fredholm) equation of the second kind $u(s) = f(s) + \lambda \int K(s,t)\, u(t)\, dt$, where f and K are known continuous functions, λ is a parameter, and the unknown is a continuous function u. (Her theorems also cover the more general case of L^2 functions.) The function K is known as the kernel of the equation, and the equation is homogeneous if $f \equiv 0$. Taking up a technique suggested by Liouville and developed by Neumann and Volterra, Fredholm conceived of the equation as the limiting form of an $n \times n$ linear system of algebraic equations as $n \to \infty$. Cramer's rule then suggested to him the form of the solution to the integral equation ; this was in 1900, when Anna was in college. Fredholm's success stirred Hilbert to look into integral equations, and the next 10 years saw Hilbert lead his students -- including Anna -- into the field.

Hilbert reformulated Fredholm's analogy by representing u, f and K in terms of an arbitrary complete orthogonal system of functions. A purely formal substitution and equating of coefficients leads to the infinite linear system $x_i + \sum_j K_{ij} x_j = f_i$ with i, j in N, where the x_i are the "Fourier" coefficients of u relative to the orthogonal system, as are the K_{ij} and f_i for K and f. Hilbert and Schmidt in 1904-1905 employed properties of symmetric matrices to prove special results for a kernel that is symmetric, that is, $K(s,t) = K(t,s)$ for all s,t in $[a,b]$. In particular, the homogeneous integral equation is solvable for at least on real λ, called an eigenvalue of K; all countably many eigenvalues of K are real, and to each there corresponds a finite number of orthogonal solutions (eigenfunctions); and (the expansion theorem) any function representable as $f(s) = \int K(s,t)\, g(t)\, dt$, for some g, can be expanded in an absolutely and uniformly con-

vergent series of orthogonal eigenfunctions w_i as $f(s) = \sum w_i(s) \int f w_i$. Biorthogonal systems and operators allowed Anna to extend these results to a wider class of kernels, including what are now known as symmetrizable ones.

Particular operators singled out for mention in [4] include $T(f) = f$, $T(f) = f - (p \int pf)/\int p^2$ (p in L^2), and $T(f) = \int K(s,t)\, f(t)\, dt$. The first of these corresponds precisely to the Hilbert-Schmidt theory for symmetric kernels. Anna uses the second in [1] to solve an integral equation with side condition; the operator transforms it to an equivalent equation with symmetric kernel. The third is used in [4], and in slightly greater generality in [2], to yield the results on symmetrizable kernels: If L is a kernel for which $M(s,t) = T_s\, L(s,t) = \int K(s,r)\, L(r,t)\, dr$ is symmetric, then L itself has all the desirable properties mentioned above for a symmetric kernel.

[6] is the keystone of her other papers. It generalizes the results of [4] to the context of infinite linear algebraic systems, and the methodology is the same: to use a biorthogonal system of functions to reduce a given system of equations to one with a symmetric matrix of coefficients. The main theorem was already announced in 1910: Let A be a limited matrix for which there is a positive definite limited symmetric matrix T such that AT is symmetric; then A has a nonempty set of eigenvalues, all of which are real. Here limited means that A applied to a vector of finite ℓ^2-norm (meaning that the sum of the squares of its components is finite) yields another such. (The reader may enjoy the exercise of proving the analogue for finite matrices.) This result finds application in [7] in connection with the Radon integral, in [8] concerning a particular pair of linear systems in two parameters, and in [9] to establish a direct correspondence between linear algebra equations and linear differential systems of the second order, as well as in her student M. C. Gray's thesis on singular differential equations.

Anna's remaining papers are more isolated: [5] is flawed by a false lemma, [10] investigates the spectrum of a special real matrix, and [11] patches up an algorithm of Van Vleck's for calculating the GCD of two polynomials. Each of the papers [1,8,9, 10] was followed by thesis work in the same area by her students L. Guggenbühl, M. Buchanan, M. C. Gray, and O. M. Hughes, respectively. A few other papers were presented by Anna but remained unpublished. Most to be regretted is that her Colloquium Lectures did not reach print. The lectures, on quadratic forms in infinitely many variables and their applications, summarized and surveyed the broader scene in which her own research had played a part for 20 years.

Responsibility and recognition

Anna was active in both the American Mathematical Society and the Mathematical Association of America. In the former organization she was appointed to the Board of Trustees (1923-24) and then was elected to the Council (1924-26). In 1926 the Association invited her to serve on a three-person committee to select the winner of the first Chauvenet prize for excellence in mathematical exposition. She was active in the Philadelphia Section of the Association, serving as its chairman (1943-44).

Her professional achievements did not go unnoticed. In 1921, the third edition of the American Men of Science starred her name, indicating that she was considered prominent among American mathematicians. She received honorary doctorates from the New Jersey College for Women (now Douglass College of Rutgers University) in 1932 and Mount Holyoke College in 1937. In 1940 she was one of the hundred American women acclaimed by the Women's Centennial Congress as having succeeded in careers not open to women a century before.

Her teaching continued to draw accolades. She gave generously of her time, her money, and herself to her students. Needy students would often receive copies of books she claimed she no longer used. (New copies would appear forthwith on her shelves). She would take graduate students with her to "Q.E.D.", where she provided them with needed encouragement and necessary research time. Students felt free to talk to her about problems of all kinds that troubled them. Typical of their reactions are the following

excerpts from letters:

> "I was deeply impressed by your interest in your students and even more by your feeling for mathematics." (scrapbook letter--Vera Ames Widder, 1948).

or

> "I hope I will be able to pass on to some of my students a bit of the feeling for mathematics which you have given yours." (scrapbook letter--Annita Tuller Levine, 1948).

Having personally experienced the intense frustrations of being a woman mathematician, Anna tried to prepare her students for the realities of life that would face them. Hence, she exposed them to many professional meetings at surrounding colleges and universities. As one student expressed it:

> "I like to recall the many meetings to which you took us and the advice and direction you gave us for entering into the meetings on an equal basis with the men instead of getting into a corner for a little hen party." (scrapbook letter--Vera Ames Widder, 1948).

Many of her students went on to successful careers as university professors and mathematical researchers.

As an administrator, Anna worked to enhance the national reputation of the Bryn Mawr mathematics department. Despite financial exigencies, she tried to create an atmosphere for students and faculty in which there was ample opportunity for professional growth and development as well as for free interchange of ideas. In the words of one of her colleagues:

> "I shall always look back in those years with deep gratitude that the opportunity was given me to share them with you. You never wavered. The shrine of mathematics didn't need any apologies. There was no compromising. There was work to be done and you kept the path free from pitfalls and blind alleys.
>
> You know,--when it comes right down to it,--you have not only been a mathematician and mathematics teacher,--you have been a sort of Institute for Advanced Study." (scrapbook letter--Gustav A. Hedlund, 1948).

During her tenure as chairperson Anna was instrumental in offering professional and political asylum at Bryn Mawr College to the eminent German-Jewish algebraist Amalie Emmy Noether. Realizing that a woman of the caliber of Noether would have little or no interest per se in teaching conventional undergraduate mathematics, Anna strove to get her an appointment in which she would be free to do research and consult with advanced graduate students. A group of students was then organized who were qualified to take part in such advanced algebraic seminars. Anna laid plans to use Noether in an exchange of graduate mathematics courses between Bryn Mawr and the University of Pennsylvania.

The two women, each famous in her own right, were not only professional colleagues but also became close friends. They shared a common love of mathematics as well as a mutual understanding of the problems faced by female mathematicians in Germany. Unfortunately, Noether's association with Bryn Mawr College was relatively short-lived. She died unexpectedly in 1935, following surgery, less than two years after her arrival in America. The Bryn Mawr community as a whole, and Anna in particular, was deeply shocked by her death.

Anna retired in 1948. Many of her students, colleagues, and friends contributed remembrance letters to a scrapbook presented to her at a testimonial dinner. In 1964 a mathematics graduate seminar room was set up at Bryn Mawr College and named after her. Retirement for Anna, however, did not mean complete withdrawal from mathematics. As long

as she was physically able, despite recurring severe bouts of arthritis, she attended mathematical meetings. She also travelled, spending most of her summers at "Q.E.D." Throughout her life she always enjoyed the out-of-doors. Bird-watching, hiking, fishing, wild flowers--all of these gave her great pleasure. She also kept in touch with many of her students, taking great pride in their achievements.

She suffered a stroke early in 1966 and died a few months later on March 26th, at the age of eight-two. According to her wishes, she is buried in the Lower Merion Baptist Church Cemetery at Bryn Mawr beside Alexander Pell. A memorial service was held at Bryn Mawr College in which she was eulogized by a colleague, John Oxtony, as well as by a former graduate student, Ruth Stauffer McKee.

The biography of Anna Johnson Pell Wheeler is of interest not only because she was a great mathematician, but also because it highlights many of the problems still faced by women mathematicians today. It continues to be very difficult for women to reconcile their own needs and desires for professional fulfillment with the roles that society tries to superimpose upon them. The difficulties Anna encountered, in getting well-paying positions, and in achieving lasting recognition, are still very real challenges today.

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DATA ON WOMEN IN SCIENTIFIC RESEARCH: Part 3

by Betty M. Vetter, Executive Director, Scientific Manpower Commission

EMPLOYMENT SETTINGS

Research in Academic Institutions

More than half (53%) of the U.S. basic research effort is performed in academic institutions, and this level has been relatively constant over the past six years.[1] In January 1976, 230,500 scientists and engineers were employed full-time at colleges and universities, up from 224,800 a year earlier. The 35,900 women in this group are 15.6% of the total. Available data show that 44,549 of these academically employed scientists and engineers (19%) are engaged principally in research and development but do not tell us whether that proportion is different for women than for men.[2]

Graduate students are a significant fraction of the scientific and engineering research work force in academic institutions, making up 44% of the total numbers in the academic research work force in January 1975.[3] (Tables 6 and 7) Their proportion of the total effort in time is, of course, much less because they are working only part-time in research. By field, proportionately more students than faculty were performing research in engineering, physical and environmental sciences, social sciences and psychology with proportionately fewer in the mathematical and life sciences. Unfortunately, these data are not available by sex.

In 1975, there were 52,600 women enrolled full-time in graduate science departments[4] in a total full-time graduate enrollment of 210,700 full-time science and engineering students, making women only about one-fourth of the total of all graduate students in science and engineering. Whether women, in the same proportion as men, have research assistantships or are otherwise primarily involved in research, we do not know, since the available statistics do not provide these data by sex. In 1976, 40,200 graduate students were employed part-time in research and development.[5] We do not have this number broken out by sex.

Among the 17,100 post-doctorates appointed in science departments in 1975 (up three percent over 1974),[6] the proportion of women also is not known. However, in fiscal year 1976, 26.5% of new male science doctorate awardees that year indicated plans for postdoctoral appointments as did 27.4% of women in these fields.[7] An equal proportion (about 20% of each sex) already had located such appointments by the time their Ph.D. was received. Thus, we might assume that the proportion of women in postdoctoral positions among all fairly new doctorates is not significantly

Table 6: Number of scientists and engineers primarily engaged in research and development in universities and colleges by field of specialization: January of selected years

Source: National Science Foundation, NSF 77-310

[In thousands]

Field of specialization	1965	1969	1971	1973	1974	1975	1976
All fields	40.0	47.1	48.3	46.6	47.4	50.0	51.0
Engineering	4.2	5.0	4.8	5.0	4.9	4.8	4.7
Physical and environmental sciences.....	5.9	7.0	7.3	7.9	8.3	8.1	8.6
Chemistry	2.3	2.9	2.6	2.8	3.0	2.8	2.9
Physics	2.1	2.4	2.4	2.5	2.5	2.4	2.4
Other	1.5	1.9	2.3	2.7	2.8	2.9	3.2
Mathematics	.9	1.7	1.4	1.3	1.5	1.5	1.6
Life sciences	25.0	28.3	30.4	28.0	28.0	30.6	30.8
Social sciences and psychology	4.0	5.2	4.2	4.4	4.7	5.0	5.3

Table 7: Number of graduate students engaged part time in research and development by field of specilization: January of selected years

Source: National Science Foundation, NSF 77-310

[In thousands]

Field of specialization	1965	1969	1971	1973	1974	1975	1976
All fields	27.2	35.8	37.2	34.6	36.9	39.7	40.2
Engineering	6.4	7.9	8.9	8.4	9.4	11.1	11.0
Physical and environmental sciences	8.1	10.6	10.5	8.8	9.2	9.0	9.2
Mathematics	.9	1.6	1.5	1.5	1.5	1.4	1.3
Life sciences	8.5	10.0	11.2	10.5	10.7	10.8	11.4
Social sciences and psychology	3.3	5.7	5.1	5.4	6.2	7.4	7.3

different from that of men. Since women earned 14% of science and engineering doctorates in 1974,[8] we might assume that about 14% of these postdoctoral appointees (about 2,400) were women, and that perhaps a third of them were engaged in research.

Expenditures for research and development are highly concentrated in a few universities. The leading 20 universities in separately funded R & D expenditures accounted for 36% of total R & D spending in 1977, and this shows little change since 1970.[9] The proportion of women among full-time employed scientists and engineers in the top 19 institutions in R & D expenditures is shown in Table 8. While the proportion of women among scientists and engineers in these schools ranges from 3.2% at Texas A&M to 26.3% at the University of Washington, the proportion of women among all full-time scientists and engineers reported by these combined institutions is a surprising 17.4%, a proportion higher than women's share of earned science and

Table 8: NUMBER AND PERCENT OF WOMEN SCIENTISTS AND ENGINEERS (AS OF JANUARY, 1976) IN NINETEEN UNIVERSITIES REPORTING LARGEST AMOUNT OF SEPARATELY FUNDED R & D EXPENDITURES

1975-76

Source: National Science Foundation, NSF 76-328 and NSF 77-314

UNIVERSITY	TOTAL	WOMEN	% WOMEN
1. U. Wisconsin - Madison	2,568	624	23.5
2. Mass. Inst. of Tech.	1,807	234	12.9
3. U.C. - San Diego	880	85	9.7
4. U. Michigan	3,041	732	24.1
5. U. Minnesota	2,801	456	16.3
6. Stanford	1,717	305	17.7
7. U. Washington	2,146	564	26.3
8. U.C. Berkeley	1,368	165	12.1
9. Columbia	1,289	250	19.4
10. Cornell	2,020	325	16.1
11. Harvard	3,090	429	13.9
12. U.C. - Los Angeles	1,518	195	12.8
13. U. Chicago	1,355	247	18.2
14. U. Pennsylvania	1,298*	208*	16.0
15. Johns Hopkins	1,929	288	14.9
16. U. Illinois - Urbana	2,041	423	20.7
17. U.C. - San Francisco	914	233	25.5
18. Texas A & M	1,757	57	3.2
19. U. Texas - Austin	1,603	307	19.2
TOTAL, 19 Institutions	35,232	6,127	17.4

*January 1975

engineering Ph.D.'s during the period from 1950-1976 (10%) shown in Table 9 by field; higher than the proportion of women among scientists and engineers in the leading 50 institutions in R & D expenditures; and higher than the proportion among scientists and engineers in all doctorate universities as of January 1976 (14.9%) as shown in Table 10.

The proportion of women among scientists and engineers employed at colleges and universities has increased in every field between 1974 and 1976 as shown in Tables 10 and 11. Table 10 gives this information for only the leading 20 doctorate-granting universities in employment of scientists and engineers, while Table 11 includes all two-year and four-year colleges and universities.

An interesting finding is that women make up a larger proportion of total science and engineering employment in the largest universities in employment of scientists and engineers than in all universities as a whole (Table 10), and that their proportion in doctorate granting universities is higher than in colleges and universities combined (Table 11). Further, when the leading 10, 20, and 50 institutions in employment of scientists and engineers are examined separately by type of institution (Table 12) we find a higher proportion of women at institutions employing the largest numbers of scientists and engineers than in all institutions of the same type at all public and all private institutions, and at doctorate granting institutions. On the other hand, at institutions granting a master's or a bachelor's degree as the highest degree, the proportion of women is less at the schools employing the most scientists and engineers. This is readily explained at the bachelor's level when we note that the U.S. Naval and Military academies rank first and second in employment of scientists and engineers, and include only 1% women in this employment.

Table 9: Number and Percent of Doctoral Degrees Granted to Women, By Field and Decade, 1920-1975

Source: Doctorate Records File, National Research Council

	1920-29		1930-39		1940-49		1950-59	
	No.	%	No.	%	No.	%	No.	%
PHYSICAL SCIENCES	247	7.6	442	6.6	406	5.0	685	3.7
Math	51	14.5	115	14.8	89	10.7	113	5.0
Physics & Astron.	39	5.9	51	3.8	62	4.2	98	2.0
Chemistry	141	7.3	254	6.4	223	4.2	443	4.4
Earth Sciences	16	4.8	22	3.5	32	5.7	31	1.9
ENGINEERING	2	.9	6	.7	7	.5	20	.3
LIFE SCIENCES	378	15.9	765	15.1	738	12.7	1318	9.1
Biological	341	19.5	698	17.8	699	15.7	1174	11.8
Agricultural	8	2.2	11	1.6	5	.6	36	1.1
Medical	29	10.9	56	12.4	34	6.9	108	8.1
SOCIAL SCIENCES	325	17.1	562	15.8	580	14.5	1510	11.0

	1960-69		1970-76		1920-76 TOTAL	
	No.	%	No.	%	No.	%
PHYSICAL SCIENCES	1,577	4.6	2,579	7.3	5,936	5.5
Math	364	5.7	726	8.8	1,458	7.7
Physics & Astron.	213	2.2	384	3.7	847	3.0
Chemistry	931	6.4	1,292	9.6	3,284	6.6
Earth Sciences	69	2.0	177	4.5	347	3.3
ENGINEERING	77	.4	234	1.1	346	0.6
LIFE SCIENCES	3,078	11.6	5,692	16.4	11,969	13.5
Biological	2,739	15.1	4,635	20.2	10,286	16.8
Agricultural	80	1.4	272	3.8	412	2.1
Medical	259	9.5	731	18.1	1,217	13.1
SOCIAL SCIENCES	3,604	14.3	8,710	21.6	15,291	17.3

At two-year institutions, the proportion of women among full-time employed scientists and engineers is significantly higher (20.4%) than at doctorate granting institutions (15%), but even here, the proportion is highest at the schools of this group that employ the most scientists and engineers.

This finding, that except for master's and bachelor's institutions, a higher proportion of women are in the science and engineering population in the schools of each category employing the largest numbers of scientists and engineers, might seem to indicate that women are making better progress in the leading institutions in research than in the less research-oriented institutions of each type. However, if this is true, it is equally true that the proportion of women among academically employed scientists and engineers is still highest at two-year institutions even though it is increasing at doctorate granting institutions faster than at those granting only a bachelor's or a master's degree.

Among academically employed scientists and engineers in 1975, 67.5% of men but only 63.8% of women scientists and engineers were employed at doctorate granting institutions; 11.7% of men and 10.3% of women at master's institutions; 9.9% of men and 10.6% of women at bachelor's granting institutions; and 10.8% of men and 15% of women at two-year institutions.[10]

Table 10: Proportion of Women Among Full-time Scientists and Engineers at Doctorate-granting Institutions by Field

Source: National Science Foundation - NSF 74-315, NSF 75-331, NSF 76-328

20 Leading Institutions

FIELD	JANUARY 1974			JANUARY 1975			JANUARY 1976		
	TOTAL	WOMEN	% WOMEN	TOTAL	WOMEN	% WOMEN	TOTAL	WOMEN	% WOMEN
TOTAL, ALL S/E FIELDS	36,653	5,916	16.1	41,187	7,158	17.4	40,933	7,316	17.9
ENGINEERING	3,543	65	1.8	4,825	177	3.7	4,830	210	4.3
PHYSICAL SCIENCES	3,037	144	4.7	3,622	215	5.9	3,564	255	7.2
ENVIRONMENTAL SCIENCES	897	45	5.0	1,160	80	6.9	1,236	87	7.0
MATHEMATICAL SCIENCES	1,715	115	6.7	2,017	186	9.2	2,069	210	10.1
LIFE SCIENCES	21,150	4,526	21.4	22,614	5,190	23.0	22,876	5,180	22.6
PSYCHOLOGY	1,344	266	19.8	1,534	388	25.3	1,488	418	28.1
SOCIAL SCIENCES	4,968	755	15.2	5,415	922	17.0	4,924	956	19.4

	50 LEADING INSTITUTIONS January 1976			ALL INSTITUTIONS January 1976		
	TOTAL	WOMEN	% WOMEN	TOTAL	WOMEN	% WOMEN
TOTAL, ALL S/E FIELDS	75,435	12,040	16.0	154,208	22,940	14.9
ENGINEERING	8,302	261	3.1	16,864	372	2.2
PHYSICAL SCIENCES	6,975	417	6.0	15,498	944	6.1
ENVIRONMENTAL SCIENCES	2,333	139	6.0	4,764	243	5.1
MATHEMATICAL SCIENCES	4,153	394	9.5	10,393	1,050	10.1
LIFE SCIENCES	10,829	8,338	20.4	77,948	15,018	19.3
PSYCHOLOGY	3,047	763	25.0	7,479	1,617	21.6
SOCIAL SCIENCES	9,796	1,728	17.6	21,262	3,696	17.4

Table 11: Full-Time Scientists and Engineers Employed in Universities and Colleges by Field of Employment and Sex: January 1974-76

Source: National Science Foundation, NSF 76-321

	1974			1975			1976		
	TOTAL	WOMEN	% WOMEN	TOTAL	WOMEN	% WOMEN	TOTAL	WOMEN	% WOMEN
TOTAL	218,843	32,442	14.8	224,784	34,133	15.2	230,539	35,929	15.6
ENGINEERS	22,764	339	1.5	22,579	369	1.6	22,799	447	2.0
PHYSICAL SCI.	33,412	2,266	6.8	33,479	2,321	6.9	34,442	2,500	7.3
Chemists	14,075	1,358	9.8	13,826	1,431	10.4	14,172	1,521	10.7
Earth	6,563	327	5.0	6,789	320	4.7	7,260	379	5.2
Physicists	10,870	395	3.6	10,941	387	3.5	10,867	402	3.7
Other	1,904	159	8.4	1,923	183	9.5	2,143	198	9.2
MATH. SCI.	22,157	2,822	12.7	22,392	2,925	13.1	23,081	3,093	13.4
LIFE SCI.	88,900	18,056	20.3	92,004	18,557	20.2	92,589	18,679	20.2
Agricultural	12,781	1,461	11.4	13,613	1,796	13.2	12,963	1,417	10.9
Biological	31,539	5,735	18.2	33,490	6,374	19.0	34,744	6,987	20.1
Medical	44,580	10,860	24.4	44,901	10,387	23.1	44,882	10,275	22.9
PSYCHOLOGISTS	14,957	3,188	21.3	15,995	3,588	22.4	16,758	3,977	23.7
SOCIAL SCI.	36,653	5,771	15.7	38,335	6,373	16.6	40,870	7,233	17.7

Table 12: Number and Proportion of Women Among Full Time Scientists and Engineers in the Leading Ten, Twenty, and Fifty Institutions in Employment of Scientists and Engineers, and in all Institutions by Type of Institution, January 1976.

Source: National Science Foundation, NSF 76-321

Institutions	Top 10			Top 20			Top 50			ALL INSTITUTIONS		
	Total	Women	% W	Total	Women	% W	Total	Women	% W	Total	Women	% W
Public	22,267	4,007	18.0	36,588	6,348	17.3	63,978	9,818	15.3	162,128	24,795	15.3
Private	17,930	3,062	17.1	26,715	4,556	17.1	37,395	5,898	15.8	68,411	11,134	16.3
Doctorate	24,079	4,530	18.8	40,993	7,316	17.8	75,435	12,040	16.0	154,208	22,940	14.9
Master's	3,432	438	12.8	5,664	739	13.0	10,621	1,460	13.7	26,376	3,702	14.0
Bachelor's	1,849	225	12.2	2,833	315	11.1	5,076	682	13.4	23,031	3,798	16.5
2-Year	2,668	641	24.0	4,070	968	23.8	7,145	1,677	23.5	26,424	5,395	20.4
All	40,197	7,069	17.6	63,303	10,904	17.2	101,373	15,716	15.5	230,539	35,929	15.6

This follows the pattern of faculty employment of women by type of institution, and would seem to indicate that women scientists and engineers, like all women employed in academic institutions, are less likely than men in the same field to be employed by universities and more likely than men to be employed in two- and four-year colleges. It may also indicate that a significant fraction of women employed in universities which perform the most research are not faculty members but may be employed on a non-permanent basis as research workers on soft-money projects of other faculty members.

Unfortunately, the questionnaires used for these surveys of science and engineering employment at academic institutions do not request any information by sex except an actual "head count" by field. We cannot separate by sex the degree levels of these employees, nor do we know by sex the proportion engaged principally in teaching, in research and development or in something else. We cannot separate by sex the faculty members from the laboratory assistants. We do not know how each institution defines "scientists and engineers". Is the woman typist with a bachelor's degree in biology included? Is the total staff in a science department (including secretaries and other staff personnel) counted as scientists in that field? Does the method of counting differ from one institution to the other? We do not know. However, we do know something about these scientists and engineers as a group.

While no information is available by sex, 71.1% of all full-time scientists and engineers employed at colleges and universities in 1976 held a doctorate, 24% had a master's degree and 7.4% a bachelor's degree only. [11] The proportions among women may be different.

No current data are available on faculty by field and sex, nor is the principal activity of scientists and engineers in university employment available by sex. Among all full-time employed scientists and engineers at academic institutions in 1976, 19% are principally in R&D and 75% in teaching. Among those employed part time, 11% are working principally in R&D and 87% are teaching. Data about faculty by field and sex would indicate whether women in science and engineering have different proportional representation on college and university faculties (relative to their share of earned doctorates) than have women in other fields. It also might show whether the proportions of women scientists and engineers in faculty positions in larger, research-oriented universities are different than in smaller or less research-oriented universities or colleges. We do not know how many women scientists and engineers are principally performing research in academic settings. Information from other studies indicates that the proportion of both sexes engaged principally in research is similar, since the proportion of women scientists and engineers listing basic or applied research as their primary activity was similar to the proportion

among all doctorates in 1975 (Table 4) and among all scientists and engineers at all degree levels in 1974 (Table 2). However, no data are available to show the nature of their appointments, status, or responsibility relative to men.

Although no current data are available to provide us with cross tabulations by sex among academically employed scientists and engineers for academic rank, salary, principal activity, field or other demographic characteristics that would allow comparison of men and women, we have some information of this type for Fall 1972. Among 36,000 full-time employees at academic institutions who were engaged in organized research in the fall of 1972, 11,000 (30%) were faculty, 1,900 (5%) were teaching or research assistants and 20,000 (56%) were "other professionals". Among the faculty group, only 13% were women, but 25% of the research and teaching assistants were women and 26% of the "other professionals" were women.[12] The "other professionals" group is not defined.

NOTES

1. NSF "Academic R & D Expenditures Up 9 Percent in FY 1976," NSF 77-314, p. 2
2. NSF, Manpower Resources for Scientific Activities at Universities and Colleges, January 1976, NSF77-308, pp.9-14 and Detailed Statistical Tables, NSF76-321
3. NSF, National Patterns of R & D Resources, Funds and Manpower in the United States, 1953 to 1977, NSF77-310, p. 15
4. NSF "Self Supported Graduate Science Students Increased by 22 Percent in 1975," NSF76-320, September 1976, p. 4
5. NSF, Manpower Resources for Scientific Activities at Universities and Colleges, January 1975, Detailed Statistical Tables, Appendix B, NSF75-329, p. 30
6. NSF "Self Supported Graduate Science Students Increased by 22 Percent in 1975," NSF 76-320, September 1976, p. 4
7. National Research Council, Summary Report, 1976 Doctorate Recipients from United States Universities, 1977, pp. 18 - 21.
8. National Research Council, Summary Report, 1974 Doctorate Recipients from United States Universities, 1975, pp. 18 - 19.
9. NSF "Academic R & D Expenditures Up 9 Percent in FY 1976," NSF 77-314, p. 3
10. NSF, Manpower Resources for Scientific Activities at Universities and Colleges, January 1975, Detailed Statistical Tables, Appendix B, NSF 75-329, p. 15
11. ibid., p. 10
12. National Center for Education Statistics, Digest of Education Statistics, 1976, NCES 77-401, p. 98

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NEWS FROM AWM COUNCILMEMBERS

by Lucy S. Rakov Area: High School Mathematics Teachers

One of the highlights of my school year has been the experiences I've had as a result of speaking about women in mathematics--past, present, and future. In November, as a member of a panel at the ATMNE (Association for Teachers of Mathematics in New England) meeting in Portland, Maine, I received many inquiries about AWM and many positive responses to a variety of the materials presented. In March, I soloed at the ATOMIC (Association of Teachers of Mathematics in Connecticut) convention in New Haven. This led to a day of presentations at Norwich Free Academy, Norwich, Connecticut, for students and later for teachers and guidance counselors. In May I spoke at Framingham South High School, Framingham, Mass., to students and teachers and at Newton, Mass., to colleagues of mine from all disciplines. Responses have been gratifying! I'm excited about telling people about our "roots", our experiences past and present of "integration and differentiation", and the fact that I see no "limits" for women in mathematics!

by Ruth Rebekka Struik

An AWM panel was held at the April 28, 1978 meeting of the Rocky Mountain Section of the Mathematical Association of America in Rapid City, South Dakota. The topic was how to encourage women students to take more mathematics courses. The panelists were Beverly Gimmestad (Metro State College, Denver), Jack Hodges (CU, Boulder), and Ann Pape (Abraham Lincoln High School, Denver). I was moderator. There were about ten people in the audience out of a total registration of about 70. Unfortunately, several interesting mathematical talks conflicted with the AWM panel.

We also had an AWM table.

Laurel Rogers, an AWM member, was elected President-elect of the Rocky Mountain Section. Jack Hodges, who is also an AWM member, is the next President of the Section.

Regarding future AWM activity in Colorado, I feel we ought not have an AWM meeting at the next Rocky Mountain Section meeting in May, 1979. A table can be arranged. Urging women to speak as part of the regular program and getting women elected or appointed to positions within the Section seems a better use of time and energy.

by Judith Jacobs, Chairperson, Steering Committee APMEG&W

A new organization, the Association for the Promotion of the Mathematics Education of Girls and Women (APMEG&W), was formed during the National Council of Teachers of Mathematics annual meeting in April, 1978. Its major goal is to take positive action aimed at reversing the trend of avoidance of mathematics among girls and women in elementary and secondary schools. Membership dues are $2.00; contributions are welcome. Make checks payable to APMEG&W and send to: APMEG&W, c/o Education Department, George Mason University, 4400 University Drive, Fairfax VA 22030.

AMERICAN MEN AND WOMEN OF SCIENCE

The definitive collection of scientific biographical information, AMERICAN MEN AND WOMEN OF SCIENCE, is now in its 14th revision. The Physical and Biological Sciences Section of the new edition will be published in the fall of 1979 with an estimated 130,000 entries.

Scientists in the physical, biological and mathematical sciences who have been profiled in previous editions of AMWS will receive forms on which to review and revise their entries during the fall and winter of 1978. Those who have moved since preparation of the last edition in 1976 should send address changes to the editors immediately.

Nomination of eligible scientists not now included in the directory is invited. There is no charge or obligation to buy involved with listing. Selection is based on attainment of the following criteria:

1. Achievement, by reason of experience and training, of a stature in scientific work equivalent to that associated with the doctoral degree, coupled with presently continued activity in such work;

   or

2. Research activity of high quality in science as evidenced by publication in reputable scientific journals; or, for those whose work cannot be published because of governmental or industrial security, research activity of high quality in science as evidenced by the judgment of the individual's peers;

   or

3. Attainment of a position of substantial responsibility requiring scientific training and experience to the extent described for (1) and (2).

Send nominations and address changes to The Editors, American Men and Women of Science, P. O. Box 25001, Tempe, Arizona 85282.

"VERY FEW WOMEN APPLY HERE"

by Judith Q. Longyear, Wayne State University, Detroit, MI 48202

One of the standard excuses for the small number of women on a math faculty is "very few women apply here". This is a difficult claim to dispute from the outside, since most departments regard their files as too private for a roving reporter's eyes. Thus, my discussion is based on 3 years of actual experience with my own institutions' files and a summer spent discussing the files of their institutions with men and women whom I regard as reasonably objective. There were eight schools involved, all listed as "strong" or better in the MAA listings, and all but one were urban.

In every case, the percentage of women applying is about 3% - not 6% or 10%, as would seem reasonable from the percentages of female graduates. These are not just the ones whose files are seriously considered, but the whole initial group of applicants. Perhaps we must ask ourselves why the percentage is so low, rather than just dismiss this claim as so much waffle.

The people with whom I spoke were all concerned about the paucity of female applicants, and had many contradictory explanations.

1) Women are afraid to apply at major universities.
2) Women will only work where their husbands have jobs.
3) Women are afraid of cities.
4) Women don't want to be stuck in the country.
5) Women won't move away from home.
6) Women won't work near home.
7) Women get pregnant and aren't interested any more.

All of these sound ridiculous to some people and some sound ridiculous to all people, but nobody has given me a convincing explanation for what certainly seems to be a low percentage of applicants.

Could we please have an open forum on this question? We can't holler very effectively about the small percentage of women currently being hired (at all levels) unless we can either refute the claim that "very few women apply here" or change the basis for it.

OF POSSIBLE INTEREST

TABS: Aids for Ending Sexism in School is a quarterly journal concentrating exclusively on practical classroom aids for challenging sexism in school. Produced by a group of feminist teachers, writers, and editors, TABS serves educators in all fields, K-12. It regularly features classroom posters and mini-posters, lesson plans and awareness exercises, textbook reviews, cartoons, resource reviews, news items, and readers' ideas. Feature articles on projects and people focus on ideas that readers can adapt for use in their own schools. One-year subscriptions (4 issues) are $8.50 by personal check and $17.00 by institutional check (outside U.S., add $2.00). Order from TABS, 744 Carroll St., #1J, Brooklyn, NY 11215.

Susanne Culler, Math Faculty at Santa Barbara City College, and Lois Phillips, Tri-Counties Program Director of Antioch University/West, have developed a curriculum using an affective or "confluent" approach to math anxiety. Using the "Education of the Self" model (Gerald Weinstein, Mandala Press, Amherst, Mass.), they have organized a four-session workshop which can easily be expanded into a full-semester college or continuing education course. The curriculum uses a behavioral desensitizing approach to eliminate mental blocks and release anxiety in situations which involve computational skills, logical problem solving, geometric relationships/measures, and abstract patterns and systems. Remediation in these areas through games, puzzles, and "hands-on" projects is the mathematical content. Role play, guided fantasy, relaxation, and personal sharing are the psychological component. For more information, write: Susanne Culler, Santa Barbara City College, 721 Cliff Drive, Santa Barbara, CA 93109.

AWM's Secretary's Hours

Due to the pressing amount of work, Margaret Munroe is in her office at least five hours of every day, Monday through Thursday. She is also there some Fridays; consequently, if you fail to reach her on a Friday, please call again on Monday.

JOB ADS

Institutional members of AWM receive two free ads per year. All other ads are $5.00 apiece and must be prepaid. The vacancies listed below appear in alphabetical order by state. All institutions advertising below are Affirmative Action/Equal Opportunity employers.

University of Connecticut. Dept. of Math offers Special year in Logic, 1979-80. Need candidates with research records in Recursion Theory or Model Theory. Also opening for senior position in Math Dept. Candidates should have outstanding research & demonstrated leadership in their field. Send curriculum vitae & references to Professor Joseph Landin, Head, Dept. of Mathematics, Univ. of Conn., Storrs, Ct. 06268.

Mass. Inst. of Technology, Dept. of Math, Cambridge, MA 02139.
(1) 1 - 3 Asst. Professorships. Qualifications: superior ability as a research mathematician, demonstrated effectiveness as a teacher & at least 2 years of postdoctoral experience.
(2) C.L. E. Moore Instructorships in Mathematics are open to postdoctoral mathematicians. Appts. are for 1 year, renewable for 1 add'l year. Salary $16,500. Applications due by 12/30/78. Send reference forms direct to M.I.T. c/o Pure Math. Committee, Rm 2-263.
(3) Statistics: 1 or 2 vacancies for Instructor or Asst. Professor are expected in Fall, 1979. PhD in Statistics preferred. Write to H. Chernoff, M.I.T., for application forms.
(4) Limited no. of postdoctoral instructorships are available in field of Applied Mathematics. Two year appts. are based on superior research potential. Final decisions will be announced by 3/15/79. Write to Committee on Applied Mathematics, Room 2-345.

SUNY at Buffalo. Opening for Chairman of Mathematics. Leadership of about 40 faculty. SUNY/Buffalo has 25,000 students including 80 math graduate students. Send vitae & names of 2 or 3 referees to Professor H. Segal, 109 Cook Hall, SUNY/Buffalo, Amherst, N.Y. 14260 by January 10, 1979. Also Dept. of Statistics: 3 openings for Asst. Professor in Sept., 1979. We have strong interest in recent PhD's with specializations in inference, sampling, time series and applied probability. Send curriculum vitae & 3 letters of recommendation to Willard H. Clatworthy, Dept. of Statistics, SUNY/Buffalo, 4230 Ridge Lea Rd., Amherst, N.Y. 14226.

Northern State College, Aberdeen, S.D. Opening for Asst. Professor of Mathematics. PhD in Math required. Send resume & 3 letters of recommendation by Nov. 1, 1978 to Dr. Russell O. Brock, Dean, Division of Arts & Sciences, Northern State College, Aberdeen, S.D. 57401.

Ohio State University. Openings at all professional ranks. Applicants for junior positions should have significant research accomplishments. Also need mathematicians working in Numerical Analysis, Partial Differential Equations & Applied Mathematics. Please send applications & resumes to Prof. Joan R. Leitzel, Dept. of Math, 231 W. 18th Ave., Columbus, Ohio 43210.

Oregon State Univ. Dept. of Computer Science. Assoc. Professor, tenure track. Phd in Computer Science required. Send personal vitae by 11/15/78 to Curtis R. Cook, Dept. of Computer Science, Oregon State Univ., Corvallis, Oregon 97331.

Oregon State Univ. Dept. of Computer Science. Occasional Instructorship positions are open during 78/79. These are temporary, part-time as need arises. Please contact Robert A. Short, Chmn., Dept. of Computer Science, Oregon State Univ., Corvallis, Oregon 97331.

ASSOCIATION FOR WOMEN IN MATHEMATICS
MEMBERSHIP APPLICATION

Name and
Address_____

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Institutional affiliation, if any_____

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The AWM membership year is October 1 to October 1.

New_____ Renewal_____

Individual $10.00_____

Family $12.50 _____

Retired, Student, Unemployed $5.00_____

Institutional $25.00 (Two free advertisements in the Newsletter) _____

Contributing Member $20.00+ _____

Make checks
payable to: ASSOCIATION FOR WOMEN IN MATHEMATICS

and mail to: Association for Women in Mathematics
c/o Department of Mathematics
Wellesley College, Wellesley MA 02181

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~~Election Special~~ 1978