

**Round Table D: July 23, 1996**

## **WOMEN AND MATHEMATICS**

**edited by Kari Hag**

*Norwegian University of Science and Technology, Trondheim (Norway)*

The purpose of this Round Table was to address the underrepresentation of women in mathematics. We wanted in particular to focus on how differences in culture and tradition affect this situation since the proportion of women in mathematics varies considerably from country to country.

Some of the issues proposed for the Round Table were:

- Importance of a friendly, supportive atmosphere, mentoring.
- Attitudes towards equal opportunities and affirmative action.
- Different structures in academia - early permanent jobs versus late tenure.
- Rigid versus flexible paths for career development.
- Different conceptions about the role of women in society and mathematics.
- The status of positions versus the number of women holding them.
- Network for women in mathematics.

Close to 100 people took part in the Round Table. The presentations and general discussion were lively and a number of issues and suggestions were put forward. These will be followed up by the EMS-Committee on Women and Mathematics. To supplement the Round Table on interesting developments in Sweden and the US two new articles have subsequently been added.

# 1 Program of the Round Table

## 1.1 Opening

Kari Hag opened the Round Table by presenting the EMS-Committee on Women and Mathematics which had undertaken to arrange the Round Table:

Eva Bayer, France, (past Chair)  
Christine Bessenrodt, Germany (Chair),  
Kari Hag, Norway,  
Ina Kersten, Germany  
Stewart Robertson, United Kingdom,  
Laura Tedeschini Lalli, Italy,  
Vera Trnkova, Czechoslovakia.

She had taken on the responsibility of chairing the Round Table. In the preparation of the program she received assistance from members of the Committee but worked most closely with **Bodil Branner**, Denmark and **Marjatta Näätänen**, Finland.

Kari Hag referred to the important and comprehensive report by Eva Bayer of the previous Round Table on Women and Mathematics. (*First European Congress of Mathematics, III, Round Tables*, Birkhäuser Verlag 1994, 37-74.)

This document underlines the importance of collecting data on women in mathematics at regular intervals and Kari Hag reported that the Committee had made new inquiries about statistics to the mathematical societies in Europe. She also presented the main points from the following report by **Christine Bessenrodt**.

### **Women Mathematicians in Switzerland**

In the spring 1994, the EMS-Committee on Women and Mathematics sent out letters to all Swiss universities and polytechnic schools asking their opinion on the low number of women mathematicians in Switzerland and about programs to improve the situation. Answers were received from all institutions except the University of Neuchatel.

With one exception, all shared our concerns about the underrepresentation of women among the mathematicians in Switzerland and expressed the desire to improve the situation. But only a few institutions actually described programs for achieving this.

The University of Geneva at least has a law saying that persons of the under-represented sex are to be given preference if they have equivalent scientific and teaching qualifications. The Swiss Federal Institute of Technology (EPF) at Lausanne has established a special program to advance equality between the sexes. For women scientists, this program includes:

- financial help for graduate students with children;
- the creation of doctoral fellowships reserved for women;
- the creation of a few assistant professor positions reserved for women;
- making it easier for women to obtain part-time employment, even as scientists on jobs with large responsibilities.

These propositions seem very promising, and it is to be hoped that they will serve as a model for other institutions.

In some replies, the low number of women students was given as an explanation – but this seemed to be specific to only few institutions. In some others, 30% women in mathematics were reported from the student up to the Ph.D. level. Also, the low number of applications for positions from women was mentioned; it was deplored in addition that there were very few Swiss candidates. The reason for this may be a structural one: young Swiss mathematicians may feel that successful applications come either from very local candidates, or from internationally renowned scientists from abroad, and hence they may be discouraged from applying. It is well-known that women are especially apt to react in this way.

As all suggested explanations seemed to be based on rather incomplete or local data, we planned a more detailed follow-up study on the statistics of women Ph.D.'s in mathematics in Switzerland. As a first step, we obtained rather extensive data concerning the University of Geneva. We then wrote again to the same Swiss institutions reporting the results of the first inquiry and asking explicitly for the number of Ph.D.'s in mathematics obtained at these institutions between 1975 and 1990, and in particular the number of women among them; the statistics for the University of Geneva was enclosed as an example.

In reply to this, only four institutions sent us further information for the Ph.D. statistics, including also some information on women holding faculty positions.

During the period 1975-1990, 33 mathematicians obtained their Ph.D. at the University of Bern. There was only one woman among them and there is currently only one female Ph.D. candidate. On the positive side, Bern has one woman professor in Mathematics among the 5 full professors.

The complete information collected for the University of Geneva describes a very different situation: there 8 out of 39 Ph.D.'s in the period 1975-1990 were women.

We got rather complete statistics from the EPF Lausanne for this period: 3 out of 63 Ph.D.'s in Mathematics were women. Moreover females constitute 33 % of the students in mathematics and about 25 % of 90 assistants are female. However, there are no women among the 18 professors.

The figures coming from the ETH Zürich seemed to indicate some improvement in recent years: during the period 1975-1990 14 women among 179 candidates obtained their Ph.D. while the corresponding figure for 1991-1994 was 6 out of 46. Unfortunately, there were only 4 women among the 78 assistants (but 8 among the 59 "Hilfsassistenten"). Among the 32 professors there was one woman assistant professor (for 2 years).

There also seems to be some change in recent years at the University of Zürich-Irchel: 6 women among the 75 Ph.D.'s were reported for 1975-1990 and 4 out of 22 for 1991-1994. Here, this figure corresponds to the number of 4 women among the 24 assistants. However there are no women in higher ranks.

Summarizing the incomplete information that we have received, we see that the picture all over Switzerland is not completely homogeneous with respect to the percentage of women Ph.D.'s (except that it is everywhere still much lower than the percentage of female students in mathematics). Some positive examples and improvements in recent years indicate clearly that there is great potential for the departments which should be supported and encouraged by further actions. The situation, however, is nearly the same everywhere when one looks for women mathematicians holding tenured positions in a department – at best there is a single woman professor. We hope very much that in the near future the number of women faculty members will increase at Swiss universities and polytechnic schools.

## 1.2 Video *Women and Mathematics across Cultures, EWM — European Women in Mathematics*

The video was made by **Marjatta Näätänen**, University of Helsinki, Finland. It consists of a short presentation of the organization European Women in Mathematics, EWM, followed by four interviews. (Information on EWM is given in the Appendix of this report.) The videotaping was done at the Madrid meeting of EWM September 1995 where Marjatta Näätänen interviewed the following women mathematicians, all of whom have studied and worked in several countries:

Marjorie Batchelor, United Kingdom,  
 Laura Fainsilber, France,  
 Isabel Labouriau, Portugal,  
 Mara Neusel, Germany.

The list of issues for the Round Table given in the preliminary remarks is an extract of points put forward by these four women. We expand the points with the understanding that the video, as a collection of personal interviews, should be **seen** and not just summarized.

- **Importance of a friendly, supportive atmosphere, mentoring.** The isolation is tremendous, for example, in the mathematics departments in Germany and Switzerland. There are places where women students simply feel ignored. Attention and contact with professors mean a lot to women students trying to build a career in a masculine field.
- **Attitudes towards equal opportunities and affirmative action.** This was said to be quite different in England from what it is in the US. In England, there seems to be an absence of concern that equal opportunities and affirmative action are implemented while in the US they are “frightened by” the law. Therefore they look for women and interview women for jobs.
- **Different structures in academia - early permanent jobs versus late tenure.** In many countries junior mathematicians go from postdoc to postdoc at a time which is particularly crucial to women. In France the situation is different. And there you have many impressive women mathematicians although some of them may have had years when they have not been able to do much research.

- **Rigid versus flexible paths for career development.** How should one compare the CV of a man working full time on mathematics to the CV of a woman raising children and working half time on mathematics? According to one woman's experience this question is never raised in England.
- **Different conceptions about the role of women in society and mathematics.** The difference between England and Latin countries was said to be striking. In a Latin country being a woman and a mathematician is not an issue. Maybe more women are having a career there than in England. To look into this question should be an interesting topic for a social historian.
- **The status of positions versus the number of women holding them.** The following empirical "law" seems to hold in many protestant countries: the status of a position times number of women holding such a position is constant. (The status of a professor is particularly high in Germany.)
- **Networks for women in mathematics.** One needs a strong women's network to combat the old boys' club in countries like Germany. EWM is very valuable. It is important for women from northern Europe to come and see women working together on mathematics.

### 1.3 Short presentations

**Ragni Piene** of the University of Oslo, Norway, was the moderator for the panel which had three invited speakers in addition to Kari Hag.

**Dusa McDuff**, State University of New York at Stony Brook, USA,  
**Roswitha März**, Humboldt-University, Berlin, Germany,  
**Sylvie Paycha**, University of Clermont-Ferrand, France.

#### Report by Dusa McDuff.

The question of how to be both a mathematician and a woman has certainly been (and still is) a live issue in my life. However, I don't think that that is peculiar to me but that it reflects social conditions in both Britain and the United States (and no doubt in other countries too). Since I think that

self-doubts can have a huge negative impact on creativity, I think that this is one of the most important issues for women to talk about. Therefore, my remarks will be largely personal.

In some ways, I grew up with all the advantages: my family was academic, my mother was a trained architect with a fulltime job, and I was always expected to get an education and have a career. However my family was definitely different from those of my schoolfriends in Edinburgh, and I grew up in relative isolation, always thinking of myself as exceptional, not part of any group or community or used to working together with other people.

I was an undergraduate in Edinburgh and a graduate student in Cambridge, where I solved a well known problem in the theory of von Neumann algebras. I then followed my husband to Moscow, he being a specialist in Russian literature. There I met Gelfand who was a great influence for many years. He encouraged me to become a topologist. However, on returning to Cambridge in 1970 after 6 months in Moscow, I was again very isolated and took several years to find my way back into mathematical research. My first child was born during this time, but this was not what was holding me back: the time after childbirth can be very productive (as I found after my second child was born in 1984). The real trouble was that at that point I approached mathematics in far too passive a way, as something beautiful but distant, and that I was not talking to anyone. Looking back, I think that my isolation was quite largely self-imposed but that it may well have been necessary for my survival as a mathematician, since it made it possible for me to distance myself from the restrictive cultural messages about women that existed all around me. Eventually I started working with Graeme Segal, with whom I essentially did a second Ph.D.

Quite out of the blue, I was invited to MIT for the year 1974–5, to take up a visiting position especially reserved for women. This was a wonderful opportunity which made a big change in my life. I began to have a few mathematical ideas of my own again, and became aware that one has to build one's own career (e.g. by applying for fellowships) and that this was my chance to do so. Meeting Ragni Piene there (the first woman mathematician with whom I felt I had anything in common) was also important.

After that, I probably would have been able to survive mathematically whatever happened. However, after moving to the States in 1978, I appreciated the positive encouragement that I felt the math community extended to me. The foreignness of the culture also meant that I was not so aware of general expectations about what I should be (with my accent I could never fit in

unnoticed, anyway), although it took me a long time to develop any sense of connection with the community I live in.

Recently I went back to Cambridge and was dismayed to find that things there had hardly changed since my time. I took the initiative to encourage British Women in Mathematics to hold yearly meetings, but have not had time to do much more than attend those meetings. I think it very important to make women visible and to form networks to support women in order to counteract the isolation that women can still suffer.

### Report by Roswitha März.

First of all, I do not think that there is a special problem for women in *mathematics*. I am sure that we are still far from having equal opportunities for women and men *in science and in scientific institutions in general*.

As far as I know, a similar situation can be observed in all European countries. The presence of women decreases exponentially the higher the position, the higher the income, the greater the power and opportunities of influence. Mary Osborn, (1994, *SCIENCE* 263, 1389-1391) has studied the share of women among full professors in Europe and the United States. Germany, with only 2.5%, is considerably behind the United States with about 14% or Turkey with about 20%. Only the Netherlands comes off worse than Germany.

Let me quote an interesting observation of Mary Osborn: "Surprisingly, the percentage of women at all levels seems smaller in the more economically developed northern European countries, with the exception of France, than in the southern European countries. In addition, in northern European countries such as England, Germany, and the Netherlands, the numbers have remained static for a decade or more, whereas in the United States the percentage of full professors who are female has increased by 60% in the last 10 years."

Next, I would like to present some further interesting numbers. At the Technical University Dresden, about 300 full professorships were available in the last few years. These positions were advertised. After looking through and evaluating the applications, the University made up lists of candidates with places 1 to 3. These lists were handed over to the state secretary, who decided on each appointment. Here are the related figures (1994, *KONSENS* 5, 4-5). Among all applicants, there were 6.3% women. Among the applicants who were nominated for the list (places 1 to 3), 3.8% were women. Among those who were finally appointed, only 1.3% were women. While 76% of the men heading the lists were appointed, only 33% of the women heading the

lists were appointed. 10 men were appointed although they had only “back” places (2-3). However, this privilege was conceded to one woman only.

Does this indicate discrimination against female scientists? Obviously, it does! Those structural discriminations are realized not only via the given academic structure, but also by politics.

My second point concerns the issue of “early permanent jobs versus late tenure”. I have had personal experience with two extreme cases. Formerly in the GDR, we had early permanent jobs almost exclusively. Today, we have hardly any permanent jobs, except for the professorships. Both versions seem to be bad.

Surely, too many early permanent jobs entail negative consequences. That is inflexible, no longer creative but convenient people could “block up” the universities. On the other hand, the consequences of always having short-time jobs are also bad. Everybody **has to be** successful, necessarily, to get the next job in time. One is oriented in getting ahead in life rather than in considering serious, complicated problems from which nobody knows what will develop. This is bad for science! Moreover, teaching seems to be less important. This is, in particular, bad for women in science because their careerism is less distinctive.

In my opinion, a compromise would be the best solution. A greater number of permanent jobs should be available for scientists. In particular, all women and men who have completed the habilitation should get, if they wish, an appointment at their university.

My final point concerns the issue “networks”. Yes, I think that women should unite in networks - either official or unofficial ones. Women should act together, keep each other well-informed and help each other to gain more self-confidence.

Timely information about vacancies, possible applicants and advice for evaluations as well as hints to possible grants - I consider it to be very important that women should encourage each other to become better known and more visible in the scientific community. Women should invite each other to give papers at colloquia, to chair sessions, to make known their results. In this sense, women should deliberately search for women and help them to get good chances.

A first success: In 1995, a nice Oberwolfach conference was held on differential-algebraic equations, where 24 of the 43 participants were female. Also the program of lectures was slightly dominated by female mathematicians.

Women's networks should reveal discrimination against women, discuss it and make society more sensitive to it.

### Report by Sylvie Paycha.

I represent here both EWM, as its present convenor, and the French organization “femmes et mathématiques”, as former chairwoman. The latter was founded in 1987, and now includes 100 members or so.

Before I tell you how this French organization was founded, let me try to describe some specific features of the French tuition system and comment on the situation of women mathematicians in France.

In France permanent positions start when you are relatively young, approx. 30 years old for maître de conference positions. This is an advantage for women when compared to other systems in Europe in which permanent positions start later on the whole. This is one of the reasons which contribute to the fact that the proportion of women mathematicians among mathematicians in French universities, although still very low (and it is getting lower still as we shall see later on) is higher than in northern European countries.

However it is not the only reason and one should take into account the specific organization of the French higher educational system. There are two parallel systems in France: Universities on the one hand and “grandes écoles” on the other hand, with very competitive entrance exams. Earlier the entrance exams for men and women were separate and most women mathematicians trained in France at that time came from a “grande école”. The fusion of the competitive exams for men and women that took place about ten years ago was followed by a rapid decrease in the number of women starting a career as a mathematician. A group of women mathematicians, concerned about this and about the fact that women are a (small!) minority among mathematicians, founded the French organization “femmes et mathématiques”.

Let me now say a few words about my own path as a French woman mathematician. It starts rather atypically since I do not come from any of these “grandes écoles”. I graduated at a university in Paris, after which I went to Germany to prepare a Ph.D. in mathematical physics, working there as an assistant for four years. This turned out to be an interesting experience for me as a young woman mathematician. There were very few women in the mathematics department where I was working which could have made me feel quite uncomfortable, especially as I was only an assistant, at the very bottom of the German university hierarchy! However I just made my way along, and not being German, I was quite unaware that I was probably transgressing some (if not most !) of the implicit rules, such as the ones which underlie the

hierarchical structure of a German university department. This "unawareness" gave me a freedom as a young woman mathematician to try out new things such as organizing an interdisciplinary seminar and inviting full professors to join in, something that I would probably not have dared try out, had I known the hidden rules!

After this, coming back to France was not an easy job since I did not belong to any of the French schools or research groups. It was very near the border between France and Germany, in Strasbourg, that I eventually got a position and spent 6 years as a maître de conférence. After that I was appointed as professor (a year ago)... right in the center of France!

I was quite lucky to get a professorship at a time when the proportion of women among mathematicians in France is decreasing with the decrease of the number of positions on the whole and more strikingly so for professorships.

Let us first glance at the "maître de conference" positions. All the figures given here are available in the "Rapport Basdevant (DSPT1), 1995". In 1991, 23 out of a total of 113 "maître de conference" appointed in France that year in France were women (20.5%). In 1992, 28 out of 119 were women (23%), 10 in pure mathematics and 18 in applied mathematics. In 1993, 39 out of 145 were women (26.8%), 16 in pure and 23 in applied mathematics. In 1994, 25 out of 147 were women (17%), 7 in pure and 18 in applied mathematics. As you go up in the hierarchy, the figures become drastically low and tend to zero. Let us look at the number of women mathematicians recently appointed as "professors". In 1991, 14 out of a total of 78 professors appointed that year in France were women (18%). In 1992, 8 out of 82 were women (9.7%), 2 in pure and 6 in applied mathematics. In 1993, 13 out of 88 were women (14.5%), 4 in pure and 9 in applied mathematics. In 1994, 4 out of 51 were women (7%), 4 in applied and none in pure mathematics.

When the jobs get rare, women are the first ones to feel the consequences!

### **Report by Kari Hag.**

In Norway more than 40% of the members in parliament and government are women and we have had a woman Prime Minister for many years. She enjoys telling how small boys now ask her, "Can a man become a Prime Minister in Norway?"

But in academia we still have some way to go. According to recent figures, there are 10% women among the full professors, 20% among the tenured fac-

ulty and 40% among those who hold fellowships or scholarships. For mathematics the figures are lower as you can see from our statistics.

On the positive side the number of Ph.D's has grown in recent years both in total and in the number of women. For example, 59 including 13 women have finished a Ph.D. in mathematics during the last 4 years. However, very few women find employment at the universities. Only 1 woman has a post doctoral fellowship and she has gone to Italy and would like to stay there. More than half the female Ph.D.'s are in applied mathematics and statistics. Very few go into pure mathematics. In Norway, the youngest woman with a position in pure mathematics is about 50.

In Italy the situation is quite different! They have few women in politics and many women in mathematics. The percentage of women who earn the first university degree in mathematics is 70. For most other subjects the difference between Norway and Italy is not large. In physics the percentage is slightly higher in Italy (30 compared to 23) but in chemistry it is approximately 50 in both countries. In the biological sciences, medicine and law the percentages are the same as well (respectively 65, 50 and 55). Does this mean that there are fewer women in engineering in Italy than in Norway? The statistics say that 23% of these students are women in both countries. (Looking more closely at the numbers one finds that engineering includes architecture, an area very popular among female students, and architecture constitute almost a third of the engineering student body in Italy.)

Why then so many women in mathematics in Italy? Let me paraphrase from e-mail discussions with Laura Tedeschini Lalli of Italy:

*About women's choices in Italy...Of course, here we only have guesses, based on personal conversations with many friends and students and so on... Keep in mind that in Italy you apply to the same school of mathematics and get the same first two years training, whether you want to go into research, industry, or teaching at any level.*

*In those first two years, students have to take 8 yearly courses, covering a wide range of math, which are on average tougher than the same level courses at most other European universities, as we are discovering via the European exchange programs. While this might be wrong for a number of reasons and purposes, it is worth stressing that it ultimately works for this aspect: By the end of the second year, those who have survived and had enrolled in mathematics intending to teach, realize instead that they can go on with theoretical courses which they have mastered and enjoyed. This really happens a lot. The*

*typical woman mathematician in Italy has enrolled in mathematics thinking it is a good subject for a teaching job, there are more jobs teaching mathematics than other subjects. This is also why her family was happy and didn't question her choice. In two years, she might become bold, and go on. The family only finds out at the end, when she gets the degree, and starts looking for fellowships instead of jobs in schools. By then, everybody is proud. I really think this is a pattern, except when coming from a very educated family that might trust their children more...*

*It sounds as though in other countries mathematics is considered "unfeminine". Not only do girls expect not to be able to understand it, they even seem to think it would make them less feminine. This seems very scary, especially in adolescence. This one thing is REALLY not true in Italy...*

*Maybe it would be interesting to develop a questionnaire on how girls see themselves when studying different subjects in different countries. One has to be extra careful in these things, but it would be nice to know.*

I agree with Laura, and would like to start with Italy and the Scandinavian countries.

## 1.4 General discussion

The report below is based on notes taken at the Round Table. In some cases, participants submitted further comments which have been included.

*On the situation in eastern Europe*

**Nadija Zinchenko, Ukraine**, Kiev University

In eastern Europe and the former Soviet Union, many mathematicians are losing their jobs and women are the first to do so. There is a general crisis in science since the governments do not believe that science is important for society. Non-academic institutions are dying. There are about 50% female students, perhaps more, who finish a candidate degree, similar to a Ph.D. degree, in mathematics. Not so many women finish the higher doctoral degree and, since it is a requirement for obtaining a full professorship, there are not many female full professors. The number of female mathematicians will decrease now. Women must work in our society, but they need not create a career. The society used to be closed. A positive change is the better contact

with people outside. It is our own problem to solve economic and educational problems. Help with making contact and exchanging information from outside is needed.

**Polina Agranovich, Ukraine, Kharkov**

We have some scientific grants and funds, for example the INTAS-grant and the INCO-COPERNICUS grant. I think this is very important and a good way to help our scientific work. I suppose this form is interesting for foreign scientists as well. In the frame of grants we can take part in conferences, seminars . It is a real possibility for youth to study mathematics in this very difficult time for us. It is, in fact, easier for us to be in e-mail contact with people from the west than with those from Kiev!

**Eva Bayer, France**

There are now many international cooperation programs. It would be good to encourage women to take a very active part in these. This could lead, for instance, to the creation of networks that contain many women - of course, not exclusively women. For example, there exists a program called “reseaux formation-recherche” with which one can form networks between one or more French regions and some regions of Eastern Europe or the former Soviet Union countries. The networks provide money for short visits and also doctoral scholarships.

*On affirmative action*

**Donald Collins, United Kingdom**

I would like comments on three concrete suggestions for affirmative action which had been discussed in his department and which had not been supported.

- Special Ph.D. fellowships for women.
- Grants for women graduate students to participate in the meeting of BWM.
- A prize for the best female first year student.

**Dusa McDuff**

I believe one has to think very carefully when creating anything which is “just” for women, though sometimes it is justified. As for the question of the

prize, I understand the reluctance of the department to institute a prize for women only (especially when there is no analogous prize for men). It would be better if such a prize were donated by a private person. I once received a special prize: the best mathematical achievement in the last five years by a woman, and I really appreciated it. Such a prize has real value in helping make the work of women visible. A department can try to preserve the spirit of the award while not restricting the prize for women, by for example having several prizes, one year two women and one man will get prizes, next year it may be opposite, etc. Or, it could keep track of who gets the prize and try to make a generous proportion of the winners women.

### **Sylvie Paycha**

Affirmative actions in Germany has had a “backfire” effect. Women applicants for jobs are more likely to be invited to lecture because of affirmative actions, afterwards a negative report may be written in order to explain why this woman is not considered for the list. A reason has to be given.

### **Annette Huber, Germany**

Basically, the only permanent positions in Germany are professorships. There is, in general, no formal application process for the remaining junior positions up to the age of 35 to 40. Some departments have to state that they could not find a qualified woman to fill such a position when appointing a man. From what I see in my department this rule does not have any effect. Still, I think that affirmative action on the junior level could be effective. And it would be a good step to make women more visible in the teaching of mathematics.

### **Eva Bayer**

Some universities include in the announcements of openings a text like “women are encouraged to apply”. Very often, this does not mean anything, although it gives the impression that they make an effort to hire women. The Swiss Federal Institute for Technology in Lausanne announced very interesting programs to encourage women. It would be good to inquire whether anything really happened.

### **Dusa Mcduff**

Affirmative action is a subtle thing. There is a very good NSF-supported program for female visiting professors. They serve as role models at the top universities as well as having the opportunity to further their own research. It is, in particular, difficult to have affirmative action for permanent jobs. It is much better to do something at the temporary level. And such temporary positions do help in career-building which is extremely important.

*On CV's***Eva Bayer**

At the council meeting of the EMS there was a discussion following the report from the committee on Women and Mathematics. It was mentioned that CV's for men and women often look very different. Many women do their best work later in life. Females are generally less competitive and take more time to gain full confidence. It was suggested that the committee should collect a large number of CV's to illustrate this phenomenon. Without such a study it is hard to treat men and women differently for an appointment. A position should not just be an award for past work, prediction of future work is important.

**Dusa McDuff**

It takes more time for a woman to feel she is a mathematician.

*On the North-South situation***Sylvie Paycha**

I can confirm what Dusa said. But I would like to ask the audience the following question. In Portugal there are many more women in mathematics. The job is not well paid and does not have a high status. Does that explain the difference between North and South?

**Francisco Craveiro de Carvalho, Portugal**

To say that the job is not well paid may give the wrong impression that women are underpaid in comparison to men in Portugal. That is not so. Men and women have the same salary and equal opportunities. The problems that women mathematicians face in the Portuguese society have to do with their being women and not with their being mathematicians.

**Maria Celeste Gouveia, Portugal**

Portuguese women mathematicians also have children and family as do other women in Europe, but they show through hard work that they can do the same as men in their jobs. So they have the same opportunities and, in the universities, jobs are given taking into account the scientific qualifications and not the sex. That is the reason why Portugal has so many women in universities. I think that the situation in Spain is like that in Portugal. So the crisis in Europe is not only caused by men but also by women who don't fight for their rights.

**Irene Sciriha, Malta**

Malta is Italy's neighbor. Having been under British rule for a number of years, the Maltese have inherited the British system of education. Recently aspects of the Italian system are being introduced as well. The Latin mentality among the Maltese is significant and is very similar to the situation as explained by Laura Tedeschini Lalli of Italy. Unfortunately in Malta female mathematicians face the drawbacks experienced in England as well. I am the only female mathematician in my department. I was appointed because I had good references as a tutor and have to fight to be given time to do research.

**Rudolf Rentschler, France**

(Back to the situation in Italy and Scandinavia.) Why are there so many women politicians in Scandinavia, but so few mathematicians?

**Ragni Piene**

There is no single reason. In the Scandinavian countries women choose other fields than mathematics. Hardly anybody wants to become a teacher.

**Aderemi Kuku, Nigeria**

All over the world it is a problem that very few young people go into mathematics.

*Closing remarks***Sylvie Paycha**

It is not enough to make geographic comparisons. Time comparisons inside each country are also necessary. In France the number of women having a position in mathematics is decreasing. The more difficult it gets the more difficult it gets for women.

**Dusa McDuff**

I would like to stress the importance of networking and of encouragement within all kinds of mathematics.

**Roswitha März**

I agree with Dusa. Also do a lot of things "just" for women.

**Kari Hag**

Make women more visible. Show female students that you expect something from them!

## 2 Supplementary articles

To supplement the Round Table on the situation in Sweden, where the government has taken some new initiatives, and in the US, where the Association for Women in Mathematics, has done pioneering work, a few women from these countries have been invited to submit written contributions.

### Women and mathematics - the Swedish situation

by **Gerd Brandell and Barbro Grevholm**

*Luleå University of Technology, Luleå (Sweden)*  
*Kristianstad University College, Kristianstad (Sweden)*

#### Introduction

The gender imbalance is still great in general at the Swedish universities. Women are in a majority at undergraduate level and succeed better on average in their studies, as measured by results in exams. Nevertheless only 8 % of the Swedish professors are female (Statistiska Centralbyrån, 1995, 1996). Positions as professors are very rare in Sweden. The great majority of academic teachers with a research degree and research possibilities have positions as senior lecturers. Among those only 20 % are women. (The situation in Denmark is perhaps even worse with 5 % female professors and 18 % female senior lecturers (Drotner, 1996)). The Swedish government has stressed the importance of changing this situation and making it more gender balanced.

Mathematics is regarded as a highly prestigious subject in Sweden and academic positions are relatively few. In 1993 there were only 30 professors in mathematics at all Swedish universities. The number of senior lecturers is about 350. Research assistants (postdocs) are very few (14 in 1993). When positions are rare the competition to get one is of course harder and this seems to effect women very negatively in Sweden. The participation of women in mathematics at a professional level is extremely low. There has not been a female professor of mathematics since Sonja Kovalevsky died in 1891. There is no female research assistant and only about 20 female senior lecturers.

The mathematical community is in general anonymous and isolated. In a research study (Grevholm, 1994b) among questions put to teachers was whether they knew the name of a professor (alive, not historical) in mathematics. Hardly any could name a professor and many answered that they

had never met a professor in mathematics. These teachers had spent three or four semesters as students at a mathematics department. Professors in general devote themselves to research and to teaching and supervising graduate students. This fact is also pointed out in an evaluation of the undergraduate education in mathematics (Universitetskanslern, 1995, p 15).

The isolation of the mathematical community has also been criticised in the same report (U, 1995, p 18).

Professors of mathematics seldom take part in the official debate in society or in the public discussion of school mathematics. This issue is addressed in an international review of Swedish research in mathematics (Swedish Natural Science Research Council, 1995):

The communication to the public of the nature and value of mathematics is much more difficult than for other subjects. The Swedish mathematics community should attempt to do better whenever possible. It is important that the public from politicians to school children, understand the central role of mathematics in modern society. The ground for a solid recruitment in mathematics is laid already in primary school. The lack of women among Swedish mathematicians is an explicit example of the lack of communication with the public. (p 49)

There seems to be a view commonly held by many Swedish mathematicians that there is no labour market outside the universities. In the same report it is said:

Similarly, Swedish mathematics should benefit from closer interactions with other sciences as well as industry and other relevant fields. The isolation of mathematics often prevents Swedish mathematicians to get into contact with interesting problems. (p 53)

The isolation and lack of communication with the rest of society probably effects the recruitment of women into mathematics negatively. There are a number of other factors that prevent women from choosing mathematics. Work as a mathematician is regarded as an isolated job. Pure mathematics is glorified compared to applied mathematics by many mathematicians. This hinders students from seeing the value of research. Often there is a lack of outspoken support for female students and women are made invisible in their departments. Many mathematicians and others claim that there is no

great need for more mathematicians in society. Some women might feel awkward being the only woman in a group. All these factors certainly play an important role when women reject mathematics as their professional field.

### **Official recognition of the gender issue**

In the two reports mentioned above, the lack of women in Swedish mathematics is pointed out as a major problem.

In the evaluation of undergraduate education the lack of women is analysed and it is pointed out that the relative number of women is decreasing as we move upwards in the system, from students to PhD-students to academic teachers (U, 1995, p 17). Affirmative actions are discussed as one way of stimulating more women to participate. The following recommendation is one of the 14 given in the conclusion of the report:

The departments should in various ways take measures that stimulate increased recruitment of female students at all levels. (p 21)

In the research evaluation it is said (SNSCR,1995):

There is a remarkable lack of women among Swedish mathematicians [reference to figures and tables]. Female students then represent a large and poorly utilised pool for recruitment. They should be encouraged at all levels to engage in mathematical studies. (p 51)

And one of the recommendations in the summary is the following:

There should be much stronger emphasis upon the recruitment of women into the mathematical sciences. (p 14)

The awareness of the gender question as a problem in connection to mathematics research and academic education is clearly stated in both these evaluations, for the first time at an official level. Although evaluations as such do not bring about anything unless they are followed up by actions, this recognition of the gender issue is of great importance and can be used in the future to encourage and legitimate different actions. They also help to raise the awareness about women's situation among academic staff at mathematics departments.

### **Initiatives for more women into mathematics**

The situation is still clearly unsatisfactory in our country and the progress is slow. Nevertheless several initiatives have been taken during the last few years with the purpose of improving women's participation in mathematics education and research.

*The network Women and Mathematics*

In 1990 the network Women and Mathematics was created to support women in mathematics at all levels of the educational system. This network now has over 700 members and a regular Newsletter is sent out (Grevholm, 1996b). The network has arranged three conferences and the proceedings have been documented (Grevholm, 1992; Brandell et al, 1994a; Lindberg, in press). It cooperates with several important organisations and authorities. It has shown organisers of conferences that there are many competent women that can be engaged as speakers in mathematics and mathematics education. The network has been given the opportunity to report on its activities in every edition of the Swedish mathematics teacher journal (Grevholm, 1991).

Information is collected on women in mathematics today and in history and the network strives to make these women visible (Grevholm, 1994a). The first woman to be awarded a doctor's degree in mathematics in Sweden was Louise Petrén at Lund university in 1911. At that time women could not have a position at a university and consequently she became a school teacher in Lund. It was 36 years before the next woman did research in mathematics. That was Ingrid Lindström, also at Lund University. She became headmistress at an upper secondary school in Örebro. The third woman to get her degree was Sonja Lyttkens in 1956. She succeeded in getting a permanent position as senior lecturer at Uppsala University in 1963. Until 1995 there were in total less than 30 women in Sweden with a research degree in mathematics. This historical picture is conveyed to the young women that are research students today.

The network and the conferences have resulted in the fact that the (very few) women at different mathematics departments have come into contact with each other and developed cooperation. This has clearly been of great importance both at an individual level and as a basis for understanding the extreme situation for women in mathematics in Sweden (Grevholm, 1995).

*Special positions for women*

The government and the research councils are now funding special positions for women. Among these are professorships, postdocs and positions for doctoral students. Some of these are in mathematics. Such a professorship has been created at the mathematics department at Uppsala University. 14 women from different countries, none of them Swedish, have applied for this

position. When the appointment is made it will be the first time since Sonja Kovalevsky that a woman will hold a (tenured) professorship in mathematics in Sweden.

A programme for a female guest professor in mathematics directly funded by the government has been created at Luleå University. Two female professors from the US and Spain respectively have been holding this position for six months each in 1996. The research councils in science and technology are funding posts as guest professors also during 1997 and 1998.

Each year a famous mathematician is invited by the Swedish National Committee for Mathematics to give a series of lectures at chosen mathematics departments. In 1996 for the first time a woman was invited. Karen Uhlenbeck visited four universities and gave highly appreciated lectures for both faculty and students.

#### *Summer school for graduate students*

A Nordic summer school for female graduate students was arranged this year by Umeå and Luleå Universities in cooperation. The idea came up at the Women and mathematics conference in 1993 during a discussion among women from different universities (Brandell, 1994b). The summer school was funded by the government and was attended by 17 female students from Sweden and Denmark. Among the seven lecturers, all but one female, were Ragni Piene and Bodil Branner. Besides the lectures the participants gave seminars. Proceedings from the summer school will soon be published.

The students were enthusiastic and hoped that there would be new summer schools in the future. Most important of all seemed to be the fact that these young women got to know several female mathematicians and mathematics research students.

#### *Undergraduate education*

Strong recommendations have been made by the Swedish parliament that academic teaching should be carried out in such a way that female students are not excluded by a male academic culture in which they might feel uncomfortable. This is difficult to realise in practice, since the culture and tradition of academic teaching is deeply rooted and the process of changing it therefore must be slow. There is also a certain opposition to the strategy of reforming the educational system from those who are quite satisfied with the formal equal rights that have existed for many decades and do not find it appropriate to go further to meet the needs of the female students.

A project called "Women in Mathematics", the KIM-project was carried out at Stockholm University during 1992 and 1993. The goal was to change

teaching practice and organisation of the teaching and learning situation, so as to suit female students better (Jacobsson & Elvin-Nowak, 1994). It involved participation of all teachers in development programmes including gender issues. Other mathematics departments - though far from all - have adopted plans for increasing equity and are now implementing these. It is too early to evaluate the outcome of this in actual figures.

Too few students go into science and technology, both at the secondary level in school and at university level. Programmes for recruiting more good students into these areas often give special attention to female students. Since mathematics is a basis for these areas, this has implications for mathematics as well. Five such programmes received substantial funds from the Swedish council for renewal of undergraduate education from 1994 for several years. The intention is to create programmes in engineering and science that will attract more female students (Wistedt, 1996). The funds are used for teacher development in gender issues as well as for development of pedagogical methods, that are aimed to attract more women. The methods that are used are often problem based learning and projects parallel to ordinary courses.

The first students were admitted to these new programmes last year, 1995. It is too early yet to evaluate the programmes, but they are apparently struggling with some problems. Although female participation has increased, the dropout rate is sometimes high and it seems to be mostly women who choose to leave. Nevertheless these programmes represent a great challenge to all those involved and they certainly will give the university system a lot of new experiences when it comes to implementing new pedagogical and radical ideas in a gender perspective. One of the teachers comments on a principle that is used, Noah's principle (50 % women among the teachers involved), in an evaluation report (Wistedt, 1996, p 47):

We are, of course, aware of the fact that there exist deeper problems of equality, but such a simple, almost banal measure, has brought to the fore a range of hidden circumstances, for example how many competent women there are... this is a bit shameful to admit... but how many exceedingly competent women there are, that I have never noticed. Isn't it shocking?

Besides these programmes with special funding, several universities have started other new programmes in engineering and science with the aim of attracting more female students (Brandell, 1996). Applied mathematicians mostly receive their training in engineering schools, mainly through programmes in engineering physics and related areas. Therefore more women

entering these programmes means more women candidates for jobs as professional mathematicians in the future.

### **The situation in school**

#### *Teachers*

There is a shortage of trained teachers of mathematics at all levels of the school system. Many mathematics teachers do not look upon themselves primarily as teachers of mathematics but as teachers of physics, chemistry, science, technology or economics. In upper secondary school (age 16 to 19) one position for teachers is that of lecturer, a position that requires a PhD in the subject. There are hardly any school teachers with this background in mathematics nowadays. This is partly a consequence of the fact that there are so few graduates with a research degree. The new PhDs are all swallowed by the university system. Besides, the compulsory part for studies of mathematics in teacher education has been cut for teachers for years 4 to 9 (age 10 to 16). A serious effect of this is that the mathematical background of the mathematics teachers is insufficient in many cases. As a consequence few teachers are genuinely interested in improving the teaching and learning of mathematics.

#### *The school-system*

All pupils receive a nine year compulsory education with mathematics every year. Girls have better marks than boys (Grevholm & Nilsson, 1994). The students think the subject is important but they do not find it interesting. In the final year students have to choose one of 16 programmes in upper secondary school for their continued education. Here a marked gender difference can be noticed. The most advanced course in mathematics is taken in the natural science programme and this is chosen by twice as many boys as girls. This programme is a prerequisite for university studies in mathematics and science. Here we have a serious barrier for girls. When they avoid this programme they have limited their choices for careers in the labour market.

The upper secondary school is not gender neutral. Actually most of the programmes are dominated by one sex. We could in fact partially talk of a girl's school and a boy's school (SC, 1995). The results of the girls are good and they have better marks than boys in programmes preparing for university studies and more girls choose these programmes. Girls more often than boys go on to tertiary studies in general. But with twice as many boys in the natural science programme, the number of women in tertiary mathematics is also only one third of the total. The balance between the sexes in different subject areas seems to level out in time in most subjects, but not in mathematics. In mathematics there are no changes or perhaps a lower percentage of women

can be noticed if we compare data from the mid 80s with the first years of the 90s (Grevholm, 1996a).

### Conclusions

In Sweden there are no legal barriers for women in education and research. More women than men graduate from university (59 % women in 1994/95), but in research education men dominate examinations (71 % in 1993/94). The higher up we look in the academic hierarchy the fewer women we find (8 % professors).

The picture in mathematics is worse, because of the lack of women even at upper secondary level and still more so at higher levels, where there are no professors. If we compare for example with Italy the first impression there is much better (Spitaleri, 1996a,b). This fact ought to be investigated further.

A lot of actions have been taken lately as described in the examples above, but we need to follow the results of these actions carefully and if necessary find other ways to improve women's participation in mathematics. We are certainly convinced that both mathematics and society will gain from the participation of women in the subject at all levels.

### References

- Brandell, G. et al (Eds.). (1994). *Kvinnor och matematik. Konferensrapport*. Luleå, Luleå University.
- Brandell, G. (1994). Finns det uteslutningsmekanismer riktade mot kvinnor vid de matematiska institutionerna? Finns det hinder av annat slag? In G. Brandell et al (Ed.) *Kvinnor och matematik. Konferensrapport*. (pp. 177-182). Luleå, Luleå University.
- Brandell, G. (1996). *Gender in engineering education*. Centre for Women's studies, Luleå, Luleå University.
- Drotner, K. (1996). Køn og kvalifikationer. *Politiken*, 11 Nov, 1996.
- Grevholm, B. (1991). Kvinnor och matematik - nätverk bildat. *Nämnnaren*, nr 2, 43-45.
- Grevholm, B. (Ed.). (1992). *Kvinnor och matematik. Rapporter om utbildning, nr 1, 1992*. Malmö, Lärarhögskolan i Malmö.
- Grevholm, B. & Nilsson, M. (1994). Sweden. In L. Burton (Ed.), *Who counts? Assessing mathematics in Europe*. (pp. 241-262). Birmingham, Trentham Books.
- Grevholm, B. (1994a). Svenska kvinnor i matematiken. In G. Brandell et al (Ed.) *Kvinnor och matematik. Konferensrapport*. (pp. 62-73). Luleå, Luleå University.

Grevholm, B. (1994b). Gender and mathematics education. Theory into practice. In E. Pekhonen (Ed.), *Proceedings of the Nordic conference of mathematics teaching in Lahti 1994. Research Report 141*. (pp. 78-84). Helsinki, University of Helsinki.

Grevholm, B. (1995). A national network of women: Why, how and for what? In P. Rogers & G. Kaiser (Eds.), *Equity in mathematics education*. (pp. 59-65). London, Falmer Press.

Grevholm, B. (1996a). Women's participation in mathematics education in Sweden. In G. Hanna (Ed.), *Towards gender equity in mathematics education*, (pp. 111-124). Dordrecht, Kluwer Academic Publishers.

Grevholm, B. (Ed.). (1996b). *Kvinnor och matematik. Rundbrev 1990-1995*. Malmö, Lärarhögskolan.

Jacobsson, C. & Elwin-Novak, Y. (1994). *Kvinnor i matematiken. Ett trevligt inslag eller pålika villkor?* Stockholm, Council for the Renewal of Undergraduate Education.

Lindberg, L. (in press). *Kvinnor och matematik. Konferensrapport*. Göteborg, Göteborgs universitet.

Spitaleri, R. M. (1996a). Women's Know-How and authority: Italian women and mathematics. In G. Hanna (Ed.), *Towards gender equity in mathematics education*, (pp. 111-124). Dordrecht, Kluwer Academic Publishers.

Spitaleri, R. M. (1996b). Women's Authority and Career: A Few Meanings. In *EWM's Newsletter* no 3, January 1966 (pp. 10-12).

Statistiska Centralbyrån (SC.) (1995). *Women and men in Sweden. Facts and figures 1995*. Stockholm, Statistics Sweden.

Statistiska Centralbyrån (SC.) (1996). *Women and men in Sweden. Facts and figures 1996*. Stockholm, Statistics Sweden.

Swedish Natural Science Research Council (SNSCR.) (1995). *International Review of Swedish research in mathematical sciences*. Stockholm, Swedish Natural Science Research Council.

Universitetskanslern (U.) (1995). *Nationell utvärdering av grundutbildningen i matematik*. Stockholm, Universitetskanslersämbetet.

Wistedt, I. (1996). *Gender-inclusive higher education in mathematics, physics and technology*. Stockholm, Högskoleverket

## Women in Mathematics in the United States

by Marie A. Vitulli and Sylvia Wiegand

*University of Oregon, Eugene, Oregon (USA)*

*University of Nebraska, Lincoln, Nebraska (USA)*

In this article we describe the current situation for academic women mathematicians in the United States and the impact and activities of the Association for Women in Mathematics (AWM).

Many of the problems facing European women in mathematics also face women mathematicians in the U.S. There has, however, been a remarkable increase in the participation by women in mathematics in the last twenty-five years and women have enjoyed considerable success in their mathematical careers. At mathematics meetings everywhere more women are visible; for example at a regional meeting of the American Mathematical Society (AMS) in Lawrenceville, New Jersey in October 1996, two of the four invited hour addresses were given by women and half the speakers at the commutative algebra session were women. On the other hand there appears to be a perception by some that opportunities are now slanted unfairly in favor of women. We examine this perception, which is a threat to continued progress.

### **The Association for Women in Mathematics**

One of the contributing factors to the rise in the number of women in mathematics worldwide has been the support and encouragement of the U.S.-based Association for Women in Mathematics, which began in 1971 with the purpose: "to serve and encourage women to study and have active careers in the mathematical sciences". Now, twenty-five years later, AWM is a substantial organization (4500 members) that sponsors outstanding programs for women in mathematics.

When the AWM began its Noether Lecture Series in 1980, named for Emmy Noether, women rarely gave the prestigious invited hour addresses at meetings of the AMS and the Mathematical Association of America (MAA). Since then the situation has changed dramatically (the 1997 meeting in San Diego will include three other hour addresses by women). The lectures have become a showcase for the most distinguished women mathematicians. Although the speaker is generally over the age of fifty, she need not be from the U.S. (If outstanding foreign women are known to be visiting the U.S., they are considered for the award. It has proven complicated to arrange and finance travel otherwise.)

The AWM regularly schedules a wide variety of other events for the annual Joint Mathematics Meetings of the AMS and the MAA; for example, there

students as well as a business meeting, dinners, and a party. Each year the AWM presents awards to an outstanding woman educator (for contributions to mathematics education), and to an outstanding woman undergraduate (for excellence in mathematics). As a result of all this activity women are now extremely visible at meetings—and feel much more comfortable and welcome than in the old days.

AWM frequently organizes special workshops, such as one held in Berkeley in July 1996 in honor of Julia Robinson. The events at that workshop included mathematics talks given by prominent women mathematicians, a special talk about Julia by her sister, panel discussions on popular topics, and opportunities for recent Ph.D.s and graduate students to communicate their work. These workshop and other outreach activities sponsored by AWM have been inspirational for young women and have helped them to establish contacts that will be useful later in their careers. (Older women mathematicians also gain inspiration and excitement from these events; the presence of so many impressive women mathematicians of all ages inspires every woman to continue to work hard and realize her potential, and the women are terrifically supportive of each other.)

Other ongoing programs and projects of AWM include: a monthly newsletter; mathematics education programs; career publications; an AWM membership directory; the Directory of Women Mathematicians; the Sonia Kovalevsky mathematics days (especially for high school girls in mathematics); and many other special events. All these AWM programs are produced by energetic and dedicated volunteer woman mathematicians and the tiny devoted AWM staff. Like most women and women's organizations, they are over-extended and under-funded!

### **A Presidential Year**

During the year 1996 the presidents of nine major mathematics and related organizations in North America were women.<sup>1</sup> The abundance of women simultaneously in leadership positions of all these organizations was mentioned at a meeting of the Conference Board of the Mathematical Sciences in December 1996; it was the first such meeting to include so many women, and

---

<sup>1</sup>The organizations and their presidents are: 1. The American Mathematics Association for Two Year Colleges: Wanda Garner; 2. The AMS: Cathleen Morawetz; 3. The American Statistical Association: Lynn Billard; 4. The Association of State Supervisors of Mathematics: Mari Muri; 5. The Canadian Math Society: Katherine Heinrich; 6. The National Council of Teachers of Mathematics (NCTM): Gail Burrill; 7. The Society of Industrial and Applied Mathematics: Margaret Wright; 8. The Sociedad Matematica Mexicana: Patricia Saavedra; and 9. The AWM; Chuu-Lian Terng. The Executive Directors of the MAA (Marcia Sward) and the NCTM (Linda Rosen) for 1996 are also women.

many of these women were present. Some said that there was a “ripple effect”; when some organizations started nominating women, the other organizations followed suit. Others said that feminine traits such as attention to details are evidently becoming more valued for presidents of these organizations.

### **Affirmative Action Curtailment and Backlash**

The increased representation of women in mathematics is also a result of a wide range of local and national affirmative action programs. In the last few years these programs have been attacked from diverse fronts. The National Science Foundation proposed ending the Visiting Professorship for Women Program, a productive and supportive program which existed for about ten years. (It has been reinstated). Scholarships, fellowship programs and special admissions policies for undergraduate, graduate, and postgraduate programs intended to increase the participation of women and minorities have also come under attack. Many states, such as California, have eliminated affirmative action programs for higher education. Articles and letters to the editor in professional journals have protested affirmative action programs and preferential treatment for women and minorities; other articles document the existence of an affirmative action backlash.<sup>2</sup> Department heads sometimes tell unsuccessful male job applicants that the department was pressured into hiring a woman; obviously this increases the backlash and does a disservice to the profession.

### **Employment Study**

Mary E. Flahive (Oregon State University) and Marie Vitulli analyzed data from the 1991-1995 AMS-Institute of Mathematical Statistics (IAS)-MAA Annual Surveys for gender differences in initial employment of new Ph.D.s in mathematics from U.S. institutions between 1990 and 1995.<sup>3</sup> This data analysis was undertaken partly in response to affirmative action backlash. The questions studied and their findings are summarized in the tables and discussion below.

Question 1: Do men and women have the same employment rates? To answer this the rate of joblessness was calculated; that is, the percentage of individuals who were either still seeking or were unemployed and not seeking employment out of all those new Ph.D.s who reported their initial employment status. The jobless rate for females was 10.2% and for males 12.0%—these rates are not substantially different.

---

<sup>2</sup>A. Jackson, *Notices of the AMS* Vol. 40, (Jul.-Aug. 1993) pp. 588-590 and Vol. 41, (April 1994) pp. 286-287.

<sup>3</sup>The full report will appear in the February 1997 issue of the *Notices of the AMS*.

Question 2: For the Ph.D.s who obtained jobs, what types of jobs were men and women getting? Table 1 below summarizes the frequencies and percentages of first jobs in various categories. "Group I" refers to the top 48 Ph.D.-granting mathematics departments, "Group II" to the next 56 departments, and "Group III" to the remaining 72 Ph.D.-granting mathematics departments. The designations "Bachelor's" and "Master's" refer to departments in which the highest degree offered is the bachelor's (undergraduate degree) and master's degree, respectively. (That is, Ph.D. degrees are not offered.)

Type of Employer	#	Females (%)	#	Males (%)	Totals
Group Ia*	108	(15.4%)	491	(19.6%)	597
Group II	34	(4.9%)	149	(5.9%)	183
Group III	65	(9.4%)	183	(7.3%)	248
Master's	82	(11.9%)	235	(9.4%)	317
Bachelor's	185	(26.9%)	422	(16.8%)	607
Other Academic (incl. foreign)	155	(22.5%)	652	(26.0%)	807
Government, Industry	62	(9.0%)	379	(15.1%)	441
Totals	689		2511		3200

Table 1. Observed frequencies of first jobs for New Ph.D.s 1990-1995

Note:\*Group Ia=Group I + Research Institutes.

Apparently U.S. women take first jobs at bachelor's-granting mathematics departments at a much higher rate than men. Whether this noteworthy difference is due to employer-bias or preference on the part of the new Ph.D.s is unclear; but certainly it is related to the high percentage (62.4% in 1995-964) of tenure-track jobs at bachelor's-granting departments. (The term *tenure* refers to the promise of lifetime employment at the institution. Positions that could lead to tenure are called *tenure track positions*. Non-tenure-track positions are usually terminal after a fixed number of years.) Women's career patterns generally differ from men's. Many women are most creative and productive later in their careers. The early years are important for their careers, to be sure, but they are also important for their families, because they are the prime child-bearing years. Temporary jobs seem to disproportionately

and negatively affect women for these reasons. A possible explanation for the large proportion of women in bachelor’s departments is the fact that diverse forms of scholarship and service to the institution are valued and rewarded in these departments. Today many research universities are under pressure to increase the quality of undergraduate education but few of these universities reward faculty for good teaching.

Question 3: Have women been equally successful in obtaining academic positions at a department of at least comparable ranking to that of the degree-granting department? After earning the Ph.D. many non-U.S. citizens left the U.S. and the type of foreign employment they find is unknown. Consequently, this analysis includes only the U.S. citizen cohort, which consists of 412 females and 1303 males. Table 2 below summarizes these comparable employment rates.

Employer Type	Type of Ph.D.-Granting Department					
	Group I		Group II		Group III	
	Female	Male	Female	Male	Female	Male
Group Ia	25.9%	26.7%	na	na	na	na
Group Ia-II	na	na	9.3%	14.9%	na	na
Group Ia-V	na	na	na	na	19.8%	16.1%

Table 2. Comparable Employment Rates for U.S. Citizen New Ph.D.s 1990-1995

“na” means that this data entry is not applicable

Since the data does not distinguish between either one-year and multi-year positions or between tenure track and non-tenure track positions, the analysis for Question 3 is not completely satisfactory. For instance, a tenure track appointment in a Group I department is counted the same as a one-year “hold-over” position for a former student. These observations are particularly important because a very high percentage (84.2% in 1995-96<sup>4</sup>) of the first jobs in U.S. doctorate-granting mathematics departments are not tenure track.

<sup>4</sup>Notices of the AMS, Vol. 43, (December 1996), pp. 1493-1511. After a 6 year probationary period, a tenure track professor is reviewed for tenure. If tenure is awarded, with few exceptions, the professor has a promise of lifetime employment from the institution. If tenure is denied the professor must leave the institution.

Nevertheless the information in Table 2 suggests that women are about as successful as men at obtaining comparable employment; thus the perception that women have an advantage appears to be false.

### Temporary Positions

An increasing number of U.S. mathematics departments are offering recent Ph.D.s temporary postdoctoral positions (called *postdocs*; this refers both to the positions and to the recipients). Some departments offer postdocs with reduced teaching loads and a chance to work with senior mathematicians in the postdoc's research field. Other departments offer postdocs with nearly the same teaching loads as tenure track positions; they use the postdocs as a way of bringing young people, or sometimes women, to a department. Departments sometimes hire women as postdocs to counter the charge that women are severely underrepresented on their faculty. These departments artificially increase the number of women on their faculty and thereby "look better" in affirmative action studies, which are frequently required for good standing with grant-giving agencies, including the federal government. Postdocs with no real benefit to the recipients are surely harmful to young mathematicians in general, and women in particular. If women are getting a large share of the postdocs but are not obtaining tenure track positions as subsequent jobs, then the apparent near-equality of the comparable employment rates for men and women is questionable.

### Increases in Numbers of Women in Mathematics

The number of women who receive Ph.D.s in mathematics and the number who obtain entry-level positions at doctorate-granting mathematics departments have both increased over the past twenty-five years. Table 1 shows that 21.5% of the new Ph.D.s in mathematics from U.S. institutions between 1990 and 1995 were women. Looking at U.S. citizens only, in 1972 only 6% of the U.S. citizen Ph.D.s were women; in 1976 women were about 12%. The percentage of U.S. women grew to 23.9% of all U.S. citizen Ph.D.s between 1990 and 1995 and the percentage for 1996 was over 25%. Women received 20.1% of the jobs for new Ph.D.s at doctorate-granting U.S. mathematics departments or research institutes between 1990 and 1995. There haven't been comparable increases in the number of women in senior-level positions at doctoral-granting mathematics departments, despite the fact that since 1982-83 at least 20% of the new U.S. citizen Ph.D.s. in mathematics have been women. In 1993 only 5.8% of the tenured faculty at Ph.D-granting mathematics departments were women; at the same time 4.9% of the tenured faculty in Group I departments were women<sup>5</sup>. The AMS-IMS-MAA does not

---

<sup>5</sup>M. B. Ruskai, "Time for Advancement" MAA Focus 14(6), 25-28 (Dec. 1994)

conduct longitudinal studies to follow the careers of new Ph.D.s, both men and women, five and ten years after the Ph.D. The combined societies are reluctant to take on the project until a funding source can be found. The AWM and the Joint Committee on Women in the Mathematical Sciences have advocated for longitudinal studies for the past several years.

In summary, the prospects for women Ph.D. mathematicians are better in the U.S. than they were 25 years ago, but there is still room for improvement. We hope that the momentum and progress will continue.

### 3 Statistical data

The statistics on women in mathematics in Europe is visualized in a striking way in the video “Women and Mathematics across Cultures, EWM — European Women in Mathematics”.

#### Percentage of Women among tenured Mathematicians

“Color code”

0–4%     11–20%     31–40%

5–10%     21–30%     41–50%

Before the second European Congress of Mathematics a letter was sent by the EMS-Committee on Women and Mathematics to all mathematical societies of Europe. We tried to make it clear that it is important to follow changes in the role of women in mathematics within each country. Therefore we asked for the same information in 1995 as was asked for in 1990 (as to Ph.D's awarded in 1995 we added that for small numbers we would like the number to be an average, preferably for the last 4 years):

- I. The number of mathematicians holding a permanent position in a mathematics department of a university or a research institution in the country in question.
- II. The number of full professors ("full professor" being the highest academic position).
- III. The number of Ph.D's awarded in 1995.
- IV. The percentage of women among the students in mathematics.

We requested the numbers of women, as well as the totals, in the questions I, II, III.

Since the 1995 survey was a repetition of that in 1990 and since it is a primary aim of the EMS-Committee on Women and Mathematics to collect such data every four years, we hoped that many countries would have efficient means for doing this. As of October 20 the societies in Denmark, Finland, Israel, Macedonia, Norway, Slovenia, Slovakia, Switzerland and the United Kingdom have furnished us with complete data. We have also received some data from France and Sweden. The German Mathematical Society will include our questionnaire when it updates its Address Book of mathematics departments in the fall.

The United Kingdom now has a higher education statistical agency which was able to provide the necessary figures for them. For many other countries, however, the following letter from Luc Lemaire of Belgium, unfortunately, reflects some of the difficulties encountered in obtaining such data.

*As for the questions in your letter, I fear there is no way I could get the answers within your deadline (or even deadline + large  $\varepsilon > 0$ ).*

*The way I got answers the first time was to write all mathematics departments, wait a few weeks (months), write again etc. Indeed, I don't believe global statistics are available in Belgium.*

*If I do the same now, I won't get complete answers before at least 6 months. Moreover, the shortcoming of the approach will be the following: In the figures of 4 years ago there was an element of choice by the various chairs of departments who gave them. Is X a mathematician or a physicist, is Y in a mathematics department etc. If I ask the same questions now to different people, the difference in those choices may well exceed the evolution due to the small number of retirements or appointments in the last 4 years - so the evolution of the situation will not be faithfully represented...*

If we combine the new figures with the figures from the survey in Table 1 on page 43 of *First European Congress of Mathematics, III, Round Tables*, Birkhäuser Verlag 1994, we obtain the following summary. Data is from 1990 unless otherwise indicated.

**PERCENTAGE OF WOMEN IN MATHEMATICS IN EUROPE**

<b>Country</b>	<b>Students</b>	<b>Ph.D.'s</b>	<b>Mathematicians</b>	<b>Full Prof.</b>
Austria '89	39%	3/21=14%	54/762=7%	0/73=0%
Belgium	54%	12/32=38%	30/219=14%	8/134=6%
Bulgaria	40%	4/23=17%	254/855=30%	1/42=2%
C.S.F.R	42%	1/10=10%	60/500=12%	2/65=3%
Denmark	30%	1/5=20%	4/121=3%	1/19=5%
Denmark '95	30%	0.75/4 <sup>1</sup> )=19%	3/121=2%	1/21=5%
Estonia	60%	0/4=0%	32/109=29%	0/8=0%
Finland	41%	8%	3/127=2%	1/34=3%
Finland '95	37%	1/6=17%	9/146=6%	1/34=3%
France	30%	20%	20-25%	8%
France '95				10%
W. Germany '87	33%	19/208=9%	40/1500=3%	4/490=1%
Greece			67/283=24%	3/56=5%
Georgia	70%	1/28=4%	486/1217=40%	7/72=10%
Hungary	15%	5/38=13%	32/281=11%	4/103=4%
Ireland	30%	2/3=67%	7/135=5%	0/9=0%
Israel '95	45%	10/37=27%	15/295=5%	5/165=3%
Italy	70%		609/1727=35%	84/646=13%
Iceland	33%	0/0	0/10=0%	0/4=0%
Luxemburg	24%		1/7=14%	1/5=20%
Macedonia '95	73%	7/11=64%	25/56=45%	1/12=8%
Netherlands	22%	2/41=5%	19/437=4%	1/88=1%
Norway	20%	0/5=0%	9/103=9%	3/45=7%
Norway '95	29%	3.25/14.75 <sup>1</sup> )=22%	8/117=7%	3/67=4%
Poland (5 univ.)	60%	3/16=19%	107/359=30%	7/44=16%
Portugal	50-60%		40-50%	5%
Slovakia '95	29%	4/11=36%	149/482=31%	1/27=4%
Slovenia '95	52%	0/2=0%	4/51=8%	0/14=0%
Spain			168/1075=16%	12/279=4%
Sweden	30%	1/10=10%	7/150=5%	0/21=0%
Sweden '95 <sup>2</sup> )		1/14 <sup>1</sup> )	22/310=7%	0/41=0%
Switzerland	25%	4/42=10%	3/141=2%	0/91=0%
Switzerland '95	20-30%	10/50=20%	4/150=3%	2/90=2%
U. Kingdom	31%	46/266=17%	97/1379=7%	3/267=1%
U.Kingdom '95 <sup>3</sup> )	37%	36/198=18%	250/2143=12%	10/325=3%
Ukraine	50%	1/3=33%	31/145=21%	1/33=3%
Yugoslavia	60%	4/24=17%	91/530=17%	12/132=9%

1) Average figures 2) Broader definition of mathematicians 3) Polytechnics are now universities; the number of universities has increased from 50 to 150

### ACKNOWLEDGEMENTS

This Round Table could never have taken place without the help of so many dear friends and colleagues. I wish to thank them all and, in particular, Bodil Branner, Lois Gehring, Marjatta Näättänen and Ragni Piene for their invaluable support and counsel in different phases of this undertaking.

Kari Hag

## 4 Appendix

### Description of EWM

European Women in Mathematics (EWM) is an affiliation of women bound by a common interest in the position of women in mathematics. Our purposes are:

- To encourage women to take up and continue their studies in mathematics.
- To support women with or desiring careers in research in mathematics or mathematics related fields.
- To provide a meeting place for these women.
- To foster international scientific communication among women and men in the mathematical community.
- To cooperate with groups and organizations, in Europe and elsewhere, with similar goals.

Our organization was conceived at the International Congress of Mathematicians in Berkeley, August 1986, as a result of a panel discussion organized by the Association for Women in Mathematics, in which several European women mathematicians took part. There have since been six European meetings: in Paris (1986), in Copenhagen (1987), in Warwick (England) (1988), in Lisbon (1990), in Marseilles (1991), in Warsaw (1993), and in Madrid (1995). The next meeting will be in Trieste, Italy, December 13-17, 1997.

At the time of writing, there are participating members in the following countries:

Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom; contacts in Albania as well as with several non-European countries. Activities and publicity within each country are organized by regional co-ordinators. Each country or region is free to form its own regional or national organization, taking whatever organizational or legal form is appropriate to the local circumstances. Such an organization, Femmes et Mathematiques, already exists in France. Other members are encouraged to consider the possibility of forming such local, regional or national

groups themselves. There is also an e-mail network, and EWM has its own Web page. The address is: <http://www.math.helsinki.fi/EWM>.

For further information contact:

The secretary of EWM: Riitta Ulmanen,  
Department of Mathematics,  
P.O.Box 4 (Yliopistonkatu 5),  
FIN - 00014, University of Helsinki, Finland;  
e-mail: [ulmanen@sophie.helsinki.fi](mailto:ulmanen@sophie.helsinki.fi),  
Tel 358 9 191 22853, Fax 358 9 191 23213