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The International Commission on Mathematical Instruction

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Legend: IMU stands for *The International Mathematical Union*; ICSU stands for *The International Council of Scientific Unions*; CTS stands for *The Committee on the Teaching of Science* (of ICSU).

Gender and Mathematics Education

Key issues and questions

Discussion Document for an ICMI Study

1. Rationale for the study

The study proposed in this discussion paper is based on a simple premise: there is no physical or intellectual barrier to the participation of women in mathematics, science, or technology. Having said this, we must ask ourselves: why don't they participate more? Here there is no simple explanation. For if there are no physical or intellectual barriers, there must be social and cultural barriers that account for their under-representation. For the most part, these barriers have not been raised intentionally. They are an integral part of a social order that carries with it discrimination. The perspective of this study is that discrimination on the basis of gender is no longer acceptable. Judge Rosalie S. Abella, an advisor to the Ontario government, has posed the problem as follows:

> Systemic discrimination requires systemic remedies. Rather than approaching discrimination from the perspective of the perpetrator and the single victim, the systemic approach acknowledges that by and large the systems and practices we customarily and often unwittingly adopt may have an unjustifiably negative effect on certain groups of society. The effect of the system on the individual or group, rather than its attitudinal sources, governs whether or not a remedy is justified.
>
> Remedial measures of a systemic and systematic kind are meant to improve the situation for individuals who, by virtue of belonging to and being identified with a particular group, find themselves unfairly and adversely affected by certain systems of practices (CAUT, 1991, p. 12)

Statistics on the participation of women at the tertiary level in general and in mathematics, science, and technology in particular strengthen the case for a social, systemic viewpoint. We have to ask why women specifically avoid mathematics and sciences. Taking Canadian data as an example, we note that while women are attending universities in unprecedented numbers (and earning more than 50% of all bachelor's degrees in Canada), they are overrepresented in the humanities and under-represented in mathematics and science. The proportion of women undergraduate students in the mathematical and physical sciences increased from 19.4% to 28.5% in the years 1971-1987, and in the engineering and applied sciences in increased from 1.2% to 12.2%. This constitutes very modest progress, when one compares it to the progress women have made as students in other traditionally male-dominated professions. Over the same period (1971-87), the proportion of women among those obtaining a bachelor's degree in law increased from 9.4% to 46.7%, while the proportion in medicine went from 12.8% to 41.7%. At the doctoral level, though women have increased their participation they are still underrepresented in mathematics ands science.

Two decades of research on the problem of gender imbalance in higher mathematics,

and in mathematics-related carriers, have consistently found that when gender-related differences in achievements are present they are rather small. Or put in other terms, achievement *per se* does not account for the large discrepancies in enrolment in higher level mathematics courses and in the election of mathematics-related carriers. This finding is perplexing in light of what we find in the media on girls and mathematics and science.

In the United States and Canada, and in other countries as well, a lot of publicity has been given to girls' supposed inferiority in these subjects. Articles have appeared in popular magazines claiming that women are inferior in what they have referred to as "cognitive abilities", "spatial skills", or "aptitude for mathematics". It has also been claimed that women are incapable of grasping mathematics or science because they are "emotionally minded". It is hardly surprising that such messages in the popular press influence girls to believe in their inherent ability to succeed in mathematics, and thus discourage them from taking up mathematics or other branches of science.

Such claims are usually based upon studies of achievement. Yet, as stated above, most studies that have found achievement differences in favour of boys have found very small differences that are not educationally significant. The more important point is that the popular press, and indeed many of the researchers, have confounded achievement with aptitude, ignoring other factors. The truth is that we do not really know how to measure aptitude, or even whether aptitude alone is a determining factor in achievement. Some research suggests that learner's attitudes towards learning and their career aspirations are powerful determinants of achievement.

While studies that show lower achievement for girls often receive wide publicity, studies that show the opposite may not. Research on the International Educational Association (IEA) mathematics results from 20 countries at the Grade 8 level (age 13) shows that boys and girls are about equal in achievement, and that the differences among countries are much larger than any differences within countries (Hanna, 1989).

Another study which challenges the popular notion of girls and lower mathematics achievement is one by Alan Feingold (1988). In reviewing the research results on cognitive gender differences for a period of 30 years in the United States, Feingold shows that differences had actually declined over the three decades preceding his study. Clearly the research message is that the problem of gender differences and mathematics achievement, and on gender-based inequities in matematics-related careers, is a socially constructed one.

At the same time numerous studies have been done which indicate what can be done at the level of societies and of education systems to counteract the development of gender inequities. This discussion paper is an attempt to summarize key questions in one segment of the literature on retaining girls and women in mathematics and science - namely, analyses of gender issues in mathematics education. It is hoped that the idenfication of the relevant questions will focus attention on key gender-related issues in mathematics education for the 1990s and beyond.

2. Factors generating gender inequities in mathematics

Attitudes

Femininity and masculinity are socially developed constructs which are reinforced by the interactions of children with each other and with adults. Implicit and explicit assumptions and messages about female and male intelligence, needs, and inclinations seem to affect attainment in mathematics. To a certain extent, gender differences in mathematics performance might be a reflection of differences in attitudes towards mathematics.

Girls tend to avoid mathematics courses when they are no longer compulsory. It appears that the attitudes females have towards mathematics, their feelings as learners of the subject, and the values that shape their attitudes determine whether or not they persist in mathematics course-taking. Girls who are aware that mathematics will be relevant to their lives and useful in their future careers are far more likely to remain in mathematics courses.

The larger question in this context pertains to socialization. What is its role in the observed differences in attitudes towards mathematics? More specifically, the following questions are helpful:

* Is there an implicit message in society that competence in mathematics is more important for the attainment of boys' career ambitions than it is for girls?

* How can we increase the confidence of females in their ability to do mathematics?

* Do specific teaching approaches and learning modes lead to more positive attitudes to mathematics?

* How does understanding the similarities between male and female achievement and attitudes help practitioners establish a basis for resolving inequities?

Culture

Ethnomathematics recognizes the influence of sociocultural factors on the teaching and learning of mathematics. Documentation exists that emphasis placed within schools on the application of mathematics differ markedly within countries and from country to country and that this emphasis affects student performance. We have much to learn from this research, especially if we include consideration of the following additional questions:

* How informative are, or what do we have to learn from, international performance comparisons?

* Are there cultural patterns, such as social customs, family customs, customs in our educational system, and customs specific to mathematics, that

discourage girls and women from pursuing matematics?

* What difficulties in mathematics do males and females from minority groups face?

* What methods of encouraging, recruiting, and retaining women and minorities are used by different cultural and national groups?

Mathematics as a discipline
Recently, the existence of gender biases in the practice of mathematics has been studied extensively from several different perspectives including a feminist one. The questions emanating from this line of research are worth examining. Some essential questions are:

* What are the consequences in the theory and discourse of mathematics of the fact that it was constructed in predominantly patriarchal societies?

* Does the nature/structure/language of mathematics have a bias that promotes gender imbalances?

* What is the nature of the different areas of mathematics that appears to encourage (or not, as the case may be) students to persevere?

* What features of mathematics as a discipline (e.g. the contribution it can make to developing creativity and enjoyment, and its value in developing reasoning powers) can be emphasized to make it more relevant to both genders?

3. Manifestations of gender inequities

Jobs and careers
Historically woman have been seriously underrepresented in mathematics and related fields. This does not appear to be due to lower levels of achievement. Gender-related differences in mathematics achievement, when they are found, are very small and thus do not account for these large participation discrepancies. Even though more women have chosen to pursue careers in mathematics and science in the last decade, there is still a concern over their low representation in mathematics, engineering, and the natural sciences.

Educators need to pursue an understanding of the factors that account for the discrepancies in involvement in higher level mathematics courses and to develop strategies that will help both genders stay in mathematics courses and thus keep open the full spectrum of career and job options. Research still needs to be done around the following questions:

* Do social perceptions (media, publicity, etc.) discourage girls from choosing

careers that require mathematical skills?

* How can (female) students be helped to see that mathematics can also contribute to the solution of problems which they will meet out of school and to job opportunities?

* Should the privileged position of mathematics as a screening device for professions be challenged?

* Why hasn't the preparation in mathematics translated into greater numbers of female science and engineering majors?

* How can the visible proportion of women in mathematics and related fields be increased so that these options and occupations become part of female students' accepted range of choices?

* How can women's opportunities for careers in scientific and technical professions be expanded? Conversely, should women go into mathematics-related fields given the nature of the present system?

Girls and technology

The technological environment can, and does, affect student atitudes and their conceptions of what comprises desirable knowledge and understanding. In 1990, Ursula Franklin noted that the practices used in technology define its content and "when certain technologies and tools are predominantly used by men, then maleness becomes part of the definitions of those technologies". As a result, many female students do not appear to hold a worldview which includes technology as relevant to their lives or as appropriate for them.

Few educators would disagree that schools must be more responsive to the science/technology thrust of our contemporary world and to the related educational needs of all students. However, international investigations have noted consistent gender inequalities in the technological education. Important questions for educators to discuss include:

* How does the considerable and growing impact of technology on schools and its changing role affect the education of females?

* How can we foresee and influence how technology changes their education?

* Can we influence the designers and producers of technology, and hence how girls are educated, by setting technological goals (e.g. development of technical hardware for educational purposes)?

* How are the areas of computer studies and mathematics to be made more relevant/accessible to girls?

* How can the computer be used as a learning and teaching aid? What are the

effects of certain implementations on the cognitive development of the learner?

* What are the epistemological changes due to the use of computers?

4. Foci for change

Curriculum
To achieve gender equality in mathematics education, educators need to look at the development, content, and presentation of the mathematics curriculum within its general educational context.

In this regard it is helpful to find examples of success in teaching mathematics to all students (and to be aware of criteria used to denote the term "success") and to learn from these successes. Some worthwhile questions for consideration are:

* Given the pattern of lower rates of female participation in elective mathematics courses, and the fact that mathematics is critical to careers at technical, professional and managerial levels, to what extent would it be appropriate to make mathematics a compulsory subject in schools?

* What would a gender neutral curriculum and pedagogy look like?

* Would singe-sex education benefit students who tend to opt out of mathematics?

* Should different mathematics curricula be provided for different groups of students?

* Does the mathematics curriculum fail to deal with topics of particular concern to girls and women?

* Why do specific mathematics topics seem easier to one group of students than another?

* What are the essentials which must be contained in mathematics curricula?

* How can different components of curriculum - instructional methods, assessment programs, and resources produced by teachers and by publishers - be designed so that the development of mathematics skills and knowledge becomes a prime aim for all children?

* How can the pace and range of work in the mathematics classroom be adapted to allow for increased understanding by all students?

* Does the mathematics curriculum necessarily have to be so overloaded that the quantity tends to control the pedagogy?

Assessment
Assessment is a crucial component of mathematics education. It generally functions to provide information to assist in decision making about individual students, classes, teachers, programs, or institutions. The kind of information sought, how it is gathered, and the form in which it is reported, all have a bearing on mathematics education.

Major challenges and questions exist within the realm of assessment as it relates to gender issues. A critical question, for example, is whether mathematics is taught equally well to different groups of learners. Important queries within this larger question include:

* What is mathematical ability and how can it be mesaured?

* What kinds of mathematical tasks are being assessed (short technical exercises, long tasks, extended problems, etc.)?

* Are the methods of assessment used more favourable to certain groups of students?

* How can we ensure that classroom materials and exam questions properly reflect gender equity? Should they include a wider range of human activities and interests than traditional materials and examinations?

* Is the range of experiences provided in the mathematics classroom (or elsewhere in the school) biased in favour of one group of students to the possible detriment of others?

* Are there examples of assessment practices which are known to have a positive or negative influence on instruction? What aspects should be maintained and encouraged?

* Are there examples of assessment practices which negatively influence instruction; for example, by focussing instruction on assessment and tests rather than on more general goals?

* How do different assessment modes influence the social environment in the classroom?

Teachers and the school
Teachers are one of the most important educational influences on students' learning of mathematics. The school environment or social context in which students learn mathematics is another critical factor, influencing how they learn, their expectations, their perceptions and misapprehension of mathematics and of schooling in general. More research is needed on how the ethos of the school and individual teachers shape or alter student attitudes towards matematics.

With respect to teacher education, the general question remains of how to make teachers at all levels aware of, and hence how to eliminate, any gender bias in their

current practices. More specifically, we need to ask the following questions:

* Do we need to improve in-service training? Should we increase incentives to groups to participate and the amount of time we spend on the topic of gender awareness?

* Should more research be focussed on teachers - their conceptions of their roles both in the classroom and in society, their understanding of the educational process, their methods and teaching aids?

Research has been done on the critical factors in the school environment which reduce retention of females in mathematics courses. We need to continue to ask:

* How can pupils' (particularly girls') self-confidence in mathematics be increased?

* How can the learning climate for girls be improved?

* Does the learning climate for girls improve within single-sex settings?

* How can modes of classroom organization and teacher-pupil interactions be encouraged and developed which would benefit all children?

Working with parents

Sex-role stereotyping begins at birth, a fact alluded to in the earlier discussion of attitudes and the different socialization patterns of girls and boys in our culture. This stereotyping is reinforced as the child progresses through school by the differential expectations and treatment of boys and girls by teachers, counsellors, parents, peers, and also through instructional materials and the media. It is known that parents and educators can intervene to modify the influence of sex-role stereotyping and to provide an equitable education for all students.

As well as working at the gender factor, researchers have studied how parental educational and occupational level effects their children's mathematics learning. And so the basic public and community issues pertain to how the dual disadvantage of sex-role stereotyping and social class can be overcome. More specific questions include:

* How can parents be sensitized to ways they can encourage and support their children in mathematics/science fields?

* How can public awareness be increased, especially among parents, teachers, counsellors, of the advantages of mathematics-related careers for women and their achievements in mathematics?

* How can schools take responsiblility for informing the community about the importance of girls' participation in mathematics?

* How can the commitment of national and local governments to supporting

mathematics education for girls and women be increased?

5. Call for papers

The ICMI Study on Gender and Mathematics Eduction will consist of two components, a **conference,** and a **publication** to appear in the ICMI Study series and based on the contributions to and the outcomes of the conference.

The exact site and dates of the conference have not been finally determined yet, but it will almost certainly take place in the Southern part of Sweden in October 1993.

Against the background presented above, the International Program Committee for this study invites individuals and groups to propose or submit contributions to the study for consideration by the Committee no later than **1 February 1993**. Contributions should be related to the problems and issues identified in this document but are not required to be limited to addressing these only. Participation in the conference is *only by invitation* of the Program Committee, but those who submit a contribution are encouraged to apply for an invitation.

Contributions and suggestions concerning to content of the study and the conference program should be sent to

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The International Program Committee consists of:

Gila Hanna, Ontario Institute for Studies in Education, Toronto, Canada **(Chair)**
Geoffrey Howson, University of Southampton, UK
Hans-Georg Steiner, Universität Bielefeld, Germany
Heleen Verhage, Freudenthal Instituut, the Netherlands

The Secretary of ICMI, Mogens Niss, Roskilde University, Denmark, is a member ex-officio.

6. References

CAUT (Canadian Association of University Teachers) (1991): *Status of Women Supplement*

Feingold, Alan (1988): Cognitive gender differences are disappearing. *American Psychologist* **23** (2), 95-103

Franklin, Ursula (1990): *The Real World of Technology CBC Massey Lectures*. CBC Enterprises, Toronto and New York

Hanna, Gila (1989): Mathematics achievements of girls and boys in grade 8: Results from twenty countries. *Educational Studies in Mathematics* **20** 225-232

Editors of journals, magazines and newsletters are encouraged to publish this document.

The General Assembly of ICMI

In accordance with the *Terms of Reference for ICMI*, The General Assembly, consisting of the National Representatives on ICMI (each representing an Adhering Organization) and the Executive Committee, is going to be held at ICME-7, Université Laval, Québec City, Québec, on **Tuesday 19 August, 18.00-20.00**. Information on the location of the assembly will be provided later in due course.

In case a National Representative be unable to be present at the General Assembly he or she is kindly asked to appoint a substitute. In addition to the official members of the General Assembly, representatives of the three affiliated international study groups, IOWME, HPM, and PME are invited to participate in the meeting.

The agenda of the General Assembly is as follows:

1. ICMI finances

2. Debate on ICMI activities 1988-92, including:

- ICMI internal affairs:
  - Members, National Representatives, Sub-Commissions, possible Adhering Organizations in the new republics of Eastern Europe.
  - Information and communication, incl. the Bulletin
- ICMEs 6 & 7
- ICMI Studies
- Affiliated study groups
- Regional meetings

3. Future plans and developments

- ICMEs 8 & 9
- WMY 2000
- Future Studies
- Affiliated study groups
- Fostering cooperation in mathematics education between developing and developed countries
- Regional meetings
- ICMI infrastructure

4. Any other business

As background information to this agenda reports from ICMI and its Affiliated Study Groups are published on the pages to follow.

Miguel de Guzmán, President, **Mogens Niss**, Secretary,

Report on

ICMI Activties 1988-92

Organisation
As from 1 January 1991 a new Executive Committee of ICMI took office. This resulted in a change of President (to Professor Miguel de Guzmán, Madrid, Spain), one Vice-President (to Professor Jeremy Kilpatrick, Athens (Georgia), USA), and Secretary (to Professor Mogens Niss, Roskilde, Denmark). Consequently, the Secretariat moved from the University of Southampton, UK, to the University of Roskilde. The new Executive Committee expressed its sincere thanks and deep gratitude to the Past President, Professor Jean-Pierre Kahane, Orsay, France, the outgoing Vice-President, Professor Emilio Lluis, Mexico, and the outgoing Secretary, Professor Geoffrey Howson, Southampton, UK, as well as to the outgoing Member, Hiroshi Fujita, Tokyo, Japan, for their work and enthusiasm.

After ICME-6 in Budapest, 1988, the old Executive Committee met, for the last time, in Paris, France, 19-20 January 1990, whereas the new one had its first meeting in Madrid, Spain, 9-10 April 1991.

In 1989 a National Sub-Commission was established in Mexico in accordance with the *Terms of Reference* for ICMI, item 4. Similarly, National Sub-Commissions of ICMI were established in Belgium and in New Zealand in 1991.

Finances
The accounts for 1991 appear on a separate page of this issue of the Bulletin.

ICMEs
The latest of the quadriennial International Congresses on Mathematical Education, ICME-6, was held in Budapest, Hungary, 1988. The Programme and Organising Committees for next congress, ICME-7, which is to be held at Université Laval, Québec, Canada, 17-23 August 1992, have invested immense efforts in planning the congress which is expected to have an attendance of more than 3000 participants from all parts of the world.

The Executive Committee has decided with great pleasure to accept Spain's bid to host ICME-8, 1996, in Sevilla. A general invitation to submit bids to host ICME-9, 2000, has been issued in Bulletins Nos. 30 and 31.

ICMI Studies
In the last few years ICMI has emphasised the holding of so-called ICMI study conferences on specific key themes and issues in mathematics education and in publishing subsequent study volumes. In 1989 a conference was held at the University of Leeds, 17-22 September 1989, on the theme *The Popularization of Mathematics*. The resulting study (210+ pages) was published by Cambridge University Press in 1990. In 1990 no conferences were held. However, also in 1990 the study *Mathematics and Cognition: A Research Synthesis by the International Group for the Psychology of*

Mathematics Education (180+ pages) was published, again by Cambridge University Press. The International Group for the Psychology of Mathematics Education is one of three study groups affiliated to ICMI.

In 1991 an ICMI study conference on *Assessment in Mathematics Education and Its Effects* was held in Calonge, Spain, 11- 16 April. More than 80 invited participants from 25 countries attended and contributed to the conference. A study based on this conference will appear late in 1992, most probably in two separate volumes and with a new publisher.

It is been decided to carry on with further studies in the years to come. The first one will be on *Gender and Mathematics Education* for which an international programme committee has been appointed with Professor Gila Hanna, Toronto, Canada, as Chair. The study conference is scheduled for 1993, most probably in the Southern part of Sweden. The next study will be on *What is Research in Mathematics Education, and What are its Results?*. An international programme committee has been appointed with Professors Jeremy Kilpatrick and Anna Sierpinska as co-Chairs. The study conference is scheduled for the spring of 1994, and it is planned that the outcome of the study be presented in the ICMI sessions of the International Congress of Mathematicians which is to be held in Zürich, 3-11 August 1994.

Outside the study series, ICMI has been involved in a producing a document on *Science and Mathematics Education for Future Elementary School Teachers* jointly with ICSU/CTS and UNESCO. The document is expected to appear in 1992, published by UNESCO.

Affiliated Study Groups
Three international study groups are affiliated to ICMI. These are *The International Study Group for the Relations Between the History and Pedagogy of Mathematics*, *The International Organisation of Women and Mathematics Education*, and *The International Group for the Psychology of Mathematics Education*. Separate reports from these groups are included in this issue of the Bulletin.

Every now and then, the Executive Committee of ICMI is being approached by international study groups on various themes and issues inquirying into the possibility of becoming affiliated to ICMI. The EC has decided to deal with the principal aspects of this matter on a general basis during its meetings at ICME-7, Québec, in August.

Regional Conferences
Financial support was given by ICMI to regional conferences held by the Southeast Asian Mathematical Society (Brunei, 14-16 June 1990), the Inter-American Committee on Mathematical Education (Miami (Florida), USA, 3-7 August 1991), and to the ICMI-China Regional Conference on Mathematical Education (Beijing, China, 5-8 August 1991).

ICMI Bulletins
In 1988-90 ICMI published Bulletins Nos. 24 - 29 by the then Secretariat at University of Southampton, UK. In 1991 Bulletins Nos. 30 and 31 were published by the new

Secretariat at Roskilde University, Denmark.

World Mathematical Year 2000

At a meeting in Rio de Janeiro, Brazil, in May 1992, The International Mathematical Union, IMU, announced that the year 2000 will be a World Mathematical Year, *WMY 2000*. In its capacity as a Commission of the IMU, ICMI has been involved in giving preliminary suggestions concerning the aims, content, and activities of WMY 2000. Furthermore, in addition to holding ICME-9 in 2000 ICMI is likely to be involved in planning some of the activities of WMY 2000.

Mogens Niss

ICMI

ACCOUNTS 1991, as of 31 December 1991

Swiss Francs Account:

Income:	
transfer from Southampton (20 March)	2 068.73
IMU (Schedule A: Administration)	10 000.00
IMU (Schedule B: Scientific Activities)	18 000.00
interest	1 098.09
total	31 166.82
Expenditure:	
transfer charges	17.78
transfer to DKR account	3 500.00
EC meeting April	1 989.34
President's expenses (incl. Assessment Conf.)	1 905.59
travel grants to PME participation from E. Europe	1 004.44
balance	**22 749.67**
total	31 166.82

Danish Kroner Account:

Income:	
transfer from Swiss Francs Account (3500)	15 867.25
payment of invoice	25.00
total	15 892.25
Expenditure:	
EC meeting April	6 318.00
Assessment Conference	5 614.25
bank charge	150.00
postage Bulletin	2 503.50
balance	**1 306.50**
total	15 892.25

Sterling Account:

Income:	
transfer from Southampton (15 April)	23 106.40
royalties for studies (CUP)	613.20
interest	1 552.75
total	25 272.35
Expenditure:	
transfer charges	4.82
balance	**25 267.53**

total	25 272.35

US Dollar Account:

Income:	
transfer from Southampton (22 May)	27 836.78
IMO returned (ICMI-China Regional Conf.)	1 494.78
interest	744.88
total	30 076.44
Expenditure:	
EC meeting April	977.20
Assessment Conference	679.20
Renewed grant ICMI-China Regional Conf.	1 505.06
Secretariat	150.60
balance	**26 764.38**
total	30 076.44

Notes:

1.
The British tax authorities claimed income tax amounting to about £ 1900 levied on interest earned when the Secretariat was in Southampton. It was decided in early 1992 to pay the tax.

2.
In order to reserve money to support ICME 7 related activities, incl. EC meetings, expenditures have been kept unusually low in 1991.

3.
Administration costs to compensate Roskilde University have not been paid in 1991. Such costs will have to be paid in 1992. The same is true with the printing costs of the Bulletin.

4.
In 1992 expenditures connected with the editing and publishing of the Assessment Study as well as with the mounting of new studies are anticipated to be noticeable.

Mogens Niss
28 January 1992, note no. 1 up-dated 18 June 1992

Report by ISGHPM
The International Study Group for the Relations Between the History and Pedagogy of Mathematics:

HPM Activities 1988-92

The activities of HPM are documented in the *HPM Newsletter*, which is edited by Victor Katz, Professor of Mathematics at the University of the District of Columbia, USA, and is now appearing three times per year in March, July and November. The *Newsletter* has a circulation of over 2500 worldwide and is distributed through a network of volunteer correspondents. It is still sent free of charge to all who request it. The *Newsletter* contains not only notices of future meetings and reports on past ones, but also book reviews, brief articles on how historical material has been used in the classroom, and a have-you-read? section, edited by Ron Calinger, Professor of History, Catholic University, USA, which includes a long list of books and articles which are of interest to readers of the *Newsletter*. To a certain degree HPM exists through this outstanding document which is supported by the University of the District of Columbia, USA.

Americas Section of HPM
The Americas Section of HPM has met each spring in conjunction with the annual meeting of the National Council of Teachers of Mathematics. Each meeting has involved several speakers showing in detail how the history of mathematics can be used to improve the teaching of mathematics. In April 1989 the meeting was held in Orlando, Florida. Speakers included Charles Jones on the American curriculum reform, Joel Lehman on indefinite series, David Kullman on prosthaphaeresis, Joan Countryman on the use of original dramatic productions about the history of mathematics, and Frederick Rickey on conic sections. All of those speakers were from the United States of America.

In April 1990 the meeting was held in Salt Lake City, Utah. The speakers included Stefano Luzzatto (Italy) on the philosophy of mathematics, Ubiratan D'Ambrosio (Brazil) on Vitruvius, Steven Heath on some ideas from Euclid's *Elements*, Frederick Rickey on questions about the source of "m" for slope, and William Campbell on teaching the history of mathematics.

The 1991 meeting was in New Orleans, Louisiana. Israel Kleiner (Canada) spoke on paradoxes in the history of mathematics, Willian Dunham discussed the Bernoullis and harmonic series, Frank Swetz dealt with the Chinese *Sea Island Classic*, Florence Fasanelli spoke on Benjamin Banneker, Victor Katz considered some themes from Islamic mathematics, and Frederick Rickey presented a selection of historical ideas in algebra.

The 1992 meeting in Nashville, Tennesee, included talks by Joe Albree on reform in geometry instruction, Duane Deal on Indiana and π, Karen Michalowicz on the use of history in middle schools, Frededrick Rickey on constructing regular polygons, and Katye Sowell on Hamilton's Icosian Calculus.

Meetings organized by HPM members
Naturally, there has also been much activity in the history and pedagogy of mathematics organized by members of HPM outside the annual Americas Section meetings. Each of these was advertised in the *HPM Newsletter* and reported there afterwards. In 1988 immediately following ICME-6, Otto Bekken (Norway) and Bengt Johansson (Sweden) held a two-week workshop on the uses of the history of mathematics in the classroom in Kristiansand, **Norway**, at which mathematicians from 11 countries gave presentations on their experiences. Proceedings are available from Frank Swetz at Pennsylvania State University, USA.

In **Italy**, Luciana Bazzini and Hans-Georg Steiner (Germany) organized a symposium in Pavia in October 1988, part of which was devoted to the role of history in mathematics education. Several teachers discussed how they use historical topics in secondary schools including such topics as Babylonian mathematics, Islamic mathematics, conic sections, non-Euclidean geometry, and the history of astronomy.

In the **Netherlands**, Jan van Maanen organized a two-day summer course in August 1989 entitled "Mathematics in the Golden Age". This course attracted 80 participants, mostly teachers, who learned about the history of mathematics in seventeenth century Holland and how some of the ideas could be incorporated in their courses.

The 1990 meeting of the Canadian Society for History and Philosophy of Mathematics in British Columbia, **Canada**, had a special session on history and pedagogy organized by Victor Katz. They keynote speaker was Judy Grabiner (USA), who gave a fascinating talk on the influence of Maclaurin on the development of some important ideas in calculus. Other speakers in this session were Israel Kleiner (Canada) who dealt with the evolution of number systems, Charles Jones (USA) who considered the beginnings of the new math movement, Erica Voolich (USA) who showed her multicultural and historical approach in the elementary classroom, Victor Katz who dealt with non-Western mathematics in the university classroom, and Frederick Rickey who showed how old calculus problems can still be used in a modern calculus class.

In **France**, Evelyne Barbin organized a summer school session in Lille in July 1990, which drew over 160 participants. Themes discussed included Babylonian mathematics, analysis, Galilean and Newtonian relativity, the work of Lebniz, and French algebraists around the time of Viète. All of the themes were ultimately related to pedagogical ideas. Barbin also organized a colloquium on teaching and history in May 1992 devoted to the concept of infinity.

In **Japan**, Ryosuke Nagaoke organized an HPM session in connection with the International Congress of Mathematicians in Kyoto, August 1990. There were short presentations dealing with the general subjects of history and pedagogy at this session as well as in the regular session of the Congress.

In **England**, John Fauvel organized HIMED 90, the History in Mathematics Education conference, held in Leicester in April 1990. HIMED 90 brought together teachers at all levels and from various countries and was successful that follow-up conferences were organized by the British Society for the History of Mathematics in 1991 and

1992. The proceedings of HIMED 90 were published in a recent issue of *For the Learning of Mathematics*.

Quadrennial meeting of HPM

In August 1992, just before ICME-7, HPM will have its quadrennial international meeting, at the University of Toronto, Victoria College. A very full program is planned for the three-day meeting. There will be eight 50-minute plenary talks and sixty 25-minute presentations on a wide variety of topics involving how the history of mathematics has been used in the classroom. Presentations will be in English with overhead transparencies in French and English. The meeting includes an outing to Niagara Falls, USA, and book displays. We expect attendees from at least forty countries to what will be the largest HPM meeting ever held.

Florence D. Fasanelli

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The HPM Newsletter is available free of charge upon request from the local distributor for your country/region. Information of distributor addresses may be obtained from the Editorial Office.

Report of IOWME
The International Organisation of Women and Mathematics Education

IOWME Activities 1988-92

During the period 1988-92 IOWME has seen substantial growth in terms of international membership and activities.

Membership
IOWME had National Coordinators in the following 17 countries in 1988:

Australia, Canada, Denmark, France, Germany, Hong Kong, Korea, Israel, The Netherlands, New Zealand, Northern Ireland, Nigeria, Sierra Leone, South Africa, Sweden, UK, USA.

It has now National Coordinators in 40 countries in both the developed and the developing world. The additional 23 countries were the following:

Argentina, Austria, Barbados, Belgium, Botswana, Burkina Faso, Dominican Republic, Greece, Hungary, Iceland, India, Ivory Coast, Japan, Morocco, Mexico, Norway, Pakistan, Papua New Guniea, Portugal, Republic of Singapore, Spain, Swaziland, Trinidad.

Activities
Newsletter: IOWME continues to maintain contact among its members through the dissemination of a Newsletter edited by Heleen Verhage and published twice a year. The Newsletter publishes summaries of research papers, reports on IOWME activities around the world, as well as exchanges of opinions annnnnd information among members. It is distributed to all IOWME members and to mathematics educators in universities, in boards of education and in schools. Teachers have found it an excellent source of information on new knowledge and progress in the area of gender issues in mathematics education.

Meetings: Several countries had local IOWME scientific meetings, and in addition international meetings have been held within the annual meetings of the PME. IOWME members have also held several conferences for teachers in which issues of gender and mathematics education figured prominently.

Publications: IOWME continues to be very active in the publication of research findings pertaining to gender and mathematics education. Members of IOWME published several books during 1988-92. Among these were:

Burton, L. (ed.) (1990): *Gender and mathematics: An international perspective.* Cassel, London.

Hanna, G. and Mertins, K. (1991): *Research on gender in mathematics, science and technology: An annotated bibliography 1980-1990.*

UNESCO, Paris.

Leder, G.C. and Samspon, S.N. (eds.) (1989): *Educating girls: Practice and Research* Allen & Unwin, Australia.

In addition the educational research journals have published numerous articles on gender issues.

ICMI Study: The next study to be conducted in the series of ICMI Studies will be devoted to Gender and Mathematics Education. The Discussion Document is published in this issue of the Bulletin. A background document by Gila Hanna and Gilah Leder was published in this Bulletin No. 30, June 1991. The study conference is planned for the fall of 1993.

Gila Hanna

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Report of PME
The International Group for the Psychology of Mathematics Education:

PME Activities 1988-92

The international Group for The Psychology of Mathematics Education, PME, holds its sixteenth annual meeting in Durham, New Hampshire, USA, in the summer of 1992. Most of the efforts of the organisation are concentrated on these week-long conferences, although there is now a newsletter produced twice a year and sent to the members.

PME is a forum for researchers in mathematics education whose bias is towards cognition and the psychology of learning and teaching. The conferences provide an opportunity for the presentation of research reports and the meeting of working and discussion groups. The working groups are each kept going by the active involvement of a small nucleus of researchers. Many of them continue the work by correspondence between meetings. Discussion groups are also given time during a conference in order that an exchange of ideas can begin. This might later lead to the foundation of a working group.

Working groups currently in existence are concerned with (1) teachers and teacher-training, (2) children's understanding of concepts in Algebra, Geometry, and Ratio and Proportion, (3) Social Psychology, (4) Advanced Mathematical Thinking, (5) Represenation, and (6) Classroom Research.

Since ICME-6, 1988, the society has made a significant step forward by producing three books. The activities of PME were described in *Mathematics and Cognition: A research synthesis by the International Group for the Psychology of Mathematics Education*, edited by Pearla Nesher and Jeremy Kilpatrick and published in the ICMI Study Series in 1990 (Cambridge University Press). Since then the working group concerned with *Advanced Mathematical Thinking* has produced a book of the same name edited by David Tall and published by Kluwer. UNESCO in the near future, will publish *Significant Influences on Children's Learning of Mathematics* edited by Alan Bishop with chapters by four members of PME. This book is intended for teachers and researchers who do not have access to PME meetings or proceedings. It provides details of results reported at PME conferences as well as those in journals.

Of greatest value, however, to researchers and their graduate students throughout the world, are the sets of proceedings available from each PME conference. These now regularly run to three volumes and contain the text of the plenary lectures and research reports on ongoing activities. About a third of the submitted research papers are not accepted for presentation. Opportunity is given for a poster presentation or for a brief oral report. These allow for discussion to take place between members involved in the same type of research or who are investigating the same topic.

Each year we greet members from countries which presviously had no representation. The venue of the meeting is in a different country each year, which allows for the

participation of those are are relatively local. A growing practice is that of mathemmatics educators in the host country (or in a neighbouring one) organising a conference for their own teachers, using the services of some of the visiting experts and thus reducing costs. PME has also had a small travel fund to assist researchers in the third world and under-represented groups to attend meetings.

Until 1991 all the organisation and administration of PME has been carried out on a voluntary basis by members. In 1991 we asked a past secretary of PME, Joop van Dormolen to consider becoming a part-time manager of the organisation. Having Joop as the link between past and future international committees, providing continuing stability and being our 'memory' will be invaluable as the society progresses and continues to flourish.

Kathleen Hart

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Committee for Mathematics Education
of the
European Mathematical Society

The European Mathematical Society (EMS) has established a Committee for Mathematics Education (CME). A main purpose of the committee is to enhance and initiate all kinds of activites related to mathematics education in research and practice in Europe. Therefore it is viewed for specific European purposes and interests to complement the highly valued rôle of ICMI whose construction is partly imitated by CME.

At the meeting of the Executive Committee of EMS in Prague (March 28-29, 1992) the Committee for Mathematics Education of EMS was re-established. This had become necessary after Dr. Tibor Nemetz had to resign due to his health condition. My first action to be taken as the newly appointed chairman of CME is to thank Tibor for his commitment. There cannot really be a replacement for him and we all wish that he will recover soon. He has laid a good foundation for CME and it is relatively easy for me to start from that.

I accepted the appointment as chairman of CME under the premises that this is a committee within the Society dedicated in principle to all aspects, questions and developments of mathematics education as a research field and as a practice field in schools and universities. That is a tremendously complex and widespread area of activities carried out by researchers and teachers at many different levels. Therefore it appears to be wise to choose some focus of interest and emphasis at least for the start of the committee.

By that we do not want to exclude any other topic or section of mathematics education and the following list of points is open to discussion in any case:

* **Undergraduate mathematics education** cureently shows a bunch of problems and phenomena which are worth investigating: resequencing of content (e.g. calculus vs. discrete mathematics), rôle and usage of computers, relation to computer science education, high drop-out rates, student learning and understanding, advanced mathematical thinking, proportion of independent student work vs. lectures, content and form of exams (e.g. when using the computer);

* A long standing and as yet unsolved problem is **mathematics as a service subject** in other studies. There too, the computer (e.g. via *Mathematica* or *Maple*) will give rise to changes in content and method (e.g. what about project studies and more integration with the main subject);

* In various places special types of curricula for **mathematics studies** are developed and implemented (like *Industrial Mathematics* and *Computer Science Mathematics*). Their rationales and goals are of much interest and the program should be evaluated adequately. Further, what is the relation to the more traditional studies? More generally, this addresses the question of

applications within the mathematical studies.

* The **recruitment of students** for mathematics studies is far from being satisfactory in many places. One should in more detail investigate the (complex) reasons and possible remedies.

* This leads to another propsed focus of work for CME: **matheatics education at the** (upper) **secondary level.** Here again a restriction will be wise, for instance to questions like the following ones:

  differentiated curricula vs. universal ones; how to differentiate; rôle and influence of computers and mathematical software; changes in the curriculum (e.g. discrete mathematics, dynamical systems); rôle of applications; affective aspects of mathematics education in school (how to create enthusiasm instead of disdain?).

* Many grave and serious problems are related to **transition from school to university**. New ideas for smoothing this sharp gap are needed.

* **Teacher education** might be the key to partly solving some of the problems mentioned above. Getting more information about successful models or projects would be very valuable here: Amount and content of mathematics education in teacher education; school practice; student teaching; scope of mathematics as part of the teacher education, etc.

Well, that is already a long and demanding list. How can and will CME support activities on these topics and problem fields? In general, the committee is very much dependent on what colleagues concerned with educating students in school and at university and mathematics education researchers are prepared to contribute. CME will offer:

* to communicate pertinent information on all related activities in the form of a supplement to the EMS newsletter. This supplement will also be distributed outside of EMS (like to mathematics education societies, teacher organizations, etc.). Welcome are among other items: (short) reports, announcements, hints to publications, and the like;

* to function as a general clearing house and point of liaison for contacts between EMS and all bodies professionally concerned with mathematics education;

* to initiate and enhance the organization of seminars on selected topics, e.g. from among the above list;

* to establish or to support establishment of study groups or special interest groups on specific topics;

* to support plans and projects for specific publications on mathematics educa-

tion.

Taking into account the limited resources - human and financial as well - CME views itself rather as acting as a catalyst for all these endeavours and as a forum for exchange of ideas and research outcomes. All those concerned with educational questions and problems are warmly invited to make use of CME and to contribute to our work. Please send all correspondence to the following address:

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Willi Dörfler

TIMSS

The Third International Mathematics and Science Study

The Third International Mathematics and Science Study (TIMSS) is a ten-year research project conducted under the auspices of the International Association for the Evaluation of Educational Achievement (IEA). More than fifty nations, from all regions of the world, and at all stages of economic development are participating. Cross-national studies have a long history, and the research foci of the current study result from reflection of past studies. The emphasis on the nature of assessment, and the importance of understanding the educational context as well as achievement measures guide the activities of TIMSS. The current climate of competitiveness is an economic reality and the effectiveness of the education system provides further impetus for this large study.

The International Coordinating Centre for TIMSS is housed at the University of British Columbia (UBC), Vancouver, Canada. Dr. David Robitaille, Head of the Department of Mathematics and Science Education in the Faculty of Education, is international coordinator for the project. Coordination of the activities takes place at UBC, but the development of background instruments and achievement surveys is distributed worldwide through the international composition of task forces and review committees, as well as through cooperative development ventures between institutions.

The curriculum analysis preparatory work has already begun, with the structuring of comprehensive analyses of texts and curriculum guides. An intensive survey of the time of introduction of topics and the age of concentration on those topics forms the basis for the achievement test development. Piloting of background questionnaires and achievement items is now being completed in several countries. This is the first three piloting phases. When piloting is completed, all items will have received international review, and item statistics will permit selection of the most appropriate questions.

There are regular newsletter puiblications that describe the status of TIMSS, discuss issues, and present information about both administrative and research aspects of the study. Interested readers will be added to the distribution list if they send their address to:

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The Mathematical Olympiad in Argentina

An Instrument for a Better Education for All

Recently, almost one hundred thousand students took part in the *Olimpiada Matemática Argentina* (OMA). They came from 2500 schools from all over the country. Today, when OMA is held every year, we have a truly substantial competition, and the number of participants is still increasing. The OMA reappeared in 1987 as an almost private adventure of a small group of people. Fourteen years before it had been practically forbidden.

Some remarkable aspects about this Olympiad should be emphasized:

* The young people were strongly motivated by the competition and were able to solve problems that were much more difficult than many of their teachers had thought them capable of mastering.

* There was a group of teachers of extraordinary enthusiasm and, above all, with an open attitude towards the capacity of their students which led them to set no *a priori* bounds to it.

* On the other hand, many people in academic circles were of the opinion that this activity was good and ought to be stimulated, but at the same time they were worried about the almost impossible task of setting the Argentinian students on a equal footing with those of other countries.

* Some theoreticians of mathematics education were looking with suspicion at this type of project, thinking that the spirit of competition might produce frustrations with those who are less successful.

What was the reason for such an enthusiasm *vis à vis* reluctance? The young people themselves, together with ther teachers, had discovered a new and fascinating activity: problem solving. And they were aware that what the Olympiad did was just to organize and stimulate this activity while adding to it the zest of competition.

Spreading the Olympiad throughout the country

The Olympiad is radipdly being spread out in Argentina because many teachers and students have discovered the great pleasure of solving problems. This is the real motor of the Olympiad. However, in order to make this activity accessible to others one had to make it known, to organize it, to create opportunities for others to share the pleasure of participating. The task of the OMA is to prevent the "problem solving fever" from dying out, and in order to achieve this it has to propose problems every now and then and offer all possible kinds of support to all those who accept the challenge of preparing themselves for the task of problem solving, students and teachers alike. The OMA organizers have to try to satisfy the appetite of all people addicted to problem solving.

On the other hand, the organization of the Olympiad took advantage of its competiti-

ve character in order to attract the attention of the mass media. The winners were interviewed by TV reporters and journalists, lay people wanted to know what was the spirit behind the Olympiads and began to ask what problem solving is and what kinds of problems were posed in such a competition.

The teachers and the OMA

The mathematics teachers form the backbone of the Olympiad. They are in charge of the local organization and of the student participation and they receive due credit for their well done job.

The OMA first round takes place in each participating school and the teachers themselves, who set and mark the problems, decide who will proceed to the second round. In this way they become truly instrumental in setting the right course for the Olympiad.

For the second and third rounds there are external juries, and the teachers devote themselves to coaching their own students for the contests. During the contests the teachers are offered organized lectures on various mathematical topics as well as problem solving sessions.

Teachers are also in charge of financially involving various local organizations in order to find funding of their teams. This task of course brings many frustrations with it but it also reinforces teachers' concern for the Olympiad. After many collective efforts, the final National Round is quite a *fiesta*.

Every teacher knows that there are talented teenagers in the country and that perhaps some of them are in his/her own place. One has to find them and prepare them appropriately. Once they are set on this roads towards excellence they easily surpass the teacher's ordinary expectations.

On the other hand, the OMA officials help teachers in various ways, for instance by providing them with appropriate books or by finding financial help to them from the government.

Problem solving becomes more than a pedagogical method, it evolves into an activity exercised for its own sake. And the only person capable of leading it is teacher appreciating and enjoying it him/herself. Olympiad teachers love to solve problems and are able to transmit their pleasure to their students in the classroom. Of course they are very pleased if in addition one of their students becomes the winner of the Olympiad.

The know-how behind the success

The OMA has to preserve the enthusiasm of both students and teachers, trying to carefully adjust the difficulty of the different tests. The students who pass the first round are strongly motivated add make great efforts in the continuation. Maybe some of them came to the first round almost incidentally, but if they pass it they will very happily stay in the Olympiad.

Teachers will keep working with their students on Olympiad problems at the same time as some of them are still participating in the competition. This helps keeping teacher's and students' interest alive.

The OMA introduces a group of very prestigious mathematicians as referees who with their guidance actively support the efforts of the organizers and protect the entire project from certain obscure forces in the educational system which might be powerful enough to paralyze the Olympiad.

An olympiad for each level, with a brilliant ending

The OMA is a set of three different simultaneous competitions corresponding to participants' school year. In this way, students can take part in the OMA during their whole period of schooling.

On the final day of the National Round there is an oral session. Three participants of each level explain a selected problem to the jury and the audience. This becomes a brilliant event at which everybody can see these young talents in action. It is finished with the proclamation of the champions within the festive and emotive frame.

Juan Carlos Dalmasso and **Patricia Fauring**, University of Buenos Aires, Argentina

SHORT NEWS

Iceland a new member of ICMI

It is a great pleasure for the ICMI EC to announce that the IMU Adhering Organisation in Iceland, The Mathematical Association of Iceland, has decided to register Iceland as a member of ICMI as from March 1992. The National Representative is

Dr. Kristín H. Jónsdóttir,
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ACOTS I

The First Asian Conference on Teaching Statistics, ACOTS I, is going to be held in 1993. The exact date and venue are yet to be decided.

II CIBEM

The Second Iberoamerican Conference on Mathematics Education, II CIBEM, will take place in Blumenau, Santa Catarina, Brazil, in 1994.

IASE

The International Association for Statistical Education, IASE, was created in September 1991 at the 48th Biennial Session of the International Statistical Institute (ISI) in Cairo. The IASE is devoted to the development and improvement of statistics worldwide through education and training. If you are interested in promoting the development of statistical education you will be welcome to join the IASE as a founding member. Please contact

IASE c/o The International Statistical Institute
428 Prinses Beatrixlaan, P.O. Box 950, NL-2270 AZ Voorburg, The NETHERLANDS
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ICOTS IV

The Fourth International Conference on Teaching Statistics, ICOTS IV, will be held under the sponsorship of IASE in Marrakesh, Morocco, in August 1994.

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(Readers are asked to notify the Secretary of any errors in or changes to this list)

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SINGAPORE	Dr. **Cheng Kai Nah**, Department of Mathematics, National University of Singapore, 10 Kent Ridge Crescent, Singapore 0511, SINGAPORE
SOUTH AFRICA	Professor **J.H. Webb**, Department of Mathematics, University of Cape Town, Rondebosch 7700, SOUTH AFRICA
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