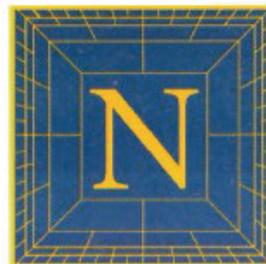


European Mathematical Society



December 2002

Issue 46

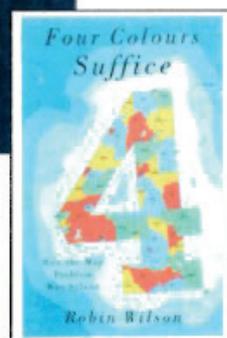
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David Brannan



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Interviews

**Rolf Jeltsch
L. Carleson & P. Jones**



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NEWSLETTER

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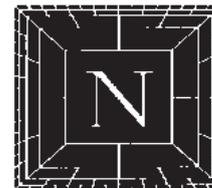
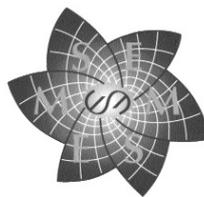
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NOTICE FOR MATHEMATICAL SOCIETIES

Labels for the next issue will be prepared during the second half of February 2003.
 Please send your updated lists before then to Ms Tuulikki Mäkeläinen, Department of
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EMS Agenda**2003****8-9 February**

Executive Committee meeting in Nice (France), by invitation of the local organisers of AMAM 2003

10-13 February

AMAM 2003: EMS-SMAI-SMF Meeting in Nice (France)

Mathématiques Appliquées - Applications des Mathématiques (Applied mathematics – Applications of mathematics)

Contacts: Doina Cioranescu, e-mail: cioran@ann.jussieu.fr and Mireille Martin-Deschamps, e-mail: mmd@math.uvsq.fr, webpage: <http://acm.emath.fr/amam/>

15 February

Deadline for submission of material for the March issue of the *EMS Newsletter*

Contact: Robin Wilson, e-mail: r.j.wilson@open.ac.uk

15 May

Deadline for submission of material for the June issue of the *EMS Newsletter*

Contact: Robin Wilson, e-mail: r.j.wilson@open.ac.uk

18-23 May

IPAM-SIAM-EMS Conference in Los Angeles (UCLA Lake Arrowhead Conference Center), USA

Applied Inverse Problems: Theoretical and Computational Aspects
webpage: <http://www.ipam.ucla.edu/programs/aip2003>

30 June-4 July

EMS Summer School at Porto (Portugal)

Dynamical Systems

Organiser: Maria Pires de Carvalho, e-mail: mpcarval@fc.up.pt
webpage: <http://www.fc.up.pt/cmup/sds>

7-12 July

CIME-EMS Summer School at Bressanone/Brixen (Italy)

Stochastic Methods in Finance

Organisers: Marco Frittelli and Wolfgang J. Runggaldier,
e-mail: runggal@math.eunipd.it

12-14 September

SPM-EMS Weekend Meeting at the Calouste Gulbenkian Foundation, Lisbon (Portugal)

2004**25-27 June**

EMS Council Meeting, Stockholm (Sweden)

27 June - 2 July

4th European Congress of Mathematics, Stockholm

Journal of the European Mathematical Society

The next issues of *JEMS* (Vol. 4, No. 4 and Vol. 5, No. 1) will contain the following articles:

Michael Hutchings, *An index inequality for embedded pseudoholomorphic curves in symplectic manifolds*;

Claire Voisin, *Green's generic syzygy conjecture for curves of even genus lying on a K3 surface*;

L. Capogna and N. Garofalo, *Regularity of minimizers of the calculus of variations in carnot groups via hypoellipticity of systems of Hörmander type*;

G. Faltings, *Algebraic loop groups and moduli space of bundles*;

B. Totaro, *Complexifications of nonnegatively curved manifolds*.

Editorial

Rolf Jeltsch (EMS President, 1999-2002)



As I leave my office as president at the end of this year, it seems appropriate to look back on the last four years. Before doing this, let me however inform you of the exciting things that are currently happening.

In November the start of the 6th Framework Program (6FP) was celebrated in Brussels by a conference with about 9000 participants. The EMS was of course represented and used the panel discussions to show the needs of the mathematics community. Our vice-president, Luc Lemaire, gives in a short article in this issue the different possibilities where mathematics can make use of the 6FP. In the report on the executive committee meeting last September (see page 11), you will see that the EMS plans to be involved in several projects. Since mathematics is not funded as a research subject by itself, except for the human resources and mobility part, these projects will mainly focus on improving the European infrastructure for mathematicians. The EMS submitted several expressions of interest in May to show our needs to the EU Commission. These dealt with enhancing the review data base *Zentralblatt MATH*, the participation of Europe in the world effort to retro-digitise the existing mathematical literature, at least the articles in important journals, to create a Digital Mathematical Library (DML), and the creation of an information gathering and dissemination portal for professional information, such as funding possibilities, positions, and so on. Another expression of interest, made by our committee of European Research Centres (ERCOM), was concerned with the integration of mathematics into the priority themes of the 6FP. You can find the full

text of these expressions of interest on our webpage www.math.ethz.ch/EMIS/news.html. The EMS plans to submit a project concerned with organising and supporting meetings, conferences and workshops. There is a lot of interesting and challenging work ahead of us.

With the creation of the so-called 'European Research Area' (ERA), the EU commission has given a clear sign that it wants to support science in Europe. In this context a discussion has been started as to whether a European Research Council (ERC) should be created. The EMS was the only society of researchers invited to a conference on this topic in October in Copenhagen. The EMS is now represented in two bodies of the European Science Foundation (ESF) – the Standing committee on Physical and Engineering Sciences, which includes mathematics, and the ESF EURESCO Committee.

As you know, the EMS received an invitation from our Norwegian corporate member to hold a council meeting in Oslo in connection with the Abel Bicentennial Conference. We held this year's Council meeting just before this event in Oslo (see page 5). I had the honour of thanking the Norwegian government and our Norwegian colleagues for giving this generous gift to the mathematics community. In my speech I promised that we shall help to raise the status of the Abel prize to that of the Nobel prizes. In the meantime, the EMS has made its suggestions for the Abel committee who will propose a winner to the Norwegian Academy. The committee consists of John Ball, Friedrich Hirzebruch, David Mumford, Jakob Palis and Erling Størmer, and has already started with its work.

The past four years

I hope you have all noticed that applied mathematics has become more visible. The major events have been the Berlingen declaration, the start of joint meetings (first with SIAM in Berlin last year), the upcoming conference with our two French corporate societies on *Applied Mathematics – Application of Mathematics* (AMAM) in Nice in February 2003, and a more specialised joint meeting with SIAM and the Institute of Pure and Applied Mathematics on *Applied Inverse Problems* in California (see *EMS Newsletter* 45). In addition, the Felix Klein prize has been created to honour an excellent mathematical solution to an industrial problem: this prize is given out at the European Congresses in Mathematics.

Already by 1999, our Corporate Member Societies covered almost all of Europe. At

the Council meeting in Barcelona, the European Society for Mathematical and Theoretical Biology became a corporate member. This year the Society of Industrial and Applied Mathematics in Italy (SIMAI) and the Italian Association of Mathematics applied to Economic and Social Sciences joined the EMS. Clearly, there are many more specialised societies that are still not Corporate Members of EMS – for example, in the research areas of statistics, operational research, actuarial sciences, mathematical programming, and many more. The number of individual members has risen by about one-third to approximately 2300. We have started to make reciprocity agreements, and we have also introduced a new category of membership, that of Academic Institutional Members.

To counteract the high price of journals, the executive committee of the EMS has decided to start a publishing house. The EMS founded the European Mathematical Foundation (EMF) as a non-profit organisation to run the publishing business. The EMF has its seat in Zürich and is registered with the local Chambers of Commerce. Currently the managing director, Thomas Hintermann, has a work-intensive period building up the infrastructure, and you can already visit its website www.ems-ph.org. The first issue of the newly acquired *Journal on Interfaces and Free Boundaries* is scheduled to appear in March 2003 (it has been produced up to now by Oxford University Press), and our own journal *JEMS*, which is extremely successful, will be produced by our publishing division from 2004. Two monograph series are in the making, and the new *ETH Graduate Lecture Series in Mathematics* will also be published by the EMS Publishing House. I am convinced that very soon you will see in your library the beautiful 'European flag' coloured journals and books of the EMS publishing house, the beautiful dark blue with yellow text.

Clearly, one of our most important activities is the organisation of our congresses, such as the Barcelona congress in 2000. The next will be in Stockholm in 2004 – the preparations are in full swing – and it promises to be an exciting event. You will find some details in the report on the Executive Committee meeting in Stockholm in this issue, and the newest developments will be updated on the webpage www.math.kth.se/~4ecm/. We continue to run summer schools, EMS lectures (in a new format), Diderot Mathematical Forums, and other special events. Following an initiative by our corporate member the Sociedade Portuguesa de

Matematica (SPM), we have now started a new format of two-day joint meetings with corporate societies: the first such event will be in Lisbon next September. We have also created a new committee, chaired by Luc Lemaire, to consider the structure and format of our scientific meetings and to prepare an application for its funding within the 6FP.

The EMS could not function without the important work done by its dozen committees: there would be too much to report on their achievements. Maybe I could just mention a few highlights: the activities during World Mathematical Year 2000 with the poster competition and the display of the winners, for example, in the Paris metro (giving rise to the founding of the standing committee for Raising Public Awareness); the successful Reference Levels project done by the Education Committee; the recent stepping-up of activities by the Committee for Developing Countries, and the work done by the Committee for Support of East European Mathematicians.

For me it was extremely important to contact all the EMS members, corporate societies and individual members. For this reason I initiated an annual letter at the turn of the year to each corporate society and to each individual member. In these letters I have tried to explain what was going on in the EMS, what were the ideas in my mind, and I asked for input from all members. I want to thank those of you who did give me feedback on these letters.

Let me add a personal note. These four years have been very gratifying for me. I have met many colleagues from almost all European countries, and while being different in culture, they all had one thing in common – their enthusiasm for mathematics and their desire to help the community. I would like to thank all of them. These positive contacts helped me to raise my personal energy to do as much as possible. My thanks go to all our corporate societies, they helped our cause, many initiatives came from them, and they responded positively when help and advice was needed. I have received invitations on many occasions, but I have to apologise to those whom I could not visit due to time constraints..

I think that this is also the time to thank all my colleagues on the executive committee, the officers of EMS, and the chairs of committees and the committee members. Without their help, all this could not be achieved.

It is also time to wish my successor Sir John Kingman a fruitful and interesting period during his term in office. From my interaction with him in the last year, it is clear to me that he will be an excellent president.

I do believe that the EMS will continue to grow, and with the current projects in store will expand dramatically in the coming years. It will serve its purpose to further the development of all aspects of mathematics in the countries of Europe. It will become THE important mathematical society in Europe.

6th Research and Technology Development Framework Programme of the European Commission

First deadlines announced for early March 2003

LUC LEMAIRE

FP6, the 6th Research and Technology Development Framework Programme of the European Commission, was officially launched in November 2002, and at the time of writing, it is foreseen that the first calls for proposals will be announced on 17 December, with deadlines for submission of proposals in early March 2003. This concerns in particular the sub-programme *Human Resources and Mobility*, which is the one most commonly used by mathematicians.

The Human Resources and Mobility Programme is a main part of the 'structuring the European Research Area' aspect of FP6. It appears as a continuation of the preceding Training and Mobility, and Human Capital and Mobility programmes of the EU, with some modifications, and a number of improvements. In particular, the overall budget has been increased.

As in the past, the distribution of the budget between research disciplines will be based *a posteriori* on the proportion of eligible proposals. Briefly put: the more the mathematicians ask for funding, the more will go to mathematics.

Here is a list of activities, whose titles mostly speak for themselves. The name 'Marie Curie' has become a generic name for all these activities.

Host-driven actions

This line of action is implemented by the following:

- Marie Curie Research Training Networks
- Marie Curie Host Fellowships for Early Stage Research Training
- Marie Curie Conferences and Training Courses
- Marie Curie Host Fellowships for the Transfer of Knowledge

All these actions are open to organisations (universities, research centres...), who will then call on the participation of individuals.

The first deadline should be 3 March 2003, with 230 million euros to be distributed.

Individual-driven actions

This line of action is implemented by the following:

- Marie Curie Intra-European Fellowships
- Marie Curie Outgoing International Fellowships
- Marie Curie Incoming International Fellowships

This includes the well-known Marie Curie individual fellowships, with a new opening outside Europe for the international fellowships.

The first deadline will be between March and May 2003, with a budget of 64 million euros.

Excellence promotion and recognition

This line of action is implemented by the following:

- Marie Curie Grants for Excellence Teams
- Marie Curie Chairs
- Marie Curie Excellence Awards

The first deadline for the Chairs is 3 March 2003.

Return and Reintegration mechanisms

This line of action is implemented by the following:

- A reintegration mechanism for researchers who have previously benefited from a Marie Curie action (Marie Curie European Reintegration Grants)
- A reintegration mechanism for European researchers who left for a third country more than five years ago (Marie Curie International Reintegration Grants)

The EMS is very happy (and slightly proud) about this new line of action, which was one of our proposals to the commission.

The first deadline is March 2003.

Opening to Candidate countries, associated States and third (other) countries

The 6th programme is more open to countries outside the EU than the preceding ones. For each action, a set of rules will be indicated concerning the participation of researchers from candidate countries, associated states and all other countries (whether developing or industrialised). I can only advise everyone to check carefully all the rules of participation.

How to act (now)?

When this *Newsletter* reaches you, it is likely that the Call for proposals is open, and that you can read it on the site <http://www.cordis.lu/fp6/calls.htm> (or see <http://www.cordis.lu/rtd2002>).

FP6 is an important opportunity for the development of European science, and should not be missed right from the start by active researchers.

EMS Council Meeting

Oslo (Norway), 1-2 June 2002

David Brannan



The 2002 meeting of the Society's Council was held in Auditorium 2 of Georg Sverdrups Hus of the University of Oslo, Norway. Around 60 delegates of members were present, together with members of the Executive Committee and some invited guests.

Address of the President, Rolf Jeltsch

The President reported that geographically almost all of Europe is represented in the EMS. Two important societies in Applied Mathematics had joined EMS: the European Consortium on Mathematics in Industry (ECMI) and the European Society on Mathematics and Theoretical Biology (ESMTB); however there were many more specialised societies that were still not Corporate Members of the EMS – for example, in the areas of statistics, operation research, actuarial sciences, mathematical programming, mathematical education and many more.

The development of Individual Members had been slow. The actual numbers had risen from about 1700 in 1998 to about 2200 in 2001. To make it easy to join the EMS, one could now join with an application form directly through the EMS Helsinki office, and only in subsequent years have the payments to the EMS to be made through the national corporate societies. In addition, one could now pay the EMS with credit cards.

Reciprocity agreements had been made with the American Mathematical Society, the Australian Mathematical Society and the Canadian Mathematical Society; the Council would be considering the introduction of a new membership category – namely, that of Reciprocity Member. Council would also be considering introducing the category of Academic Institutional Member, to allow departments of mathematics, research institutes

and academies to join with a financial contribution adjusted to their means.

The President had written an annual letter to each Corporate Society and to each Individual Member to explain what was going on in the EMS, what were the ideas in his mind, and inviting input from all members. In addition, he had attended many conferences organised by Corporate Societies; in particular, visiting many Eastern European countries so as to have a better understanding of their problems. Since the Barcelona Council in 2000, he had visited Bulgaria, Hungary, Romania and Ukraine, and would soon visit Estonia, Poland and (again) Romania.

He had accepted becoming President of the EMS to a large extent because of his personal belief that there should be just one society caring for all of mathematics. At the time he took over the Presidency, many applied mathematicians did not feel that the EMS was 'their' Society. Since then, the EMS had changed the name of the Committee for Applications of Mathematics to the Committee for Applied Mathematics. He had also invited all parties involved – Corporate Societies, but also societies outside the EMS that are concerned with applied mathematics and/or applications of mathematics – for a brainstorming weekend in Berlingen, on 4-6 May 2001. About three dozen participants talked for two days, sometimes working until after 10 p.m., in small groups on the issues. The result was the so-called Berlingen Declaration, which was on EMS and was published in EMS *Newsletter* 40 (June 2001). This workshop increased the EMS visibility and acceptance with other societies concerned either with applied mathematics or with applications of mathematics.

To make EMS more visible to applied mathematicians, the EMS had organised a

conference jointly with the American-based Society for Industrial and Applied Mathematics (SIAM) in Berlin, from 3-6 September 2001, on 'Applied Mathematics in our Changing World'. This covered medicine, biotechnology, materials science, environmental science, nanoscale technology, communications, traffic, markets and finance, speech and image recognition, and engineering design; it also included a round table discussion on 'Applied Mathematics in Europe'. The conference had attracted about 420 participants from 42 countries (36 of them European).

This first EMS-SIAM conference would be followed by a specialised joint conference on inverse problems in May/June 2003 in Los Angeles. EMS was also currently preparing the first joint conference with the two French societies, Société de Mathématiques Appliquées et Industrielles (SMAI) and Société Mathématique de France (SMF): *Applied Mathematics – Applications of Mathematics, Mathématiques Appliquées – Applications des Mathématiques* in Nice, on 10-13 February 2003. The Executive Committee would give weight to this event by holding its half-yearly meeting just prior to the conference in Nice, on 8-9 February.

In addition the Editor-in-Chief of the EMS *Newsletter*, Robin Wilson, the Executive Committee and the Committee on Applied Mathematics had made applied mathematics more visible in the *Newsletter*.

The EMS also supported the successful bid of the Swiss Mathematical Society to hold the International Congress on Industrial and Applied Mathematics (ICIAM 2007) in Zürich, Switzerland. It was proposed that the EMS support this event and was clearly visible there.

To counteract the high price of journals, the EMS had decided to launch its own publishing house. It had founded the European Mathematical Foundation (EMF) as a non-profit organisation to run the publishing house. The EMF has its seat in Zürich and is registered with the local Chambers of Commerce. Its Managing Director, Thomas Hintermann, started to work for the EMS publishing house on 1 September 2001.

The most important work with European institutions had been influencing the shaping of the '6th Framework Programme' in such a way that it is flexible enough to be optimally used by the mathematical community. The President had attended various events organised by the EU Commission, and his personal presence had the advantage that he was able to pre-

sent the views of the mathematical community in the public discussions and in the informal discussions during breaks.

For the EMS, three projects to improve infrastructure via the 6th Framework Program had been identified:

1. Making *Zentralblatt MATH* an even more European large infrastructure;
2. Digitisation of hard copy mathematics articles/journals/books;
3. Mathematics community information as currently provided on the left-hand side of the EMIS web page (e.g. Euro-Math-Job).

In all three projects the aim was to find several member states to contribute directly and then apply for supplementary support from the EU Commission. The EMS had held a brain-storming weekend in Berlingen, Switzerland, 19-21 April 2002, to discuss the first two projects, plus its long-term policy on meetings and the EMS Publishing House.

The President reported that the next European Congress of Mathematics would be held from 28 June to 2 July 2004, in Stockholm, Sweden. The President of the local Organising Committee was Ari Laptev, and the Scientific Committee was chaired by Lennart Carleson (the Vice-Chair being Björn Engquist).

Following a proposal from the Sociedade Portuguesa de Matemática to start EMS regional meetings jointly with some Corporate Societies, the EMS would be doing just this; they would be along similar lines to the AMS 'Regional Meetings' in the USA. To handle a range of new initiatives for future meetings, the EMS had created an ad hoc Committee on Meetings; in particular, this committee would bid to the EU for money to fund a number of meetings, and would plan a structure to handle the money and the applications for support of meetings.

The Executive Committee had introduced an arrangement for Society committees that every four years a new person should become committee Chair. The idea behind this decision was to distribute the burden of serving the community across more shoulders, and to give other people the possibility to present their ideas. However, sometimes it was not easy to find a person to take up the chair. The EMS had now invited all Committee chairs to meet in Oslo to discuss these problems and possible solutions.

The EMS had become a member of the following institutions:

1. *Institut für wissenschaftliche Information e. V.* (IWI) at the University of Osnabrück, Germany. Its aim is to further research and scientific education, and in particular to develop, in cooperation with university institutions and other national and internationally recognised non-profit organisations, user-oriented systems and tools for information and communication of scientific results (e.g. digital libraries, pre-print search engines, etc.).
2. *Centre International de Mathématiques Pures et Appliquées* (CIMPA), established in Nice (France) in 1978. Its aim is to



promote international cooperation in higher education and research in mathematics and related subjects, particularly in computer science, for the benefit of developing countries. For example they organise a programme of doctoral schools, summer schools, conferences, etc. – see their web page: <http://www-mathdoc.ujf-grenoble.fr/CIMPA/index.html>

The year 2002 was the 200th anniversary of the birth of Niels Henrik Abel, the leading man of science in the history of Norway. To mark this occasion, the Government of Norway, at the suggestion of the Department of Mathematics of the University of Oslo, had undertaken to establish an *Abel Prize* in Mathematics, following the model of the Nobel prizes. It was with great pleasure that the EMS wrote a supporting letter in the process of the creation of this important new prize. The President congratulated the Norwegian nation and thanked it for donating this prize to the mathematical community.

The President commented on his belief that the EMS would continue to grow, and with the projects in store to expand dramatically in the coming years. It would serve its purpose to further the development of all aspects of mathematics in the countries of Europe, and would become *the* important mathematical society in Europe.

The President thanked the ETH for its generous financial support and provision of excellent infrastructure support during his term of office; also everyone who had helped him – the members of the Executive Committee, the officers, chairs of committees, officers of corporate societies and also those individuals who wrote directly to him, to give him support or mention things one could do. Most of all, he thanked the EMS Executive Secretary, Tuulikki Mäkeläinen, who had been a pillar of strength and had cheered him up with many short e-mails, and his two extremely able secretaries at ETH, Angela Rast and Eleonora Ghertsos.

Revisions to the Rules for EMS Prizes

The Executive Committee had proposed various changes and clarifications to the rules for the award of EMS Prizes. Council approved the new rules:

General points

1. 10 'EMS Prizes' for young mathematicians in Europe may be awarded at each European Congress of Mathematics.
2. The EMS and the Local Organising Committee of the ECM will be partners in the effort to find support for the prize money and travel support for prizewinners. The amount of each prize will be the same, and will be agreed between the EMS Executive Committee and the Local Organising Committee.
3. Following the identification of the Chair of the Prize Committee, their name, address and e-mail address will be published in the EMS *Newsletter*, together with an invitation from the Chair to all mathematicians to send in suggestions (with reasons) and one or two names of people who could be contacted for further information on the nominee. This call should be published in the EMS *Newsletter* and on EMIS, sent to EMS member societies, and included on the Congress web page.

Eligibility for an EMS Prize at an ECM

1. Eligibility for an EMS Prize is open to any persons who have not reached their 35 birthday on 30 June of the year of the Congress.
2. In the event of a possible candidate having had a broken career pattern, a corresponding increase in age will be acceptable at the discretion of the Prize Committee, subject to the candidates not having reached their 38 birthday on 30 June of the year of the Congress. (By way of example only, this provision is intended to cover items such as military service, women having children, etc.)
3. Mathematicians are defined to be 'European' in this context if they are of a European nationality, or their normal place of work (including study) is within Europe, or a substantial amount of their mathematical work has been done within

Europe. Europe is defined in this context to be the union of all countries part of which is geographically within Europe, or that have a corporate member of the EMS based in that country.

4. Prizes are to be awarded for the scientific merit of the candidates' work.
5. The Prize Committee must endeavour to ensure a fair balance of nominations, as regards the following criteria: speciality within mathematics, nationality, and geographical base.

Revision of the Society's Charter and Statutes

The Executive Committee had suggested various changes to the Charter and Statutes of the Society, which the Secretary outlined. Two proposals were made from the floor, one regarding the division of some items into different items, the other suggesting the election of Honorary Members (a move endorsed by earlier Council meetings) to be treated in con-

junction with other changes to the Statutes. Council endorsed the proposed changes, together with the proposed divisions, but (in a vote) rejected the proposal to have Honorary Members. Council authorised the Executive Committee to make such further minor technical changes as might be required by the Finnish authorities.

Report of the Secretary

The Secretary, David Brannan, reported on the discussions at the four Executive Committee meetings since the previous Council meeting in Barcelona in 2000.

Report of the Treasurer

The Treasurer, Olli Martio, noted that the financial resources of the Society, though not large, were healthy and stable. The financial statements for the years 2000 and 2001 were accepted, as were the budget and membership fees for 2003 and 2004 proposed by the Executive Committee. In particular, the membership fee for individual EMS members would be increased from 15 euro to 20 euro.

Membership of the Society

It was agreed to change the class of various corporate members: the Israel Mathematical Union from Class 2 to Class 3, the Belgian Mathematical Society from Class 1

to Class 2, and the Norwegian Mathematical Society from Class 1 to Class 2. The Association for Mathematics Applied to Social and Economic Sciences (AMASES) was accepted as a full corporate member, in Class 1, and the Società Italiana di Matematica Applicata e Industriale (SIMAI) was accepted as a full corporate member, in Class 1.

The Council approved the Reciprocity Membership agreements with the Australian Mathematical Society and the Canadian Mathematical Society.

Council noted that the Voronez Mathematical Society may have ceased to exist, and so cancelled its membership of the EMS; it was commented that Voronez has an Academy which could become an institutional member of the EMS.

Elections to Executive Committee

Sir John Kingman was elected President for 2003-06. Luc Lemaire was re-elected

as Vice-President for 2003-06. Olli Martio was re-elected as Treasurer for 2003-06. Helge Holden was elected as Secretary for 2003-06.

There were three nominations for the two vacant members-at-large seats. A secret ballot was conducted, with the result that Doina Cioranescu and Pavel Exner were elected members-at-large of the Executive Committee for the years 2003-06.

Election of Auditors

Pekka Kaasalainen, CPA, and Johan Weckman, CPA, as Deputy, were elected as professional auditors of the EMS accounts for 2003 and 2004. John Hubbuck and László Márki were re-elected as auditors for the accounts of 2003 and 2004.

Detailed review of the various Society activities

The following reports from Officers and Committees were received and accepted, in some cases after a short discussion:

- *Publications*, by Publications Officer Carles Casacuberta: Council thanked him for his excellent work.
- *Newsletter Editor* Robin Wilson: Council thanked him for a great job.
- *JEMS (Journal of the EMS)*: Rolf Jeltsch and Jürgen Jost. This covered the subscription list and the move of the journal to the EMS publishing house in 2004.

Jürgen Jost was thanked for his valuable contribution in creating a high-standard journal.

- *EMS Publishing House and European Mathematical Foundation*. Rolf Jeltsch explained briefly the financial situations of the Publishing House and of the European Mathematical Foundation, and Thomas Hintermann, the EMSph Managing Director, outlined his plans for the Publishing House.
- *Publicity Officer* David Salinger: This covered a range of posters, press releases, and material for prospective members. David Salinger now writes a monthly article for the London Mathematical Society *Newsletter*; this article is freely available to any other society, by e-mail on request.
- *Applied Mathematics Committee*: Saul Abarbanel's report expanded on the President's earlier remarks on the effort to involve the applied mathematics community.
- *Database Committee*: Laurent Guillopé explained some of the difficulties that the committee had faced, and made various suggestions for the way forward. The Executive Committee had decided to wind up the committee in its present form.
- *Developing Countries Committee*: Herbert Fleischner briefly commented on the interesting future plans of the Committee.
- *Education Committee*: Tony Gardiner outlined the committee's activities, including the problems that it had experienced.
- *Electronic Publishing*: Bernd Wegner reported on the Committee's work, as well as on the EULER and LIMES projects, and urged the delegates to try EULER (available from the EMS home page) once back in their offices.
- *ERCOM (European Research Centres on Mathematics)*: Manuel Castellet, the new ERCOM Chair, commented on various recent activities and future plans.
- *Group on Relations with European Institutions*: Luc Lemaire presented some of the successes that the EMS had had with the European Commission, as well as on the problems the EMS had faced.
- *Raising Public Awareness Committee*: Vagn Lundsgaard Hansen described various activities in some countries that had proved successful.
- *Special Events Committee*: Jean-Pierre Bourguignon reviewed various Diderot Forums, and Rolf Jeltsch commented orally on the activities and plans of the committee.
- *Summer Schools Committee*: Rolf Jeltsch reported on the committee's activities, and Mina Teicher described the future plans. The Committee as such had been dissolved, but its work would be continued under a different format.
- *Committee for the Support of Eastern and Central European Mathematicians*: Andrzej Pelczar reported on the financial support given to various individual mathematicians and mathematical events, including the committee's efforts in



awarding the Abel grants for the Abel Bicentennial Conference in Oslo.

- *Committee on Women and Mathematics:* Emilia Mezzetti had prepared a report on an interesting survey conducted by the committee, and Bodil Branner made some additional oral comments.
- *Publications Committee:* Carles Casacuberta reported on various activities, and listed the various publications that had appeared as well as those under preparation.

European Congress of Mathematics

ECM4 would be held from 27 June to 2 July 2004, in Stockholm (Sweden). Ari Laptev, the Chair of the Organising Committee, reported briefly on the arrangements for the Congress. The web



Ari Laptev

address of the Congress is www.math.kth.se/~4ecm.

The Opening Ceremony, with the announcement of the EMS prizewinners, was planned to start in the early afternoon. The Chair of the Prize Committee was Nina Ural'tseva. Novelties of ECM4 would be both Network lectures and Nobel-connected lectures.

The procedure for the selection of the 5th Congress had been widely circulated, and had also appeared in the EMS Newsletter.

Berlingen Declaration on Applied Mathematics

Rolf Jeltsch reminded the Council of the main points of the declaration:

1. The presence of applied mathematics in EMS bodies and policy decision making should be significantly increased.
2. The Applied Mathematics Committee must be kept an active body for the time being. Its mission statement should be adapted to the new role of the committee. The Chair should be invited to the Executive Committee meetings.
3. Pure and applied mathematics should be equitably represented in the publications of the EMS.
4. Special interest groups should be created gradually.
5. The EMS should consider increasing its activities by collaborating with international, national and regional societies in organising meetings.
6. The EMS should further develop its

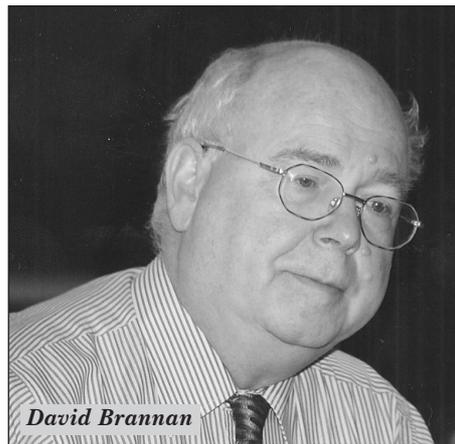
Summer School Programme. It is noted with satisfaction that the existing programme includes topics in both pure and applied mathematics.

7. The EMS should work towards the goals that:
 - (a) students majoring in mathematics should be exposed to applications of mathematics in sciences or other areas;
 - (b) high-school teachers should have adequate education in applied mathematics and mathematical modelling.
8. EMS should formulate a position with regard to the Bologna Declaration of 1999.
9. It is noted with satisfaction that the EMS established a Committee to raise public awareness of mathematics. The EMS should promote local initiatives, encourage collaboration with various organisations, and collect and disseminate information on initiatives of member societies in this area.

Council supported the Berlingen Declaration with enthusiasm.

Future Meetings

- *amam2003*, 10-13 February, 2003, in Nice (France). The Chairs of the Scientific Committee are P.-L. Lions and S. Novikov, and the home page for the event is: <http://acm.emath.fr/amam>. There would be only plenary speakers, mini-



David Brannan

symposia, Round Tables and poster sessions. Two satellite meetings had been arranged, both before and after the main meeting.

- Joint meeting of the EMS and the Portuguese Mathematical Society on 12-14 September 2003, in Lisbon (Portugal).
- Joint meeting of IPAM, EMS and SIAM on *Applied Inverse Problems* in May/June, 2003, in Los Angeles.

EU-related topics

Luc Lemaire presented the plans of EMS to get funding from the EU within its 6th Framework Programme:

- a series of conferences in the same or related subjects;
- a Congress every 4 years;
- two summer schools per annum;
- Diderot mathematical forums;
- joint meetings with other societies;
- EMS lectures: one person in one place, possibly enlarged to a conference, of

around 8-10 lectures;

- EMS mathematical weekends (such as that planned in Portugal for September 2003): 4 parallel sessions chosen by local organisers with plenary speakers. Council agreed that Education was also an important topic not to be forgotten.
- An Expression of Interest had been prepared in relation to a web initiative making information more widely available on jobs, conferences, ad a calendar of events, and sent to the European Commission. Additional interested parties would be most welcome.
- An Expression of Interest had been prepared in relation to Digitisation of Mathematical Literature, and had been sent to the European Commission; it would be much better if more countries could be involved. The purpose of the DML (Digital Mathematics Library) Project is to digitise old mathematical literature and to create new electronic articles, compatible with old articles. Several programmes were under way in various countries, but a joint world effort should be made. Plans had been made and several meetings held to explore this goal. Council felt that Europe had a key role in the digitising of old mathematical literature.
- An Expression of Interest had been prepared in relation to making *Zentralblatt für Mathematik* an even more pan-European venture, and sent to the European Commission. It was felt essential that more countries should be involved in this particular project too.

Miscellanea

A Society member had suggested for Council discussion the topic of establishing Special Interest Sections. Council instructed the Executive Committee to think about this matter, and suggested a soft structure for it.

There was a lively discussion on the Bologna Declaration. Finally an ad hoc Committee was formed (comprising Martin Grötschel, Luc Lemaire and David Salinger) with a watching brief.

Next Council Meeting in Stockholm

As the dates of the 4ECM were 27 June to 2 July 2004, the Council meeting would be on Saturday 26 to Sunday 27 June 2004, from 10 a.m. on 26 June to 2 p.m. on 27 June.

Closing remarks

Rolf Jeltsch thanked Council members for their lively discussions and active participation. He also expressed the thanks of the delegates to the local organisers of the meeting – the Department of Mathematics of the University of Oslo, the Norwegian Mathematical Society and Dag Normann.

Chris Lance thanked Rolf Jeltsch for the enormous energy and enthusiasm he had shown in his activities as EMS President, with detailed interest in all the EMS enterprises. The Council appreciated his large-scale vision how to carry the Society forward and the ways to get funding for EMSph and several fruitful meetings.

EUROPEAN MATHEMATICAL SOCIETY STATUTES

as approved by EMS Council on 1 June 2002

Name and location

ARTICLE 1

1. The European Mathematical Society, informally "EMS", is an association established in accordance with the laws of Finland.
2. Its seat is in Helsinki, Finland.

Purpose and nature of activities

ARTICLE 2

1. The purpose of the Society is to promote the development of all aspects of mathematics in the countries of Europe, with particular emphasis on those which are best handled on an international level.

The Society will concentrate on those activities which transcend national frontiers and it will in no way seek to interfere with the national activities of the member societies.

In particular, the Society will, in the European context, aim to promote mathematical research (pure and applied), assist and advise on problems of mathematical education, concern itself with the broader relations of mathematics to society, foster the interaction between mathematicians of different countries, establish a sense of identity amongst European mathematicians, and represent the mathematical community in supra-national institutions.

2. To achieve its aims the Society may prepare proposals and motions, make statements, organise courses and seminars, arrange negotiations and meetings, operate as a publisher, award grants and represent its membership.
3. The society may, as occasion arises,
 - (a) act directly,
 - (b) act through national societies,
 - (c) cooperate with other bodies having similar aims,
 - (d) set up subordinate bodies for special tasks.

Membership

ARTICLE 3

1. Members of the Society may be either
 - (a) corporate bodies with legal status, or
 - (b) individuals.
 The number of non-Finnish members may exceed one third of the total.
2. Corporate bodies with legal status may join the Society in one of the following categories:
 - (a) Full members,
 - (b) Associate members,
 - (c) Institutional members.
 Full membership is restricted to societies, or similar bodies, primarily devoted to promoting research in pure or applied mathematics within Europe. Associate membership is open to all societies in Europe having a significant interest in any aspect of mathematics. Institutional membership is open to commercial organisations, industrial laboratories or academic institutes.
3. Individuals may join the Society in one of the following categories:

(a) Individuals belonging to a corporate member of the EMS,

(b) Individuals belonging to a Society with which the EMS has a reciprocity agreement,

(c) Individuals not belonging to a corporate member of the EMS or to a Society with which the EMS has a reciprocity agreement.

4. Full corporate members are elected by the Council and other corporate and individual members by the Executive Committee. Reciprocity agreements are approved by the Council. A reciprocity agreement is an agreement between the EMS and another society concerning benefits to joint members. The expulsion of a member shall be by a decision of the Council. The procedure shall be regulated by the By-laws.
5. Members may terminate their membership by giving one year's notice in writing to the Executive Committee or to the President, or by notifying the Council at its meeting to be recorded in the minutes.
6. Members pay registration and membership dues as determined by the Council. The dues may be different for different categories of member.
7. Members who fall behind in payment of fees shall, until such fees are paid, forfeit their right to vote.
8. Members take decisions by mail ballot when this is authorised by the Statutes. The procedure shall be regulated by the By-laws.

Organs

ARTICLE 4

1. The organ of the Society with decision-making powers is the Council. The executive organ is the Executive Committee of the Society.

The Council

ARTICLE 5

1. Council elections are held every second year by postal vote according to the Statutes and By-laws.
2. Delegates shall be elected for a period of four years. A delegate may be re-elected provided that consecutive service in the same capacity does not exceed 8 years. A delegate who resigns or is unable to attend a Council meeting can be replaced by a deputy delegate according to the By-laws.
3. Each of the following groups shall elect the delegates representing the group: Each full member, the associate members, the institutional members, the individual members. The candidates for the election are nominated by the group.
4. Full members will, as decided by the Council, be divided according to size and resources into three classes having 1, 2 or 3 delegates. This division may be revised when appropriate.
5. When the number of associate members is n , the number of their delegates shall be given by the formula $\min \{(n-1)/5\} + 1, 4\}$. The number of delegates represent-

ing institutional members shall be determined by the same formula. When the number of individual members is n , the number of their delegates shall be given by the formula $\min \{(n-1)/100\} + 1, \lfloor 2C/3 \rfloor$, where C is the total number of other Council delegates.

6. The Council shall meet at least once every two years not earlier than May and not later than October.
7. Each Council delegate shall have one vote. Decisions will be by simple majority of votes cast, except where larger majorities are required by the Statutes or By-laws.
8. An extraordinary meeting of the Council may be convened at the request of the Executive Committee, or whenever this is requested in writing by not less than 10% of the Delegates.
9. The Executive Committee shall convene the Council by a letter to each Council delegate not later than two months before the meeting date.
10. The quorum of the Council shall be two-fifths of its total number.
11. Regional subgroups of the Council may be constituted for the purpose of dealing with political or economic European organisations.

Duties of the Council

ARTICLE 6

1. The Council is the supreme authority of the organisation.
2. A Council meeting will specifically
 - (a) decide on the admission of full corporate members;
 - (b) determine the registration and membership dues;
 - (c) receive the auditors' reports;
 - (d) confirm the financial statements and discharge those concerned from liability;
 - (e) elect the President, the Vice-Presidents and the other members of the Executive Committee;
 - (f) elect the auditors and their deputies;
 - (g) decide on the By-laws issued by the Council;
 - (h) deal with any other matters prepared by the Executive Committee.

The Executive Committee

ARTICLE 7

1. The Executive Committee of the Society shall consist of
 - (a) the President of the Society,
 - (b) two Vice-presidents,
 - (c) a Secretary,
 - (d) a Treasurer,
 - (e) n other Committee members, $2 \leq n \leq 5$.
2. Members of the Executive Committee shall be elected for a period of 4 years. Committee members may be re-elected provided that consecutive service shall not exceed 8 years. However, any Committee member who is elected President may continue in that position provided that his/her consecutive service shall not exceed 12 years. The President shall not serve as President for more than one period.
3. The Executive Committee is convened by the President or, in his absence, by a Vice-president.
4. The quorum of the Executive Committee shall be four and must include the President or a Vice-President.

Duties of the Executive Committee

ARTICLE 8

1. The Executive Committee represents the Society and shall have general charge of all matters concerning the Society. In particular it shall:
 - (a) administer the assets and property of the Society;
 - (b) appoint subordinate committees entrusted with special tasks within the general framework of the Society;
 - (c) prepare the matters to be discussed by the Council meeting and convene the meeting;
 - (d) implement the resolutions adopted by the Council meeting;
 - (e) appoint representatives of the Society to scientific conferences or meetings.
2. The Executive Committee shall appoint and dismiss the staff of the Society, define their duties and confirm their remuneration.

Signing for the Society

ARTICLE 9

1. The Society is signed for by its President, or a Vice-president together with another member of the Executive Committee.

Finance

ARTICLE 10

1. The resources of the Society shall consist of
 - (a) the registration and membership dues paid by the members;
 - (b) possible gifts, bequests and legacies;
 - (c) subsidies or grants which may be awarded to it by public or private bodies;
 - (d) any other resources which may derive from its own activities mentioned in Article 2.
2. The registration and membership dues depend on the different categories and classes of members as defined in Articles 3 and 5.
3. The fiscal year shall be the calendar year. The accounts shall be submitted to the auditors by the end of March. The auditors' report shall be submitted to the Executive Committee by the end of April.
4. The Council shall appoint, for each financial year, two of its own members and a certified public accountant, together with a deputy for the latter, to audit the accounts of the Society. These auditors may at all times require that the books and all relevant documents be presented to them, and they may examine the cash and financial situation.
5. The auditors may be re-appointed.

Amendments

ARTICLE 11

1. Any proposal to amend the statutes or to dissolve or merge the Society shall be sent in writing to all members of the Society at least two months before the meeting of the council which shall decide upon such a proposal.
2. To be approved any such proposal must be passed by two-thirds of the votes cast in the Council.
3. In the event of the Society being dissolved or abolished, any assets remaining after discharge of all debts shall be transferred to a legal body having aims similar to those of the Society.

EUROPEAN MATHEMATICAL SOCIETY BY-LAWS

I. MEMBERSHIP

- RULE 1: Corporate bodies wishing to become members of the EMS should provide appropriate evidence of their nature and activities.
- RULE 2: Individuals belonging to corporate members of the EMS or to societies having a reciprocity agreement with EMS may apply through their organisations for individual membership of the EMS.
- RULE 3: Individuals not belonging to corporate members of the EMS or to societies with a reciprocity agreement with EMS may apply directly for membership of the EMS.
- RULE 4: Newly elected members shall be informed of their election and receive the relevant documents.
- RULE 5: No election of members shall be effective until the relevant fees have been paid.
- RULE 6: Expulsion of a member shall be by a decision of the Council. The Executive Committee shall present to the Council a full report on the reasons for the proposed expulsion before the matter is considered by the Council. Individual members who have not paid their fees have resigned their membership.
- RULE 7: All matters of doubt or difficulty relating to membership shall be decided by the Council.

II. THE COUNCIL

- RULE 8: The Executive Committee shall give notice by letter to each member about the procedure and timetable for the election of Council delegates at least two months before the election.
- RULE 9: Delegates representing a full member are elected by the full member.
- RULE 10: Delegates representing associate members shall be elected by a ballot organised by the Executive Committee from a list of candidates who have been nominated and seconded, and have agreed to serve.
- RULE 11: Delegates representing institutional members shall be elected by a ballot organised by the Executive Committee from a list of candidates who have been nominated and seconded, and have agreed to serve.
- RULE 12: Delegates representing individual members shall be elected by a ballot organised by the Executive Committee from a list of candidates who have been nominated and seconded, and have agreed to serve.
- RULE 13: If a delegate of a full member resigns or is not able to attend a Council meeting, then the full member may elect a deputy delegate to replace him.
- RULE 14: If a delegate representing associate, institutional or individual members resigns or is not able to attend a Council meeting, then the Executive Committee shall where possible nominate a deputy delegate from the runners-up in the preceding election.
- RULE 15: The President shall act as Chairman of the Council.

III. THE EXECUTIVE COMMITTEE

- RULE 16: Officers (Art. 7.1 (a)-(d)) shall be elected by ballot for each vacancy. For the remaining posts on the Executive Committee, if there are k vacancies there shall be a ballot in which each member of Council may cast up to k votes for distinct candidates. The k candidates with the highest number of votes shall be declared elected. In the event of a tie there shall be another ballot for the candidates involved in the tie. At any meeting where elections are to take place, Council may set up a

Nominating Committee to advise the meeting on a balanced list of candidates for the elections.

- RULE 17: Every second year the terms of at least two members should expire. The President may be elected two years prior to his/her term in the office. The President Elect and Past President may be co-opted by the Executive Committee to the Executive Committee as non-voting members.
- RULE 18: Decisions of the Executive Committee shall be by simple majority of votes cast. The President shall have a casting vote.
- RULE 19: The Executive Committee shall meet at least once a year. Extraordinary meeting shall be held if requested by at least four members of the Executive Committee.
- RULE 20: The Secretary shall be responsible for setting up appropriate administrative arrangements for transacting the business of the Society.
- RULE 21: The Executive Committee shall establish a group under the chairmanship of a member of the Executive Committee which shall develop connections between the EMS and the European Community. This group shall be in power to conduct negotiations with appropriate organs of the European Community.

IV. FEES

- RULE 22: The annual dues for corporate members (Art. 3.2 and 5.4) will be expressed in terms of a unit fee x , fixed by the Council for any one year.
- RULE 23: Full members in classes 1, 2, 3 (Art. 5.4) shall pay x , $3x$ and $5x$, respectively in annual dues.
- RULE 24: Associate members shall pay an annual fee of x .
- RULE 25: Academic institutional members shall pay an annual fee of x . Other institutional members shall pay an annual fee of $3x$.
- RULE 26: The annual dues for individual members (Art. 3.3) shall be expressed in terms of a unit fee y , fixed by Council for any one year.
- RULE 27: Individual members belonging to a corporate member of the EMS shall pay the annual fee y . Individual members belonging to a society having a reciprocity agreement with the EMS shall pay an annual fee $2y$.
- RULE 28: Individual members not covered by Rule 27 shall pay an annual fee $4y$.
- RULE 29: The Executive Committee may at its discretion waive or reduce the fees of any member.

V. REVISION OF BY-LAWS

- RULE 30: Any change in the By-laws shall be decided by a two-thirds majority of the votes cast in Council.

VI. INTRODUCTORY PROVISIONS

- RULE 31: The Society will be established at a foundation meeting, organised by the European Mathematical Council.
- RULE 32: The Statutes shall be in force from the moment of their approval by the foundation meeting.
- RULE 33: All societies which have taken part in the discussions of the European Mathematical Council leading to the foundation of the Society shall, without further formalities, be deemed to be full members.
- RULE 34: As soon as the Society is created the foundation meeting becomes the Council of the Society and it shall elect the first Executive Committee directly.

Executive Committee Meeting

Stockholm (Sweden), 29-30 September 2002

David Brannan

Those present were: Rolf Jeltsch (in the Chair), David Brannan, Bodil Branner, Victor Buchstaber, Doina Cioranescu, Luc Lemaire, Olli Martio, Marta Sanz-Solé and Mina Teicher (29th only). Apologies for absence were received from Renzo Piccinini. In attendance by invitation were: Carles Casacuberta, Helge Holden,

ERCIM. Soon he would be attending a meeting in Baia Mare (Romania) and a Workshop in Germany on the long-term use of digital documents (to express what researchers want).

The *Secretary* reported that, following publication of David Wallace's history of EMS in the period 1990-98, the question



John Kingman, Ari Laptev, Tuulikki Makelainen, David Salinger, Robin Wilson and Nina Ural'tseva (30th only).

The President thanked Ari Laptev and the Swedish organisations (including KTH and the Mittag-Leffler Institute) who had generously provided hospitality.

The minutes of the previous meeting (Oslo, 31 May 2002) were accepted subject to minor changes; they were approved and would be signed later by the President.

Electronic votes

The EC ratified the result of the following electronic vote since the last meeting:

The following were elected as members of the Committee for Developing Countries (CDC) for the period 2002-05, on the recommendation of Herbert Fleischner, the Committee's Chair: Bernt Oksendal (Norway), Lars Døvling Andersen (Denmark) and Leif Abrahamsson (Sweden).

Officers' Reports

The *President* reported on some of his activities after the Oslo meeting. His Abel Prize speech had already been reported in the September *Newsletter*; he had been at the opening ceremony of the conference of the European Society for Mathematics and Theoretical Biology in Milan in July, at the IMU General Assembly, and at the ICM in Beijing, he had had given a speech at Finnish Academy of Science and Letters, and he had written an editorial for

of a continuation history had been raised. Instead of a history as such, Rolf Jeltsch offered to write his perspective on 1999-2002 after his term as President had ended. There was an interesting discussion of the difference between a history of some set of events and a personal perspective on the same set of events. The Committee noted that Aatos Lahtinen was still planning to interview those involved in the foundation of the Society, and to record their reminiscences.

Various necessary changes to bank account authorisations were agreed in light of John Kingman succeeding Rolf Jeltsch as President and Helge Holden succeeding David Brannan as Secretary in 2003.

The *Publicity Officer* reported that he had helped to staff a joint EMS booth with *Zentralblatt für Mathematik* at the ICM in Beijing, had translated the obituary for Laurent Schwarz for the *Newsletter*, and had written various articles for the EMS, LMS and other member societies' newsletters. It was agreed that the EMS should have a booth at those meetings where it is directly involved, or when it has something to show. A new publicity leaflet for the EMS would be produced before the Stockholm Congress in 2004, and a poster might be prepared to be sent to mathematics departments giving the benefits of membership in the EMS. It was hoped also that national societies would continue to carry articles for the EMS in their local newsletters.

It was reported that the draft minutes of the Oslo council meeting would appear shortly. In the meantime, the Helsinki Secretary had informed the various people involved of their election to membership of the Society.

It was reported that discussions were in hand on possible cooperation or *reciprocity agreements* with the Chinese Society for Industrial and Applied Mathematics (CSIAM), the Chinese Society of Computational Mathematics, the Chinese Mathematical Society, the Indian Mathematical Society and the South African Mathematical Society. A corporate membership drive would be conducted before the Stockholm Council meeting in summer 2004. It was emphasised that this should be instituted in early 2003, in order to allow time for all societies' slow decision procedures!

Cellule MathDoc was accepted as an Academic Institutional Member of the EMS. A suggestion was made that EMS academic institutional members should get a 20% reduction on EMSph publications. EMSph might give the same reduction for individual members for *JEMS* as Springer does now. This point would be considered by the EMF Board of Trustees at their December meeting.

Scientific meetings and activities

The Society was planning the following *Summer Schools*:

- a 2003 Summer School on *Stochastic Methods in Finance*, jointly with CIME, to be held in Brixen/Bressanone, Italy, with organisers Marco Frittelli (Florence, Italy) and Wolfgang J. Runggaldier (Padova, Italy).
- a Summer School on *Mathematics Education* in 2004.

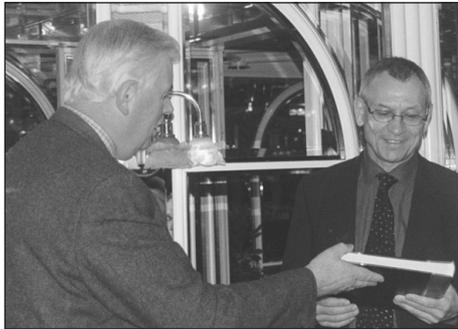
After some discussion, it was decided that the EMS should not organise a set of *EMS Lectures* in 2003. Instead the EC decided to follow a new format: the speaker and the place should be suggested simultaneously, connected with a small conference, and the publication of the results should be insisted on. A panel should be formed to consider suitable speakers and locations, with emphasis on a new subject or new ideas on older subjects.

Ari Laptev gave a report on the progress of the *2004 European Congress of Mathematics* (4ecm) in Stockholm. The logo is ready and the web page URL is . The Opening Ceremony will be held in Stadshuset (where the prizes will be presented) and Stockholm University's Aula Magna will be the main location for lectures. There were plenty of small rooms nearby, a large gallery and foyer, and exhibition space. There will be a conference excursion, poster session(s), and lectures by prize-winners. The Scientific Committee is aiming for a good balance between pure mathematics and applied mathematics. It was confirmed that no member of the Scientific Committee may serve on the Organising Committee, and that the Scientific Committee should have a sufficient representation of applied

mathematics.

There would be presentations from some of the FP5 Networks, though it was not yet clear whether the network reports would be in the final Proceedings volume. The registration fee will probably be 200 euro, with a 20 euro reduction for EMS individual members. There will probably be a reduction in both fees for those who register early.

There was a useful discussion of the membership of the Prize Committee, in



President elect, John Kingman, thanking Rolf Jeltsch and presenting him with a book of photos of past EMS events.

which Nina Ural'tseva, the Chair of the Committee, played a key role. EC members confirmed that the name of the Prize Committee Chair is public information, but not those of the Committee members; these will be made public at the ECM itself. It was confirmed that Prize Committee members must not have served on previous Prize Committees.

A call for proposals for candidates for prize-winners should be published in the EMS Newsletter in March 2003.

There was also a preliminary discussion of the membership of the Prize Committee for the 2004 Felix Klein Prize. It was noted that this prize-winner can be non-European.

As to satellite conferences, 3ecm had set up a committee within the Organising Committee to accept meetings as satellites, following previously agreed criteria for this satellite designation. It was agreed that 4ecm should set up a similar arrangement: in particular, satellite conferences should be 'open' meetings, and a call for satellites should be made.

The deadline for preliminary bids to organise 5ecm in 2008 is 31 December 2002. These bids will be discussed in February at the Nice EC meeting

Joint Meetings

A range of joint meetings were discussed:

- *AMAM2003, 10-13 February 2003, Nice, jointly with SMAI and SMF.* The speakers would include: Alfred M. Bruckstein (Haifa), Robert S. Eisenberg (Chicago), Roland Glowinski (Houston), Eugenia Kalnay (Maryland), Roland Keunings (Louvain), C. David Levermore (Maryland), Pascal Massart (Orsay), Marek Musielka (London), Bernard Prum (Evry), René Schoof (Rome), Enrique Zuazua (Madrid). It was hoped to have a good number of mini-symposia on varied topics with the meeting itself, and to

have some funds to support young participants from central and Eastern Europe.

- *EMS Mathematical Weekend in Lisbon, 12-14 September 2003, jointly with SPM.* The meeting will start on Friday at 2 p.m. and end on Sunday at 12.30 p.m., and will take place at the Calouste Gulbenkian Foundation, Lisbon. The EC felt that progress on this meeting looked very good. The Local Organising Committee comprises: Ana Bela Cruzeiro (Chair and Session on stochastic analysis), Ana Cannas da Silva (Session on symplectic geometry), Pedro Freitas (Session on non-linear evolution equations), Rui Loja Fernandes (Session on analysis and geometry); and Jose Matias (Session on calculus of variations). The speakers are: Michele Audin (Strasbourg), Jean-Michel Bismut (Paris), Bernard Dacorogna (Lausanne), Hans Foellmer (Berlin) and Gilles Lebeau (Nice). The Special Sessions are: Symplectic geometry (organised by M. Audin); Analysis and geometry (J.-M. Bismut); Calculus of variations (B. Dacorogna); Stochastic analysis and mathematical finance (H. Foellmer); and Non-linear evolution equations (G. Lebeau).

- *Applied Inverse Problems: Theoretical and Computational Aspects conference, 18-23 May 2003, at the Lake Arrowhead Conference Centre (of UCLA) in California, USA, jointly with IPAM and SIAM.* For details, see the web site . The EC felt that progress on this meeting looked very good. The meeting would be advertised on the home pages of SIAM, EMS and IPAM, as well as in the EMS Newsletter.

It was agreed to make a call to corporate member societies for future joint meetings.

Special Events Committee

Two proposals for *Diderot Mathematical Forums* were under consideration by the Special Events Committee.

The EC noted that on 15-20 October 2003 there would be a John von Neumann Conference in Budapest, organised by Istvan Juhasz.

It was decided to grant 4000 euro (mainly for invited speakers and young Eastern European mathematicians) to support a very large conference in Moscow in 2003 to celebrate the centennial of the birth of A. N. Kolmogorov, organised by the Russian Academy of Sciences and Lomonosov Moscow State University (following a letter from Prof. A. Shiryaev).

Council meeting in Oslo in June 2002

It was noted that the draft minutes of the Council meeting should appear shortly.

The finally agreed version of the new EMS Statutes and By-Laws, incorporating minor technical changes subsequent to the Council meeting itself, were noted and appear in this Newsletter. The Finnish authorities had also requested clarification of, and changes to, various points in the Finnish text of the new Statutes (Finnish law does not recognise By-Laws), even

though in one case that text had been the same since the foundation of the society.

John Kingman congratulated Rolf Jeltsch for his skilful handling of the Council meeting.

In discussion it was noted that no society or country has the right to be represented on the EC.

The meeting of Chairs of EMS Committees in Oslo on 2nd June 2002 had been very positive and much appreciated. The view was put that it may be a good idea to have such a meeting at most Council meetings, since most committee chairs are already there to report to Council.

EMS Standing Committees

We had an interesting and wide-ranging discussion of general committee matters. Among the topics were:

- the need to plan succession to chairs;
- the need to discuss the terms of reference/remit of each chair and of each committee at the EC meeting in Nice: these should all go onto EMIS once approved;
- that chairs of committees should have four-year terms, with a possible extension of another two years;
- that members of committees should have a four-year term, renewable once, unless the EC decides otherwise;
- that in a transition phase, committee chairs should consult their committee members concerning their terms of office, and that terms should be staggered.

On the *Applied Mathematics Committee*, Doina Cioranescu would replace Rolf Jeltsch, both as member and as the EC member on the committee.

On the *Developing Countries Committee*, Angel Jorba was appointed a member for four years. Tsou Sheung Tsun was appointed as the committee's Vice-Chair. The EMS has opened a special account in Helsinki for the committee, to facilitate donations to developing countries.

Olli Martio was appointed Vice-Chair of the *Committee for Central and Eastern Europe*.

Bodil Branner was appointed the responsible EC member in the *Electronic Publishing Committee*, and Colin Rourke its Vice-Chair.

John Kingman was appointed Chair of the *Group on Relations with European Institutions* for 2003-06, and Rolf Jeltsch as a member for 2003-06. It was agreed that in future the Chair of ERCOM should be a member of the Group, ex officio; and that it is very important to ensure close and good relations between the EC and ERCOM. John Kingman would be the EC member responsible for this Group, and Luc Lemaire its Vice-Chair. Several members' terms would come to an end. A Vice-Chair is not needed in ERCOM.

Mina Teicher was appointed as the responsible EC member on the *Education Committee*.

Mireille Chaleyat-Maurel was appointed Vice-Chair of the *Raising Public Awareness Committee* (RPA).

Jochen Bruening was appointed as Chair of the *Special Events Committee* for 2003-06,

Kjell-Ove Widman as its Vice-Chair, and Victor Buchstaber the responsible EC member. The committee was invited to consider its terms of reference.

The Publications Officer, Carles Casacuberta, reported on the work of the *Publications Committee*, and agreed to draft new terms of reference. He was warmly thanked for his service for many years as Chair of this committee, and was re-appointed as EMS Publications Officer for 2003. Rolf Jeltsch was appointed as Chair of the committee for 2003-04, and David Salinger as Vice-Chair. The work of the committee should be reviewed in two years' time (late 2004). It was agreed that the EMS should arrange a contract with EMSph/EMF in relation to the publication of *JEMS* from 2004.

The membership of the Publications Committee was agreed to comprise: Publicity Officer David Salinger, *JEMS* Editor-in-Chief Jürgen Jost (to be succeeded shortly by Haim Brezis), *Newsletter* Editor-in-Chief Robin Wilson, Chair of Electronic Publishing Committee Bernd Wegner, Managing Director of EMSph Thomas Hintermann, and Colette Picard.

It was agreed to designate the existing ad hoc *General Meetings Committee* as a Standing Committee of the Society. Luc Lemaire was appointed Chair for 2002-04, and its membership would include John Kingman, Rolf Jeltsch, Jean-Pierre Bourguignon, Mina Teicher, Olli Martio and Michael Sorensen – one slot is still to be finally confirmed. Diderot Mathematical Forums activities will remain outside the scope of the new General Meetings Committee.

The General Meetings Committee should focus EC efforts to obtain bulk funding for mathematics meetings from FP6. It will be responsible for joint meetings with other societies, EMS Mathematical Weekends and EMS Lectures. It should create its own terms of reference for future EC approval, and rules for deciding which meetings EMS will support. The Committee should create a Panel of Experts to help the EMS respond to EU scientific queries (such as recommendations for referees) and to suggest areas for possible summer schools. The Committee would need to create terms of reference and policy direction for the Panel.

Collisions with other mathematics meetings cannot be totally avoided, but an effort should be made. David Salinger will be the contact person on the EMS side, but he needs to know the tentative dates of planned meetings early enough.

EMS Projects

- LIMES Project (<http://www.maths.soton.ac.uk/EMIS/projects/LIMES/>)

The EC felt that the EU evaluation report on LIMES was fair. It pointed out some weak points, but considered that the project was basically progressing well. The project is in the middle of its four-year term.

- Euler Project (<http://www.maths.soton.ac.uk/EMIS/projects/EULER/>)

The next meeting of the Euler Team would be later in the autumn; a progress report would be made to the spring EC meeting in Nice. It was commented that the demonstration of EULER in Beijing had been excellent. All EMS members are encouraged to try Euler on the above URL.

- There was an interesting but complicated discussion of a project concerning *Zentralblatt MATH*. Its main point is to find a broader European permanent financial support, recognising that currently the large portion of the funding comes from Germany with a smaller portion from France. An ad hoc committee was formed to take this further, comprising John Kingman, Jean-Pierre Bourguignon, Peter Michor, Bodil Branner, Rolf Jeltsch, Bernd Wegner, Enrique Macias and Jiri Rakosnik. The crucial role of Bernd Wegner was recognised in all this work, and his long-term efforts for *Zentralblatt* were warmly appreciated. This ad hoc committee was also invited to develop a broad vision of the future of *Zentralblatt MATH*; the structure underlying the governance of *Zentralblatt* was also discussed. Europe has to care for the European mathematical literature and the EC felt the pan-European approach was the only sensible way forward.

A number of possible future projects were also discussed, particularly from the point of view of bidding for 6FP funding from the EU; these include:

- *Digitisation DML (Digital Mathematics Library)*

The IMU was taking a lead in this project, and David Mumford and Rolf Jeltsch had been charged with taking the matter further. A legal body might be necessary in order to manage the consortium effort involved. Copyright was a serious problem, and progress on the project is slow in some areas. However discussions were proceeding on such matters as digitisation, ownership of the final product, maintenance and updating.

- *Integrated Initiative via web presentation (Infogare)*

Volker Mehrmann has agreed to be the leader of this project.

- *Integrated Initiative - bulk application for conferences*

Luc Lemaire is the project leader. The General Meetings Committee form the working group.

Publishing

There was some discussion of the funding of the *European Mathematical Foundation* (EMF).

It was agreed that, wherever feasible, all EMS/EMF/EMSph publications need the same appearance; the colours blue and yellow have already been decided, but the same logo and fonts should be used in all EMF publications. It was thought that the flower graphic should appear on all EMF publications. Possibly EMS needs a file in various formats (TeX, Word and Unix) as a graphics file, so that everyone can use the

logo.

It was noted that the *EMS Publishing House* "EMSph" now has a web page: www.ems-ph.org.

The December issue of the *EMS Newsletter* would contain a report of the Council meeting and the EC meeting. Thanks were extended for Robin Wilson's excellent work on the *Newsletter* content and appearance. EC noted that Vasile Berinde will replace Kathleen Quinn as *Newsletter* conference section editor.

The subscription price of the *Newsletter* was increased to 80 euro for 2003. A rise of a few per cent for advertisements and inserts was under discussion. The new prices would be set out clearly in the *Newsletter*.

EC noted with pleasure that it now seemed feasible that the Society might be able to include the *Newsletter* on EMIS, with the conversion into electronic form of the *Newsletter* being carried out by its present printer Armstrong Press. It was agreed that EMSph should be the publisher of the *Newsletter* in future, subject to final confirmation by its Managing Director, Thomas Hintermann.

The term of office of Jürgen Jost as Editor-in-Chief of *JEMS* would end on 31 December 2002, and he was warmly thanked for a fine job in the foundation of *JEMS* and getting it on the road with a very high academic reputation. Haim Brezis has agreed to be his successor.

Carles Casacuberta as Publications Officer reported that the *Proceedings of the DMF on Mathematics and Music* had now been published, and that the EMS Lectures given by Lyubich are almost ready, Dal Maso will write up notes on his recent lectures, and the *Proceedings* of various Summer Schools are under way.

There was some discussion of the decision by Bertelsmann to sell *BertelsmannSpringer*. The EMS had held discussions with other mathematical societies on possible cooperation in this respect, and matters continued to be very fluid. In an ideal world, the EC would very much have liked to bid for Springer.

European EU-related projects and meetings

A new EU project is a Comprehensive Information system Through Integration of the *Zentralblatt-MATH* Europe-based database in the Mathematical Sciences (CITIZEMS). The project leader still has to be decided.

John Kingman would attend the meeting of PESC, the *European Science Foundation's Physical and Engineering Sciences Committee*, in Pisa in October.

John Kingman had been invited as official participant to a Copenhagen meeting on the *European Research Area (ERA): Do we need a European Research Council?*, and Bodil Branner had been invited as an observer. There was a lively discussion on the topic of this particular meeting. If a European Research Council were established, then it should be governed by scientists, and it was vital that it should have reasonable additional funding. It was

recognised that unless scientists asked for additional funding, none would be supplied.

Luc Lemaire and Rolf Jeltsch would represent the EMS at a conference on *The European Research Area and the Framework Programme* on 11-13 November in Brussels: see http://europa.eu.int/comm/research/conferences/2002/index_en.html.

Relations with various mathematical bodies

It was noted that the EMS Delegate to ICIAM is Rolf Jeltsch. Herbert Fleischner was elected the EMS representative to CIMPA.

The EMS had made a nomination to membership of the Selection Committee for the Abel Prize. The nomination process for possible prize-winners is open, with a deadline of 1 November 2002. The Prize nominations will be announced in early 2003, and the Prize Ceremony will be held in May 2003.

The EC made a grant of 2000 euro to the Charles University mathematics library in Prague, to help it recover from the devastating floods there. It hoped that the University would be able to use this donation to encourage other mathematical societies in Europe to help too. It was reported that the LMS and the Moscow Mathematical Society intended to send back copies of their publications to Prague.

The EC agreed to offer a publishing firm, Taylor & Francis Books, a link on EMIS in return for a discount for EMS members.

Future meetings

The next EC meeting will be held in Nice, France, on 8-9 February 2003.

The next Council meeting will be in Stockholm on 26-27 June 2004; the 26 June session will start at 10 a.m.

The next GPC meeting with the President-Elect and Secretary-Elect will be held at the ETH, Zürich, on 14-15 December 2002: this will be a small hand-over meeting. An EMF meeting will be held on 15 December in the afternoon.



*Ari Laptev, Nina Ural'tseva
and Victor Buchstaber*

The European Mathematical Society

David Salinger, EMS Publicity Officer

[The following notice appeared in the Newsletter of the London Mathematical Society. Please copy it and give it to colleagues who are not members of the EMS.]

The European Mathematical Society has been in existence for 12 years. Has it fulfilled the vision of its founders? The answer must be a resounding 'yes', except in one respect, which I shall come to at the end.

That vision was to bring together the mathematicians of Europe, East and West, and to represent those mathematicians in international bodies, in particular, the European Union.

Since the inception of the Society, its officers have negotiated with the European Union, patiently and repeatedly pointing out where the EU's science policies neglect or harm mathematics. Though we don't get as much as we want, the Society has succeeded in preventing maths being effectively written out of the EU's funding programmes. What is more, one of the Society's suggestions: Marie Curie fellowships for returning scientists, has been adopted by the EU for the 6th Framework programme.

The Society has been successful in seeking European Union support for *Zentralblatt MATH* and the projects EULER and LIMES. These can all be accessed at EMIS, the European Mathematical Information Service (www.emis.de), itself an initiative of the Society. It has also been successful in getting EU funding for the reference levels projects and the project for raising public awareness of mathematics (see EMIS).

Support for the EMS has been forthcoming from UNESCO-Roste. This has taken the form of grants to enable mathematicians from Eastern Europe or developing countries to attend events such as the EMS Summer Schools and the European Congresses of Mathematics, for which the European Union has also provided support.

The first European Congress was held in Paris in 1992, followed by Budapest (1996) and Barcelona (2000). The fourth, in Stockholm in 2004, will emphasise the interaction between mathematics and its applications (though it won't neglect advances in fundamental mathematics).

This brings me to one of the themes close to the heart of Rolf Jeltsch, current EMS President. He sees the EMS as representing the community of applied mathematicians as much as those doing pure mathematics. In recent years the Society has raised the profile of applied mathematics in its activities. One part of doing that was to hold a meeting together with representatives of the applied maths community: this resulted in a better understanding of what the society needed to do (see the Berlingen Declaration on the EMIS website).

Another activity particularly associated with Rolf Jeltsch is the successful setting up of the EMS Publishing House, as part of a foundation linked to the Society. This has the generous support of the Eidgenössische Technische Hochschule in Zürich. As commercial publishing becomes concentrated into a few large firms, it is important that independent academic, not-for-profit, operations should thrive. The publishing house will start producing books and journals in the spring of 2003. A year later, it will take over responsibility for the *Journal of the European Mathematical Society*. This has established itself as a periodical for high-quality articles in both pure and applied mathematics.

The EMS will continue to run the Summer Schools (for graduate students), the EMS lectures and the Diderot Forums. These last are events held simultaneously in three centres, connected by audiovisual links. The proceedings of the forum on maths and music have just been published by Springer.

The meetings programme has already been expanded to include joint meetings with SIAM (in Berlin 2001 and with IPAM in May 2003). In February 2003 we start a series of meetings with European National Societies, at Nice with both French Societies (SMF and SMAI). In September 2003, we shall co-host a meeting in Lisbon with the Portuguese Mathematics Society.

I could go on to recount much more, for instance, the role of the EMS as the European partner in the mathematics digitisation programme, its presence on the board of the Banach Centre, or its relationship with the Abel prize. But I referred at the beginning to one relative failure, and this is where you could help. We have a fairly complete list of corporate members, who are, in the main, the national European mathematical societies. But we don't have enough individual members – at present there are about 2300 of us. To be fully representative, we need more. For a modest fee (20 euro from 2003) you can support the Society's activities and participate in its governance. You will also receive the quarterly *EMS Newsletter*, an attractive and entertaining magazine containing interviews with mathematicians, short book reviews, news about the Society and much more.

Four Colours Suffice

or, how to colour a map

Robin Wilson, The Open University, UK

This autumn marked the 150th anniversary of the four-colour problem, and the 25th anniversary of the publication of its solution by Kenneth Appel, Wolfgang Haken and John Koch. In October these events were commemorated in the UK by a special anniversary week, involving fourteen events in six venues and with four speakers from the US – including Appel and Haken who were lecturing together about the problem for the first time for many years. The highlight of the week was an afternoon meeting of the London Mathematical Society at which all four visitors and I lectured on various aspects of the four-colour problem, its history, and its solution.

The origin of the problem

In October 1852 **Francis Guthrie**, a former student of **Augustus De Morgan** (professor of mathematics at University College London), was colouring a map of England. He noticed that if neighbouring countries had to be coloured differently, then only four colours were needed. *Do four colours suffice for colouring all maps, however complicated?*, he wondered.

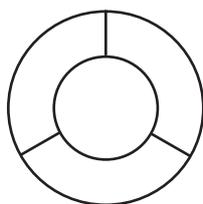


Francis Guthrie

On 23 October of that year, Guthrie's brother Frederick posed the question to De Morgan, who immediately became fascinated with it and communicated it to his friends. De Morgan's famous letter of 23 October 1852 to the Irish mathematical physicist Sir William Rowan Hamilton included the following extract.

A student of mine asked me today to give him a reason for a fact which I did not know was a fact – and do not yet. [He then described

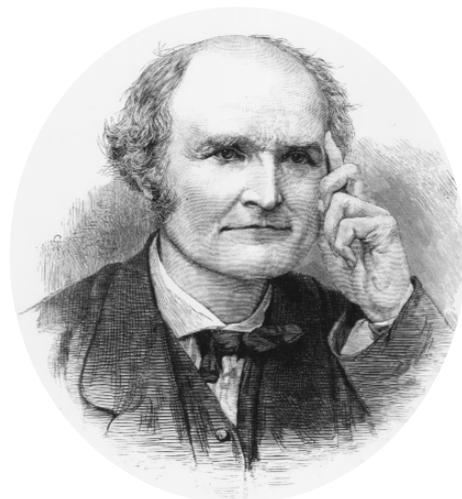
the problem, and gave the following example of a map for which four colours are needed.] Query: cannot a necessity for five or more be invented?



De Morgan also wrote about the problem to the philosopher William Whewell, Master of Trinity College Cambridge. Indeed, the problem first appeared in print in the middle of an unsigned book review (actually by De Morgan) of Whewell's *Philosophy of Discovery*. This review contained the following very strange passage:

Now, it must have been always known to map-colourers that four different colours are enough. Let the counties come cranking in, as Hotspur says, with as many and as odd convolutions as the designer chooses to give them; let them go in and out and roundabout in such a manner that it would be quite absurd in the Queen's writ to tell the sheriff that A. B. could run up and down in his bailiwick: still, four colours will be enough to make all requisite distinction...

After this, the problem was largely forgotten until 13 June 1878, seven years after De Morgan's death, when



Arthur Cayley

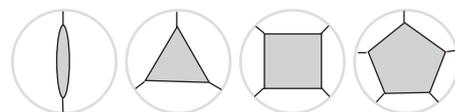
Arthur Cayley, of Trinity College Cambridge, asked at a London Mathematical Society meeting whether the map colouring problem had been settled. Although Cayley was unable to

solve it, he was able to explain where the difficulty lies, and he showed how the problem can be simplified (without loss of generality) by considering only maps in which exactly three countries meet at any point.

Kempe's fallacious proof

A celebrated 'proof' that four colours are sufficient was given in 1879 by **Alfred Kempe**, a London barrister who had studied at Cambridge with Cayley and who was later Treasurer of the Royal Society for many years. This is probably the most famous fallacious proof in the entire history of mathematics, although it contained several good ideas.

Kempe's proof was essentially as follows. We assume that *all but one* of the countries of the map have been coloured with four colours, and then show how the colouring can always be extended to the final country. Since all maps with up to 4 countries can be coloured with four colours, we can extend the colouring to 5, 6, 7, ... countries – that is, to all maps. Now, from Euler's well-known polyhedron formula, it's easy to deduce that *every map has a country with at most five neighbours* – a digon (two-sided country), triangle, square or pentagon. Kempe looked at these in turn.



If the map has a digon or triangle, we shrink it to a point. There are then fewer countries, so we can four-colour the resulting map. Put the digon or triangle back – it's surrounded by at most three countries, taking at most three colours, so there's a spare colour to colour the digon or triangle, as required.

If, now, there's a square in our map, we follow Kempe and look at just two of the colours – say, *the red country immediately above the square and the green one immediately below the square* – and ask the following question: *is the red-green part of the map above the square connected to the red-green part of the map below the square?* Let's look at the two cases that can arise.

If NO, then the red and green countries above the square are separated from those below the square, and we can interchange the reds and greens above the square (red becomes green, green becomes red, and so on), so that the

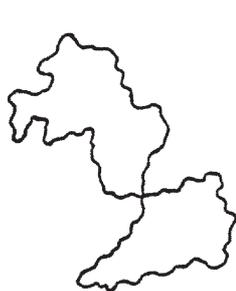


Fig. 1.

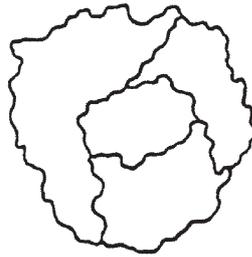


Fig. 2.

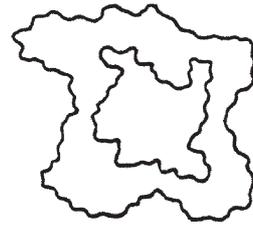


Fig. 3.

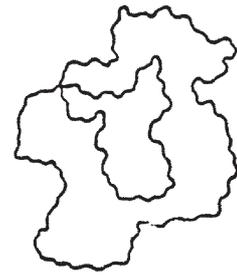


Fig. 4.

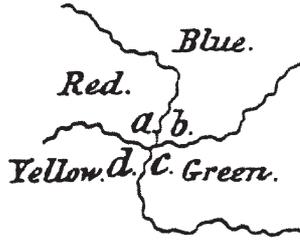


Fig. 5.

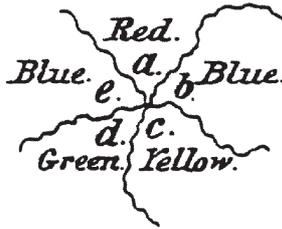


Fig. 6.

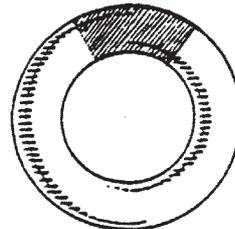


Fig. 7.



Fig. 8.

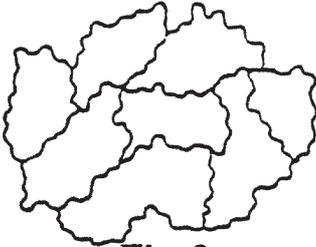


Fig. 9.

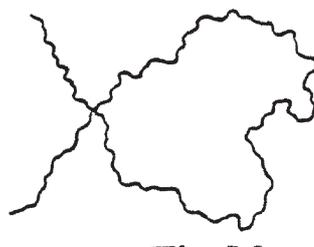


Fig. 10.

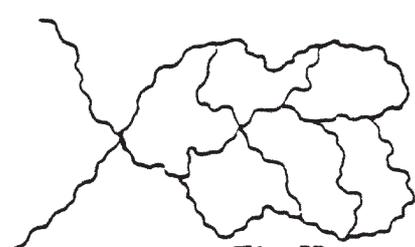


Fig. 11.



Fig. 12.

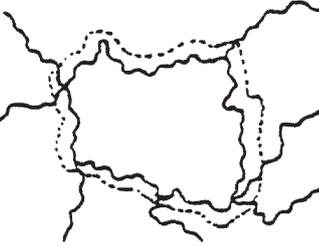


Fig. 13.

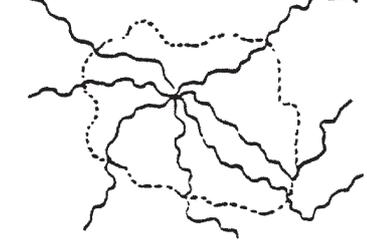


Fig. 14.



Fig. 15.

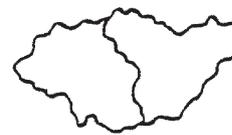


Fig. 16.

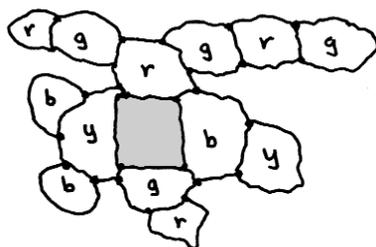
KEMPE, Geographical Problem.

[AM. JOUR. MATH., VOL. II.]

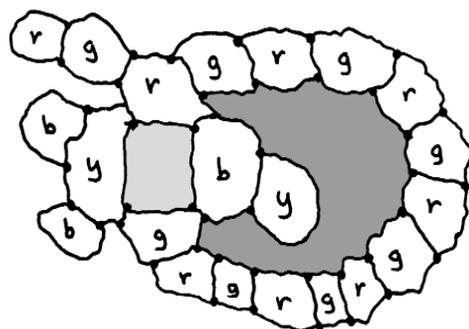
A. HOEN & CO. LITH. BALTIMORE.

The diagrams from Kempe's paper in the American Journal of Mathematics

countries immediately above and below the square are both green, and we can then colour the square red, as required.



But if YES, then interchanging the red and green colours as described above leaves us no better off than before – the square still has all four colours around it. In this case we look at the blue and yellow countries immediately to the left and right of the square. The blue and yellow countries to the left of the square are separated from those to the right of the square, because the red-green ring of countries gets in the way. We can thus interchange the blues and yellows on the left of the square without affecting those on the right of the square. The square can then be coloured blue, completing the colouring in this case.



Finally, if there's a pentagon, Kempe used a similar argument, this time involving *two* interchanges of colour, to produce just three colours around the pentagon. The pentagon can then be coloured with the fourth colour, thereby completing the colouring of the map with four colours. This completes the proof of the four-colour theorem.

Heawood's 1890 Paper

For eleven years Kempe's proof was widely accepted – by Cayley and many others – so it was a great surprise when **Percy Heawood** of Durham dropped his 'bombshell' in 1890. In his paper he pointed out a fundamental error in Kempe's proof by showing that in the case of the pentagon we *cannot* always carry out two interchanges of colour simultaneously. However, he managed to salvage enough from Kempe's arguments to deduce that *every map can be coloured with five colours* – still a remarkable result.

Heawood also tried to generalise the idea of map colouring to other surfaces. Using stereographic projection between a globe and the plane, we can see that colouring maps on the plane is the same



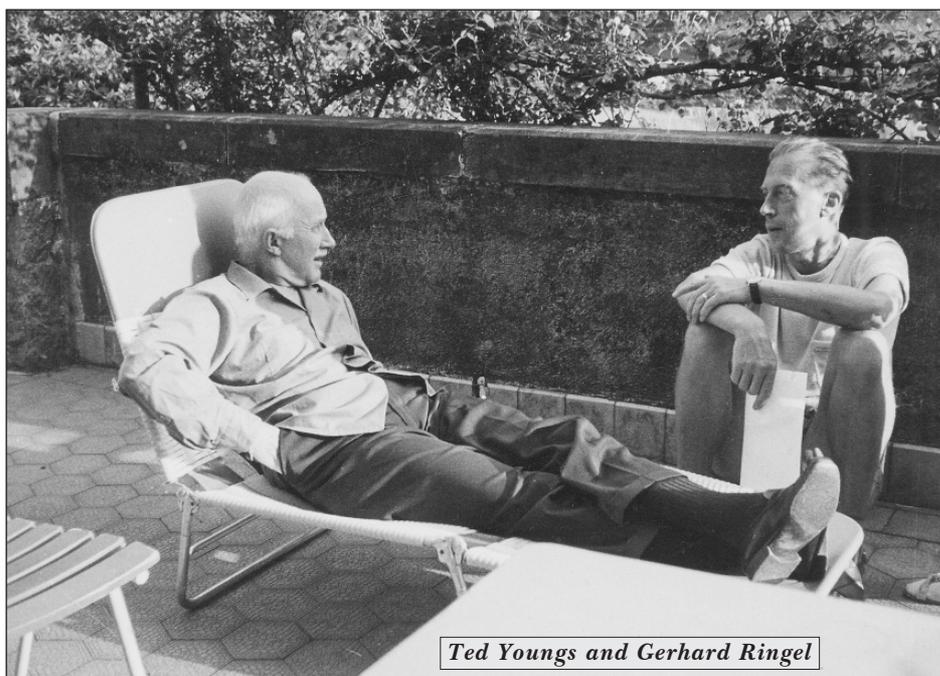
Percy Heawood

as colouring maps on a sphere – so what about colouring maps on a ring doughnut, or 'torus'? Here the magic number

there must always be maps that require this number of colours – and that took a further 78 years to prove. Proving the *Heawood conjecture*, as it came to be called, turned out to involve twelve completely separate cases.

By 1967 the German mathematician **Gerhard Ringel** and the American **Ted Youngs** had settled most of these cases. Ringel had a sabbatical year and went to California to work with Youngs on the remaining cases, and in a few months they completed the proof. Great rejoicing! Later that year, Ringel was driving up the California expressway when he was stopped by a traffic cop for speeding. The cop looked at his driving licence, and said 'Ringel, eh – are you the one who solved the Heawood conjecture?' Ringel, surprised, said 'yes'. It turned out that the traffic cop's son was in Professor Youngs' calculus class, and the result was that Ringel got let off with a warning – and if that doesn't show a use for map colouring, I don't know what does!

Returning to the four-colour problem for maps on the plane or sphere, very little progress was made for many years



Ted Youngs and Gerhard Ringel

turns out to be 7: a torus version of Euler's polyhedron formula shows that seven colours suffice to colour all torus maps, and Heawood produced a torus map that needs all seven colours.

If we now introduce more holes (such as in a pretzel), we need more colours. In fact, as Heawood showed, if we have a doughnut with h (≥ 1) holes, then every map on the surface can be coloured with N colours, where N is given by the expression

$$\lceil \frac{1}{2} \{ 7 + \sqrt{1 + 48h} \} \rceil,$$

where $\lceil x \rceil$ is the integer part of x ; for example, if $h = 1$ (for the torus), we deduce that every map on the torus can be coloured with $\lceil \frac{1}{2} \{ 7 + \sqrt{49} \} \rceil = 7$ colours, as before. What Heawood failed to show is that for any surface

– in fact, it took a further 86 years after Heawood's paper to complete the proof. Although Kempe's error proved very difficult to patch up, the eventual solution used two important ideas that can be traced back to him. We look at these in turn.

Two Fundamental Ideas

The first is that of an *unavoidable set of configurations*. Since every map contains at worst a pentagon, we say that the configurations listed as {digon, triangle, square, pentagon} form an *unavoidable set* – in any map at least one of these must appear – you can't avoid them. As we've seen, we can deal with the first three of these, but the pentagon causes trouble, so we try to replace it by some

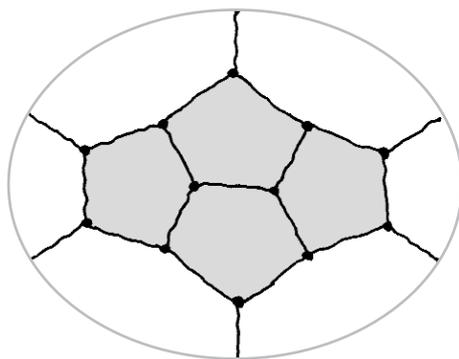
FEATURE

thing else. In fact, we can show that any map without a digon, triangle or square must have, not only a pentagon, but either *two adjacent pentagons* or a *pentagon joined to a hexagon* – so we get a new unavoidable set: {digon, triangle, square, two adjacent pentagons, pentagon adjacent to a hexagon}.

We've also seen that the digon, triangle and square are all *reducible configurations*: this means that any colouring of the rest of the map in four colours can be extended to include them – but we were unable to deal with the pentagon.



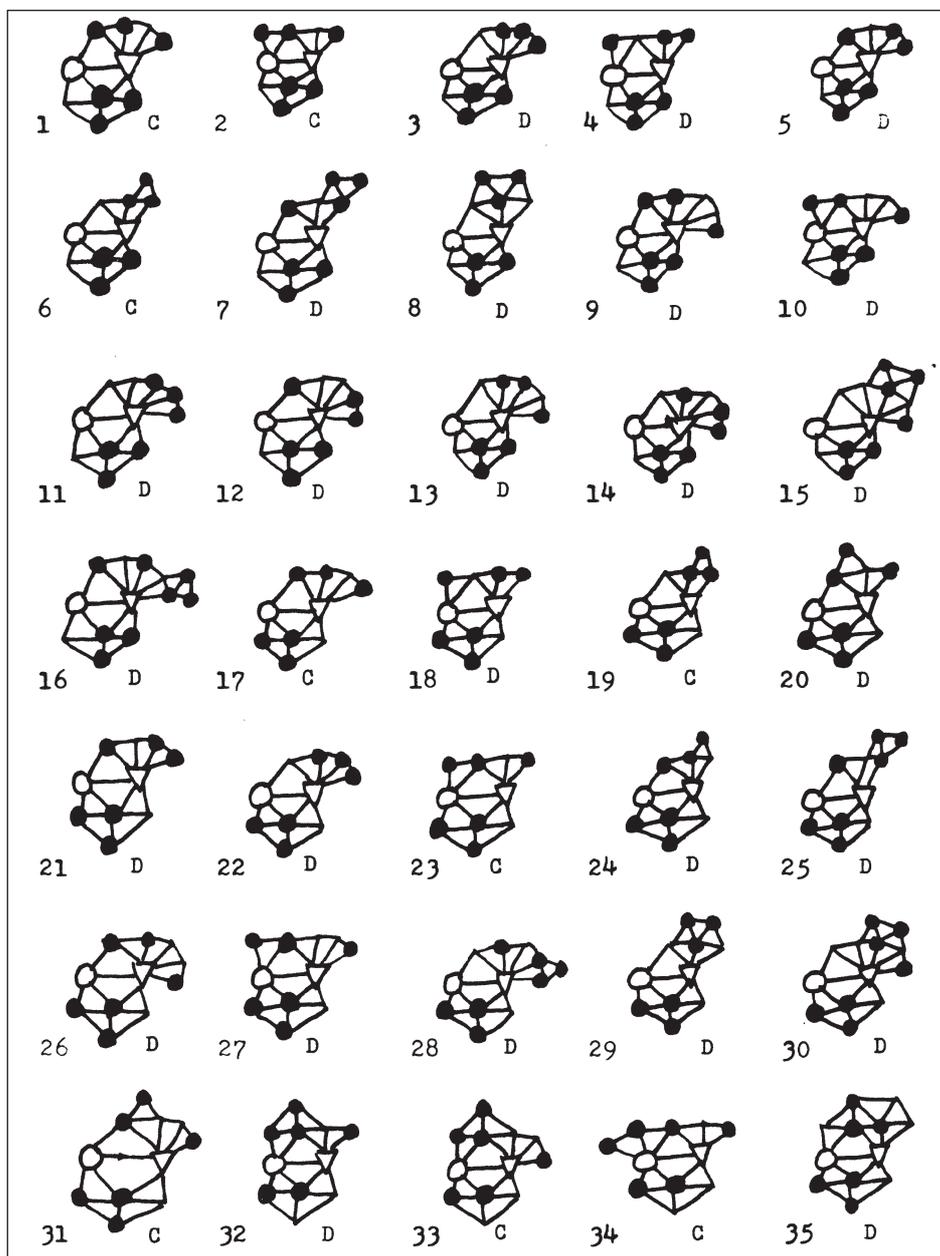
However, the American mathematician **George Birkhoff** showed in 1913 that the following arrangement of four adjacent pentagons is reducible, and after that many thousands of reducible configurations were discovered.



In order to prove that four colours are sufficient for any map, we need to find an *unavoidable set of reducible configurations* – to say that it is an *unavoidable set* means that every map must include at least one of them, and if whichever it is turns out to be *reducible*, then we can complete the colouring of the map.

The problem is solved

For the first two-thirds of the twentieth century the search was on to find both unavoidable sets of configurations



Some configurations from Appel & Haken's solution

and reducible configurations. The first person to try to combine these ideas was the German mathematician **Heinrich Heesch**, who spent forty years of his life searching for an unavoidable set of reducible configurations. Eventually, in 1976, following Heesch's ideas and with a graduate student **John Koch** to help with the computer work, two mathematicians from the University of Illinois, **Kenneth Appel** and **Wolfgang Haken** found an unavoidable set of 1936 reducible configurations, after a massive four-year search in which they made extensive use of the most powerful computers then available. Appel and Haken subsequently simplified their unavoidable set to 1482 reducible configurations and published their solution in late 1977.

Since the idea of a computer-assisted proof was then still unusual, their solution was regarded with great suspicion and raised a number of philosophical questions. Can a mathematical proof

that we cannot check by hand be regarded as correct, even if the calculations are essentially routine case-by-case checking? Or should we really have put faith in a lengthy hand-produced proof of (say) the Feit-Thompson theorem on soluble groups, or Wiles's proof of Fermat's last theorem, where the possibility of human error is enormous?

In the 1990s, a more structured proof of the four-colour theorem was obtained by four mathematicians – **Neil Robertson, Dan Sanders, Paul Seymour** and **Robin Thomas**. Their proof still uses the Appel-Haken computer-assisted approach, but involves only about 600 reducible configurations and can be run on a laptop in just a few hours. Most mathematicians seem happy to accept this proof, even if they had been sceptical about the one produced by Appel and Haken. However, as yet, there is still no generally accepted solution that avoids all use of a computer.

Further reading

A popular account of the history and proof of the four-colour theorem is given in my recent book:

Four Colours Suffice, Penguin Books, 2002.

A graph-theory text, centred around the four-colour theorem, is by my namesake:

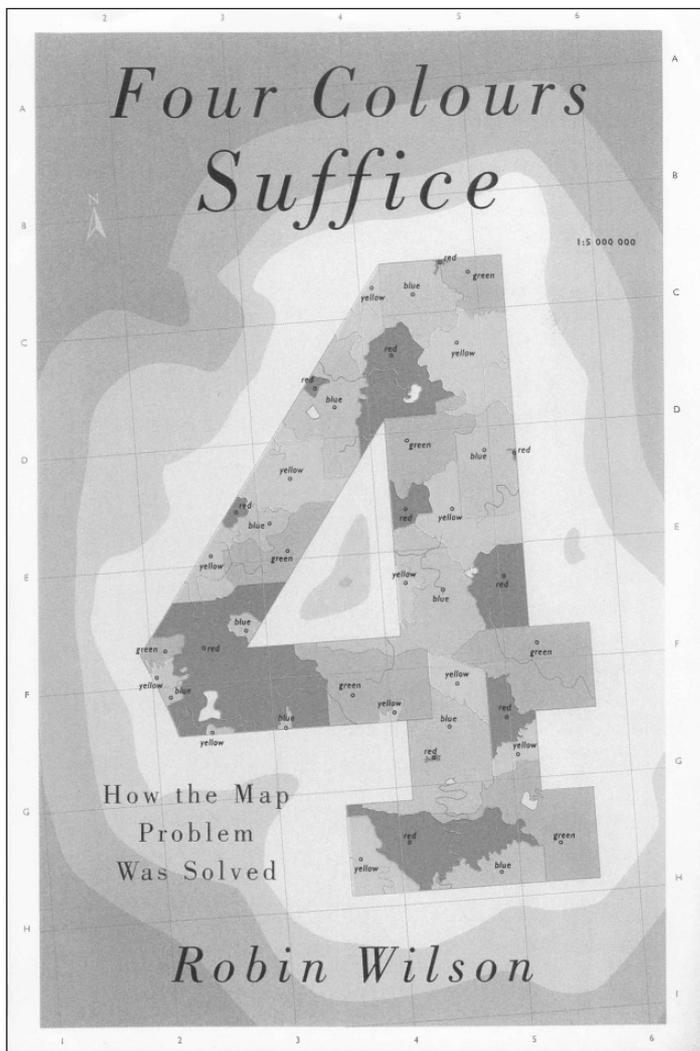
Robert A. Wilson, *Graphs, Colourings and the Four-Colour Theorem*, Oxford Science, 2002.

The 1990s proof, and a discussion of some links between the four-colour theorem and other branches of mathematics, appears in:

Robin Thomas, An update on the four-color theorem, *Notices of the AMS* 45 (7) (August 1998), 848-859.

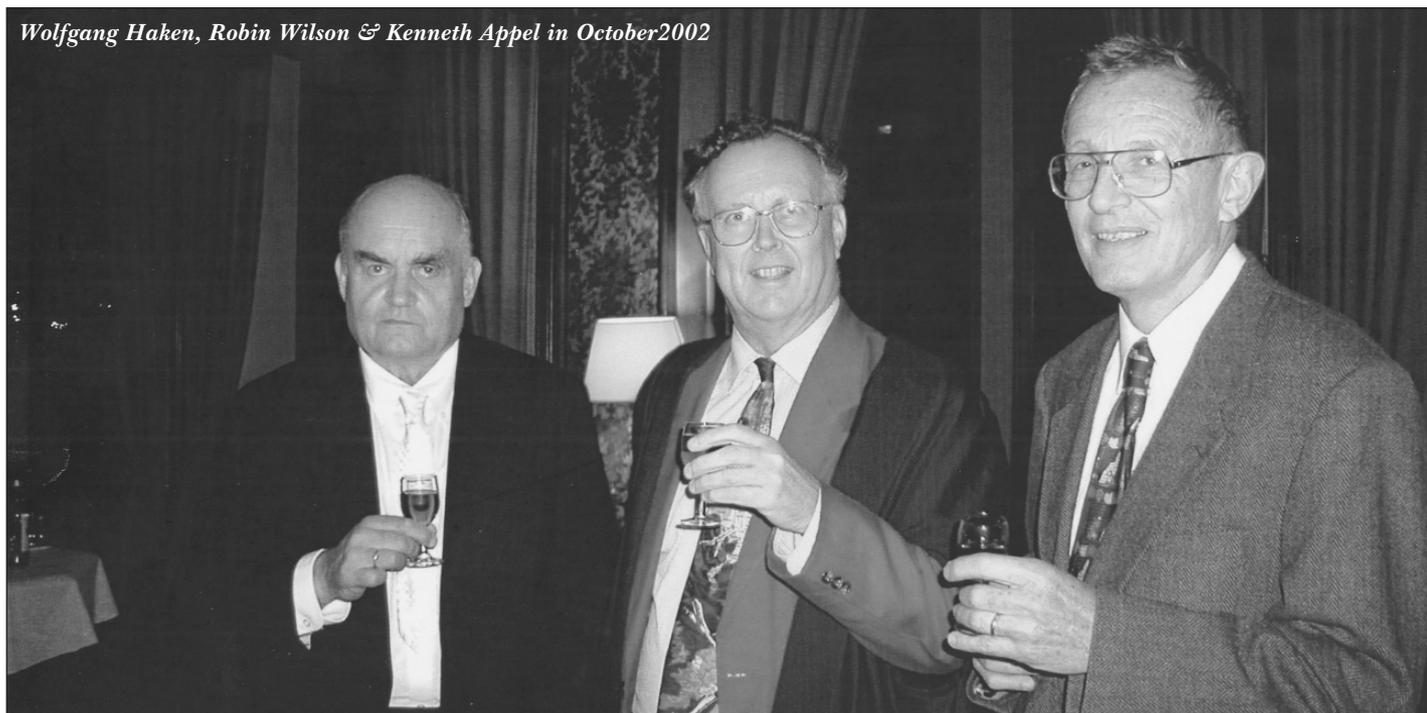
The Ringel-Youngs proof of the Heawood conjecture is described in detail in:

G. Ringel, *Map Color Theorem*, Springer, 1974.



Kenneth Appel and Wolfgang Haken in the 1970s

Wolfgang Haken, Robin Wilson & Kenneth Appel in October 2002



Mathematics and War

Bernhelm Booß-Bavnbek and Jens Høyrup

Physicists, chemists and biologists have a tradition of discussing meta-aspects of their subject – among which are the military use and misuse of the knowledge they produce. Similar concerns are rare among mathematicians.

On 29-31 August 2002, this silence was broken, when 42 mathematicians, historians of mathematics, military historians and analysts, and philosophers gathered in the historic military port of Karlskrona, to discuss four questions:

- To what extent has the military played an active part throughout history, and in particular since World War II, in shaping modern mathematics and the careers of mathematicians?
- Are mathematical thinking, mathematical methods, and mathematically supported technology¹ about to change the character and performance of modern warfare, and if so, how does this influence the public and the military?
- In times of war, what were the ethical choices of outstanding individuals, such as the physicist Niels Bohr and the mathematician Alan Turing? To what extent can general ethical discussions provide guidance for working mathematicians?
- What was the role of mathematical thinking in shaping the modern international law of war and peace? Can mathematical arguments support actual conflict solution?

Perspectives from mathematics

We have all heard the tales, reliable or not, about Archimedes and his defence of Syracuse. We may also have heard about early modern ballistics and fortification mathematics and the importance of trigonometry for navigation. All these cases of mathematics being implied in conquest, warfare, or preparation for war, have one thing in common: combined with technical and military knack was almost exclusively the existing mathematics of the time. In this respect such examples do not differ from the use of simple accounting mathematics in logistics – which after all is likely to have been much more important from the military point of view. Mathematics served as a toolbox, and military officers may have been the largest group that received some general mathematical training; but the involvement of mathematics as a general endeavour with the military institution was not very close, and specifically military applications had no independent role as a shaping force for mathematics.

All this we may therefore leave aside as anecdotal, or return to as historians. The contemporary situation can be said to start around the First World War, and to reach

full development during the Second World War.

During World War I, two important new military technologies depended on *mathematics in the making*: sonar and aerodynamics. These were so impressive that Picard, in spite of his own patriotism, regretted the perspective that young mathematicians might opt in future for applied mathematics only. In general, however, the immediate role of the pure sciences, mathematical and otherwise, was that of providing manpower that could be converted into first-class creative engineers; this was also the role of most of the mathematicians who were actually involved in the war effort (if they were not, as was the case in France, sent into the trenches). Nobody will claim that mathematics was in any way decisive for the outcome of the war, nor that WW-I applications of mathematics left important traces in the post-war world (civil aviation still belonged in the future).

Picard's worries proved unfounded. Mainstream mathematics soon reverted to the pre-War model, even more swiftly than the precariously erected organisation of planned science was dismantled.



Noli turbare circulos meos: in spite of his astounding mathematical engineering, even Archimedes pretended that he was only doing pure mathematics when his city was conquered.

All of this was different in World War II, either quantitatively or qualitatively: the organisation of science intended to support the war effort was a major concern of both Axis and Allied powers; mathematical technologies (radar, sonar, the decipher computer and *the bomb*) can be argued to have been war-decisive. Computers, nuclear energy, jet propulsion – all mathematically constructed and computed for the war – have changed our world beyond recognition after 1945.

During the War, mathematicians in large numbers were recruited, many of them to teach sailors and air-crew members basic trigonometry, etc., but many also to serve as best-level creative engineers. Afterwards, the latter have often tended to regard what

they did dismissively (“I did not write one line that was publishable”), perhaps because puzzle-solving with no further theoretical impact did not look important in the mathematician's hindsight. This assessment notwithstanding, what was done depended critically on mathematical ingenuity and training.

In some cases, of course, important theoretical impact *was* present – we all know about the emergence of computer science, information theory, Monte Carlo simulation, operations research and statistical quality control.

This time, nothing was dismantled after the War. Many mathematicians, of course, hurried away from military research, but the Cold War was already on. In the slightly longer run (a decade or so), civil reaplication of the new mathematical war techniques caused profound transformation of these and violent acceleration of their development. Only the war effort had allowed the creation of the first costly computers, but only commercial use allowed mass production, open competition, intensive development efforts and reduction of costs.

When discussing mathematical research for military purposes, both during World War II and in recent decades, we should differentiate several situations and problems.

- First, we must distinguish the application (sometimes creative, sometimes repetitive) of existing tools within the military institution itself (ballistic computation, modelling, ...) from creative mathematical research outside this institution, but directed toward military goals.
- Secondly, we should remember that mathematical research consists in more than the production of theorems of presumed military use. Several institutions (Süss's original planning of the German Oberwolfach Institute in 1944, and the American Mathematics Research Center in Wisconsin) exemplify an efficient model, a *two-way chain*, which *grosso modo* works as follows. A core group of highly skilled mathematicians familiar with the direct problems of the military employer (efficiency of bombing, controlled spread of bacteriological agents, better radar detection and avoidance of enemy detection, etc.) find out which of these can be approached mathematically, undertake an initial translation, and direct the translated problems to other experienced mathematicians who are well informed about, and centrally located within, the whole mathematical milieu; these parcel out the questions into problems that colleagues may take up as mathematically interesting, perhaps even without knowing that they enter into a network of military relevance. Once such questions have been answered, the same chain functions backwards, reassembling the answers and channelling the global solution to the employer: only the availability of large amounts of money distinguishes this from how mathematics of civilian relevance can be created.

¹ This ‘broad concept’ of mathematics is the one that applies in this article; it also embraces computers and computer science.

This is only one among several models. We know that it was planned to function in World War II Germany, but was implemented too late to become efficient. We know that it has functioned in the US. We know less about the organisation of military mathematical research in the late Soviet Union, but it seems likely that here, as in production and research in general, the civil and military domains were more efficiently separated than in the West.

Rounding off what can be said about 'the perspective from mathematics', we may make some general observations:

- Mathematical war research has resulted in certain fundamental theoretical innovations. It is striking, however, that all of these appear to depend on an exceptional mathematician: the names of Turing, von Neumann, Shannon, Wald, and Pontryagin suffice to make the point.
- However, the utility of mathematics for the treatment of military problems does not depend critically on the presence of an exceptional mathematician. Mathematicians in large numbers have proved themselves unexpectedly able to function as creative mathematical engineers.
- This ability has largely depended on their ability to become familiar with methods and approaches of various mathematical disciplines and to synthesise these. The still persistent unity of mathematics is thus demonstrated *ad oculos*, if not in the mathematical journals then in the uses.
- It should not be forgotten that the traditional application of the toolbox of already existing mathematics goes on, now at the level created by recent mathematical research.

Military perspectives

At the conference, the point was strongly made by Colonel Svend Bergstein that actual war cannot be calculated, no more today than in Clausewitz's times. Not only are many unpredictable external factors involved, but also the aspects of human behaviour that are most atavistic and contrary to reason.

Nevertheless, mathematics – that is, mathematical thinking, mathematical methods and mathematics-based technology – has become an integral, and even essential, part of modern warfare. This does not mean that mathematics has become the major expense of the military apparatus – mathematics and what goes with provide a cheap way to use expensive resources more efficiently.

Once more, we may list various aspects of this role and utility of mathematics, as discussed at the conference and in other contexts.

- Mathematics serves in managing the institution. Purchases of weapons systems are planned, and war-games and logistics are calculated.
- Weapons and weapons systems are optimised. This involves munitions (including missiles and bombs provided with guidance systems); delivery systems (including, for instance, airplanes pro-

vided with electronic countermeasure circuitry); the reconnaissance, control and communication interface ('to ensure that the right forces are at the right spot at the right moment, and with the right information about the enemy' – Svend Bergstein); and, across all of these, high-speed cryptography.

- Similarly, the strategic planning of the possible use of the weapons systems depends on mathematical calculation; even the dismantling of weapons systems without the risk of destabilising disequilibrium in the SALT negotiations was analysed mathematically.
- Perhaps unexpected by civilians but emphasised by military analysts, simple accounting mathematics *performed by mathematically trained independent personnel and not by the active warriors* is mandatory if gains and losses are to be assessed realistically – leading officers, like all of us, are easy victims of self-deceiving optimism and pessimism according to circumstances.
- Mathematics may also be an indispensable tool at the lower end of the scale. Thus, when the effect of fragmentation bombs on human bodies was to be predicted, but humanitarian concerns prohibited testing on pigs, mathematical simulation was put into play.
- Ideologically, the waging of war is made more acceptable to the public by the presentation of warfare as a question of mathematical calculation, and thus of war, as 'more rational and clean'.
- Similarly, certain uses of mathematical representations of the task to be performed may serve to make the agent see it as a normal manipulation of symbols, and thus to eliminate the need for appeals to atavistic instincts – for example, seeing a village to be bombed as triangles similar to those of a computer game may facilitate the killing. (Evidently, being at a height of 5 km already has much the same effect.)

Utility is one thing, possible backfiring that must be taken into account is another. Seeing war as 'more rational and clean' may affect (and often appears to affect) both the public and the political planners. This is pernicious, not only for the victims, but for the planners themselves who may recklessly engage their armed forces in operations and wars that are less easily won than predicted by the machine-rational perception of the character of war.

Less dangerous for planners, but just as much for victims, is the relative cheapness of present-day mathematically supported asymmetric warfare for the attackers – if the subjugation of Serbia in the Kosovo war cost only \$7 billion US (that is, \$700 per Yugoslav capita), the temptation is great to solve all similar problems in a similar way. (At the moment such a war turns out as things develop to involve the use of ground forces, costs explode, and we are brought back to the situation discussed in the previous paragraph).

Another feature of the mathematisation of warfare, also contributing to the ongo-

ing militarisation of our world but not restricted to the field of easy asymmetric wars and punitive operations, is the transformation of the 'Krupp model' into an 'infinite Krupp model'. War and prepared war are always between two (possibly more) parts – Clausewitz would speak of a *Zweikampf*, a duel, which has now become a 'duel of systems'. In the nineteenth century, Friedrich Krupp would first develop nickel-steel armour that could resist existing shells, then chrome-steel shells that could pierce this armour, then high-carbon armour plate that resisted these, then cap-shot shells that could break this plate – and that was the end of it. In the duel between soil-air missiles and airplanes, no physical limit prevents an ongoing sophistication and ensuing arms race. Cap-shot shells remained extremely expensive, and so are stealth airplanes, but such measures as depend solely on sophistication of software and hardware have neither budgetary nor intellectual definitive bounds. The virtual absence of limits enhances the stress on both sides, and thus the speed and instability of such a race.

Ethics

Mathematics, according to a familiar view, is a neutral tool. As once formulated by Jerry Neyman: 'I prove theorems, they are published, and after that I don't know what happens to them'.

This is certainly an important feature of the mathematical endeavour, and does not only hold for theorems and theorem production. Also the teaching of mathematics, the production of high-level general mathematical competence in the population, is a precondition not only for the waging of modern war but also for the functioning of our whole technological society (quite apart from its cultural value).

But the title 'mathematics and war' implies ethical dilemmas. In order to avoid having the ethical discussion end up in 'I feel.../but I feel', we may start by looking at the actual ethical choices of some well-known figures.

- *Laurent Schwartz* used his high academic prestige to make his resistance to the French and American wars in Algeria and Vietnam more efficacious; he saw no connection between his work in mathematics and his political commitment – and as far as his own theoretical production is concerned it may be difficult to find any immediate and direct link.
- *Niels Bohr*, when becoming aware of the German nuclear bomb project, supported the competing Anglo-American project; when discovering the dangers that were to arise from the success of the latter, he issued warnings to responsible politicians (Churchill, Roosevelt) and to the public (the 'Open letter') – using his prestige as an originator of the underlying theory and as a collaborator, and arguably overrating the impact his interventions might have.
- *Alan Turing*, quite sceptical of British society, for political as well as personal reasons, put his outstanding abilities in the service of war with total loyalty when

he felt it was needed; unlike Bohr, he did so without ever putting himself into focus.

- *Kinnosuke Ogura* had been a strong promoter of (Marxist-inspired) democratic modernisation of Japan, and had opposed Japanese policies as being parallel to German and Italian Fascism. After the beginning of the aggression against China in 1937, however, patriotism and the project to use war as a way to modernisation urged him to play a central role in the organisation of Japanese mathematics in the service of the military state. After the war he regretted, without specifying too directly, what he had done.
- *John von Neumann*, like Turing, applied his outstanding abilities in war research. Von Neumann did so both during World War II and in the early Cold War; and whereas Turing had been a loyal participant about whose personal attitudes in the matter we know nothing, von Neumann made the creation of the H-bomb a personal project which (well served by Stanislaw Ulam) he did all he could to promote – his aim being to make possible a pre-emptive first strike.
- *Lev S. Pontryagin* gave up an extremely fruitful research line in algebraic topology and created control theory. With hindsight this appears to have been caused by a will to serve his socialist country by solving the problems of guiding intercontinental ballistic missiles – thus making impossible the first strike.
- Decades before, G. H. Hardy had tried to avoid that usefulness of his science which consists in ‘accentuat[ing] the existing inequalities in the distribution of wealth, or more directly promot[ing] the destruction of human life’, by concentrating on supposedly useless number theory. Ironically, he repeated this phrase in 1940, when number theory was soon to become a cryptographic resource.

To what extent can these serve as exemplars and role models? First, they show that two fundamentally different situations must be distinguished. One is that of Laurent Schwartz and Hardy: deep scepticism towards their own society, or aspects of that society as a warring power. The other is that of the remaining examples: they accepted their own society and its warfare or armament policies, either in general or under actual circumstances, and certainly with different degrees of identification.

In the second situation, the ethical dilemmas are few. Obviously, one will see no objections to doing one’s best. Certainly, dilemmas are not totally absent: one may still, like von Neumann, give an extra push; one may, like Turing, be fully loyal but leave the political decisions to those who are officially entitled to take them – whether politicians, citizens in general, or military men; or one may, like Bohr, use one’s particular standing and insight and moderate, warn, or point to alternative options.

The situation of the sceptic is less clear-cut. Very few of us are in a situation (the situation, say, of von Neumann and Pontryagin) where nobody else could do what we are doing. These few may influence matters directly by deciding to cooperate or not to cooperate.

Most mathematicians, if they choose not to cooperate in mathematics research and teaching, will have little effect, and little of what most mathematicians do in research and teaching is directed toward a specific application. Deciding to abstain from working with a particular discipline because it seems ‘corrupt’ is mostly futile. Giving up mathematics is not only giving up military applications, but anything mathematics can be used for – and whatever cultural value we may ascribe to mathematics.

However, the practice of the mathematician consists in more than the abstract production and dissemination of theorems. Any mathematician is in a *particular* situation, and in any particular situation there are specific conditions and a specific room for decisions. One may, for instance, widen one’s own insight and global understanding of the role of mathematics, and try to share it with students, colleagues and the public – or one may chose to remain and live as blind as comfortable. One may be a teacher in one or the other position, teaching within a highly stratified or a more egalitarian education system. One may organise the research of an institution, one may be a prestigious researcher, or one may be the newly appointed young colleague. One may be in the top of the ‘AMRC chain’, one may be in its periphery knowing or not knowing to belong there, or perhaps be wholly outside it. In each situation, the scope of ethical choices is different, and no general ethical rules or advice can be issued. What can be said in general is that the neutrality of mathematics *per se* does not entail the neutrality of these ethical choices.

An enlightenment perspective

The Enlightenment believed that reason *might* serve general progress. Rousseau and Swift pointed out that reason is too often used in the service of purely technical rationality and for purposes of sub-optimisation, with morally and physically disfiguring effects. According to Defoe’s Robinson Crusoe, ‘Reason is the Substance and Original of the Mathematicks’. Where does that leave mathematics with regard to disfigurement and progress today?

Much of what was said above concerning the utility of mathematics for the military points rather to disfigurement. Most alarming of all are probably not the actual uses, but the ideological veil of rationality, cleanness and surgical accuracy that is derived from the mathematisation of warfare. By generalisation one might claim that this applies not only to the military aspects of our modern technical society but to the technically rational society as a whole.

However, one of the ways in which mathematics serves the military points in the

opposite direction: to that sober-minded elimination of self-deceiving optimism and pessimism which can be provided by mathematical reasoning and calculation. Mathematics-based reason at its best should allow us also in larger scale to unlearn conventional wisdom, to undermine facile indoctrination, to distinguish the possible from glib promises. It *might* help us, if not to find any absolutely best way – this is too much to expect from rational analysis – then at least to evade the worst. If reason is ‘the Substance and Original of the Mathematicks’, then mathematics might serve to make clear to us that war is fundamentally irrational and unreasonable, not only in commonplace ideological generality but in specific detail.

Just as mathematical theories, mathematics *as a general undertaking* is ethically neutral – or, better, ethically ambiguous: responsibility remains with its practitioners, disseminators and users.

References

Most mathematicians, when writing about mathematics and society, speak of a society without war. Nonetheless, a few more or less general works of relevance for the preceding can be listed:

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Bernhelm Booß-Bavnbek and Jens Høyrup (eds.), *Mathematics and War*, Birkhäuser, Basel & Boston, 2003.

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Interview with Rolf Jeltsch, EMS President Looking to the Eastern European mathematical community

interviewer: Vasile Berinde (Baia Mare, Rumania)

What is the EMS and what are its aims?

The EMS was founded in 1990. It has a double structure in the sense that it is a society of societies, but also of individual members. It consists of about fifty member societies covering all of Europe from Iceland to Georgia, and from Norway to Israel and Portugal at the southern end. The main objectives are strengthening the feeling of a European identity among mathematicians, functioning as the European partner in mathematics for the European Union and outside Europe, and nurturing relations between the mathematical community and society as a whole. Subject-wise we cover all of mathematics, pure and applied, up to and including industrial applications.

What did you want to achieve as EMS president during your term of office?

I think that I was chosen as president because most of the founding societies have been inclined more towards pure mathematics than to applied mathematics. Hence one of my major goals has been to show the applied mathematics community that the EMS does care about this field and can be their home. For this reason I was happy that we could introduce the Felix Klein prize which is presented for using mathematical methods to give an outstanding solution to a concrete and difficult industrial problem.

Last year the EMS organised the first conference devoted to applied mathematics and the applications of mathematics; in addition it was the first EMS-SIAM meeting. We shall have as a follow-up the first conference that the EMS is running jointly with some of its corporate societies, in this case the two French societies, SMAI (Société de Mathématiques Appliquées et Industrielles) and the French Mathematical Society, SMF. The title of this event is *Applied Mathematics – Applications of Mathematics*, and it will be held in Nice (France) from 10-13 February 2003. As with the EMS-SIAM conference, we hope to get funding from the EU so that we can support young researchers not older than 35, from all member and affiliated states of the EU. Clearly my concern is to make this opening-up of the EMS towards applied mathematics a permanent feature. I therefore called a brain-storming weekend in Berlingen in Switzerland to discuss this matter. As a result the so-called Berlingen declaration was formed, which you can

find on the web <http://emis.de>.

What else do I want to achieve? In recent years, prices of journals have increased well above the rate of inflation and there seems to be no end to the strategy of commercial publishers to continue with these price raises. As an alternative EMS has started a publishing house. This will be a non-profit organisation that is run by professionals. The managing director is Thomas Hintermann, and I have tried to make sure in my last year of office that we can start with two book series as soon as possible, and with a small number of journals in 2004.

Last year the Portuguese Mathematical Society suggested regional meetings of corporate member societies jointly with the EMS. This initiative came at the right time, because it looks as though the EMS might be able to do a bulk application for supporting conferences in the 6th Framework program of the EU. We must therefore set up procedures for dealing with such conferences on a scientific level, as well as on the technical level. An ad-hoc committee is currently discussing these matters. I do hope that we have the basic structure set up by the end of my presidency.

There are two more projects we are currently working on, but these will have to be continued by my successor. One is to join in the world effort to digitise all old mathematical information. Again in the 6th Framework program, there is the possibility of supporting such an endeavour. We need to motivate a few member states to contribute too, and this can be used to trigger support from the EU. This is truly a task only the EMS can do. With the same type of EU funding we would like to distribute the financial burden for the important database *Zentralblatt MATH* to many more European countries and the EU. Up to now, the major financial burden has rested with Germany.

These four topics: the EMS publishing house, the EMS policy on meetings, the digitisation and the European support for *Zentralblatt MATH*, can be seen as a general push to improve the infrastructure for mathematics, and this will be discussed in a brain-storming weekend in Berlingen this coming April.

I have tried to be a president who is close to the corporate member societies and to their individual members. For this reason, I started writing them an annual letter, and in my opinion this did increase the coop-



eration with our member societies. I wanted to be able to increase the number of individual members quite dramatically: this unfortunately did not happen. I still want to devote my energy to get more members and I hope that this interview will motivate some *Newsletter* readers to join.

How can one increase the role and interest of Eastern European Mathematical Societies and individual mathematicians in the EMS and its activities?

This is really a very difficult question. I try to visit as many conferences in Eastern Europe as possible. Last year I was in Bulgaria, Rumania and Ukraine; this year I have been in Estonia, in Poland and again in Rumania, this time in Baia Mare. During these visits I have tried to listen to the needs of the local mathematicians. I have been impressed by the amount and quality of mathematics that is done in these places, and the enthusiasm to continue to work, despite adverse conditions. Unfortunately, I have also seen that conferences are misused as personal money-making ventures that did not help the local mathematicians.

In the above-mentioned Berlingen brain-storming weekends, my institution ETH generously pays for the local expenses. This has enabled some colleagues from Eastern Europe to participate: their active participation is very important. Sadly, I have to say that economic hardship in Eastern Europe takes too much effort from our colleagues, so they cannot invest as much energy in the EMS as they would wish too.

Concerning the input of corporate societies and from individual members, both groups have their share. In the Executive committee we have excellent people working together with me: some have become involved as council members representing individual members and some as representatives of member societies. Once they are in the executive committee, they work for the mathematical community as a whole and do not act as representatives of a corporate society or a special interest group. Hence I feel both type of memberships have their share of influence.

How can the EMS implement 'equality of opportunity' amongst European mathematicians?

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This is again a difficult question. As I mentioned above, economic conditions already make up for a large imbalance of the opportunities. However changing the economic situation is well beyond the power of the EMS. What we can do, and this we are successfully pursuing, is to open up EU funding to as many mathematicians as possible, especially in economically disadvantaged regions. As a first step, we can already support conference participants from all affiliated states: this already includes many, but not all, of the Eastern European states. Since Ph. Busquin, the EU commissioner for research, wants to create a European research area, we use his intention to promote the support of visitors from outside the EU member and affiliated states: this of course includes the other Eastern European states.

What is your opinion about the extent to which the current brain drain affects East European countries, and especially Romania (see EMS Newsletter 40 (June 2001), p. 22)?

I have seen an extreme brain drain in Bulgaria, where in some mathematics departments the youngest professor is well over forty years old. I think that this is a very bad situation. What happens is that if people want to stay in mathematics and pursue an academic career, they leave the country for economic reasons. This is typical for many eastern European countries. In addition, and this phenomena occurs throughout Western Europe and in the US just as much, young people are very often no longer motivated to do mathematics because there are other challenging careers with better salaries. Computer science is an extreme competitor to mathematics, and in the USA in addition to the rise of the so-called new economy, high salaries of lawyers take their toll. In recent years, all my Ph.D. students left academia immediately they gained their degree.

Knowing Romania's achievements in its mathematics competitions for high-school and university students, what do you think about establishing a EMS committee for mathematics competitions?

This is a good question, and I have to admit that I never thought about it. My first reaction is to say that there is the Mathematics Olympiad, and as far as I know students from Eastern Europe do extremely well. I am not very familiar with the Mathematics Olympiad, but I think setting up other competitions makes sense only if the profile of these contests are distinct from the Mathematics Olympiad or similar events. I think that I should discuss this idea with my colleagues from the executive committee and with the chair of the education committee.

You recently visited Romania, on the occasion of ICNODEA at Babes-Bolyai University in Cluj-Napoca. What are your impressions about the education and research achievements? What could be done in order to improve these and to enhance collaboration with Western European coun-

tries?

I was very impressed by the level of the talks I listened to – especially some really good work from young ones. I have, however, not gained enough insight into the educational system to make suggestions. I saw some examples of young researchers holding some position in a western country, while being willing to teach part-time and do research in Rumania. Clearly it would be just easier for the person to stay in the west and not have the extra burden of also working in Rumania. I think that the example set by these people is extremely important for the even younger ones, to show that there is a future in doing mathematics. It is important that the financially strong governments in Western Europe and the European Union offer opportunities for young ones from Eastern Europe; however, they have to give an incentive to move back to the country of origin. For this reason the EMS has pushed successfully for a programme where young researchers are given support for working two years in an institution in the west and they are supported for an additional year which has to be taken in the country of origin.

Have you met Romanian students in Switzerland? How do you rate their mathematical inclination and ability?

Yes, I have met Romanian students – in fact, we have two of them in our Seminar for Applied Mathematics: they are working with my colleague. Fortunately, I can say that both are excellent and very devoted, because otherwise it would be difficult to answer your questions without breaching privacy since they are of opposite sex.

What is your opinion about the direction in which society's awareness of mathematics is heading nowadays?

Unfortunately, I have the feeling that in most countries the number of hours for mathematics in schools is currently being reduced: it definitely is like this in Switzerland. This is a bad situation, because with the spread of computers with ever-increasing computer power, more and more things are done with computers. However whenever you want to compute you need to have a mathematical model, and so we need more and more people with an excellent knowledge of mathematics.

I think that what we basically do wrong is that we do not educate the mathematics teachers well enough. Teachers should first know the mathematics and have experienced the fun and beauty of it. Unfortunately, due to reduced teaching hours one often concentrates on 'mechanical' work, rather than on training the imagination. In primary and secondary schools we rarely show students an unsolved problem. Even in universities non-mathematicians are not exposed to unsolved problems. Hence, many people leave university with the idea that mathematics is uninteresting and that everything has been solved.

Next to improving the education of

mathematics teachers, we should try to raise public awareness in mathematics. World Mathematical Year 2000 made an excellent contribution in this direction, and this is why EMS has introduced a new committee to continue this work.

Tell us about your field of research, and how it influenced your presidency of the EMS.

When I started my studies at ETH, all I wanted to do is prove theorems. Then after four semesters we had to decide which particular direction to specialise in. I was hesitating between applied mathematics and the mathematics represented by B. Eckmann. I chose applied mathematics, not because I loved it – in fact, I dislike the inaccuracies of computer arithmetic – but because I felt I could help other people to solve their problems.

In the '70s and early '80s I was lucky to be able to take part in the dramatic expansion of the theory of numerical schemes to solve initial-value problems of ordinary differential equations. However I eventually felt that we had started to do theory in its own right, rather than to solve problems for other people, so I changed to solving hyperbolic conservation laws numerically.

A typical example is the simulation of hypersonic flow using the Euler equations of gas dynamics: I was especially motivated by a colleague from fluid dynamics. The European Space Agency ESA had started the project HERMES to build a re-entry vehicle similar to the space shuttle. It was fascinating to work in this European competitive programme and to be motivated by the idea that HERMES would actually fly. As you know, the fall of the iron curtain changed the space-flight priorities of Europe and the programme was abandoned. The problem with the numerical solution of hyperbolic conservation laws is that one cannot prove much. The existence and uniqueness of solutions in two and three dimensions are still not proved, and so we cannot prove convergence or give bounds for the errors.

How has this influenced my presidency of the EMS? Most importantly, I think, is my belief that we need both pure and applied mathematics. Some of my proofs use Riemannian manifolds and I still need some deeper insight there to prove a conjecture that I believe to be true – and as I indicated above, we still need a good theory for the solution of hyperbolic conservation laws. So keeping the unity of mathematics has been my highest priority. I want to prevent one field from trying to dominate others, either by claiming that 'our mathematics is deeper and thus more important' or 'our mathematics is more applied and thus brings in more funding': unfortunately, I have heard both statements.

My other priority has been that the EMS is here to help mathematicians.

What are you working on right now?

I have now moved to the more difficult magneto-hydro dynamical equations. In addition, I have several students working

on hard computational problems, such as three-dimensional simulation of particle beams in accelerators, optimal design of interior flow devices such as a diffuser of a gas turbine, large eddy simulation combined with combustion, and the application of modern methods from computational fluid dynamics to programs for computing the global weather.

What is your attitude to teaching and mathematics education?

All my academic life I have been teaching next to research: I think teaching and research have to go together, and I personally would not like to work in a pure research environment without teaching. I do love the contact with the younger generation. However, what I really don't like are the written exams we have to do, due to the number of students. Concerning mathematics education I have already mentioned what I feel is bad about some of our teaching.

How about the mathematics education system in your country?

Well, this is a really difficult question. Switzerland consists of 26 cantons, each with its own education system. Depending on where you live, you go for four to six years to primary school, and then you either enter a secondary school for 2-3 years before going to high school, or you enter a so-called 'long' high-school curriculum. Most students who go to a profession leave school at the age of 15 or 16 years. The EMS has made a study called 'Reference levels for the 16-year old': the Swiss system is explained there in much greater detail.

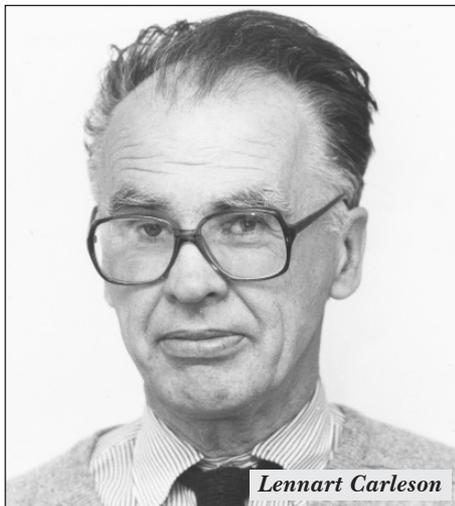
If one goes to university, one finishes high school at the age of about 19: this age has currently been lowered by about half a year by shifting the exams from January to August. In high school one can choose a more scientific curriculum, and within this the choice is between mathematics/physics and chemistry/biology. At present it is difficult to see the effect of shortening high school education and the newly defined choices of subjects. At the university level, again the universities are organised by cantons and hence differ a lot. Only the Federal Institute of Technology is a federal institution: it has two campuses: ETH in Zürich and EPFL in Lausanne.

Finally, do you know the centennial journal of elementary mathematics *Gazeta Matematica*? Could you conclude with a few words addressed to its readers, young people interested in mathematics...

I really feel bad – I do not know the *Gazeta Matematica*! Apparently it is directed to young people interested in mathematics. What should I tell them? I did mathematics because I liked it, not because of any career I had in mind. So my message is, if you like it, do it! One is most successful in the field one likes most. In addition we need many mathematicians, today even more than in my time, with all its computer applications. I think one can be confident in building a career on mathematics.

Personal Reflections on Analysis

A discussion between Lennart Carleson and Peter Jones



Lennart Carleson

The Newsletter invited Lennart Carleson (Stockholm) and Peter Jones (Yale) to talk about topics of interest to its readers. Here is the result.

LC: Mathematical fields such as geometry, algebra, and number theory of course, date back thousands of years, while analysis is a recent discovery. It can actually be dated to the 1660s when Newton was inventing the system to treat dynamics and Leibniz was constructing his machines for everything. Even if Newton's point of view had the greatest influence on the mathematical development, Leibniz has had a resurrection through the computer.

PJ: During the more than 300 years following the invention of calculus, analysis was heavily developed in many directions, and infiltrated geometry, number theory, and even algebraic geometry. If we look, for example, at Fields Medals since 1936, it is remarkable to note that 18 of the 42 recipients have a heavy component of analysis in their research.

LC: Speaking of Fields Medals, it is striking that no representative of probability has ever received the prize. An increasing component of probability will most likely arise in mathematics in general, and analysis in particular. Kolmogorov and Levy would have been candidates for the Fields Medal, but they were too early. After 1936 one does not see that many outstanding problems being solved, but rather the steady development of a general machine. But today one would expect to find Dynkin, Doob, or Kesten on the list of winners.

PJ: In the past few years there has been an explosion of activity in percolation, SLE,



Peter Jones

and other stochastic processes having a strong connection to physics, especially conformal field theory. So perhaps it is finally time for a winner in probability.

LC: Let's talk for a moment about the second half of the twentieth century. The most important developments were in PDE and its relation to harmonic analysis. Hörmander's thesis was a cornerstone and the development of distribution theory, as simple as it was, had a strong catalyzing effect. Looking back, it is curious that it took so long to develop the basic language of PDE.

PJ: This is a good example of how the role of language is often under appreciated. The introduction of 'dictionaries' between two or more fields can serve as a pole-star, as Sullivan observed for Kleinian Groups and rational dynamics. Don't forget the Number Theory - Nevanlinna Theory Dictionary, pushed by Vojta. At the same time there is a danger if you allow language to take over without having your feet on the ground. The Bourbakization of mathematics in the 1940s and 1950s led to a mostly unfruitful development within analysis, and serves as an illustration of the pitfalls awaiting a blind approach.

LC: The linear theory of PDE is to a large extent complete, and the great trend, with infinite possibilities, is nonlinear PDE. Computers have played a central role in suggesting new directions and numerically solving physically interesting equations, without linearization over long-time scales. Why do numerical calculations for nonlinear PDE tend to be so accurate? Very often there is a deep analytic structure lying behind the numerical stability. The Siegel

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disks are examples where this structure is unknown. Then we also have the instability of Navier-Stokes as a striking exception.

PJ: Over the past 50 years the most interesting subject in analysis have otherwise been Hardy Spaces and complex dynamics. After World War II, analysis has received eight Fields Medals, and one notices an increasing percentage of awards here during the past twenty years. Essentially all of these prizes were in the above-mentioned subjects.

LC: If one examines the development of various areas, they seem to have a life span of about 15 years. The problem is that often a mathematician spends his lifetime on one area and this is longer than the field's. Lars Ahlfors used to say: one should constantly change direction, but only by epsilon at a time. This principle certainly served him well.

PJ: A safe prediction is that analysis related to conformal field theory will be the next hot area. Another area that is now rather undeveloped, but with strong potential for analysis, is the connection to combinatorics and complexity theory. Here one can note that already in 1934 Whitney had introduced the divide and conquer method into analysis, with his Whitney decomposition. This is also a stopping time argument, which shows the universality of ideas from probability.

LC: Combinatorics has had one foot in analysis since the time of Euler. Analytical problems have on the other hand become more and more complicated, so it is natural that combinatorics has played a larger role in analysis. Complexity is a new subject that is still searching for its soul. I have difficulty understanding which mathematical problem lies behind $P = NP$, and why one should concentrate on that. As long as you can't tell if it's harder to multiply than add, one hasn't left first grade.

PJ: All elementary school teachers know that multiplication is harder. A central tool for the study of multiplication algorithms is the Fast Fourier Transform, and there are probably deep reasons for this. Convolution is at some level much simpler than multiplication, because it is multiplication without a carrying procedure.

LC: One can easily foresee that analysis will come to play a much larger role than today within complexity theory. Historically it has been the case in many subjects, indeed with algebra as almost the only exception, that as the theory developed, the more central problems became analytical in nature. At the time when we two became interested in dynamics (both real and complex), the field was largely ruled by topology, with very little analysis. Now the situation is exactly the opposite.

PJ: It seems likely that we have a similar situation with today's string theory, where algebra and geometry have been the cen-

tral tools. So far analysis has not played any central role there.

LC: On the other hand the situation in other physical theories is quite different. SLE seems like the dove indicating that the Ark is approaching a new land. It appears to give geometric and analytic meaning to the formal algebraic results of Virasoro Algebras. Isn't it a high priority to figure out what's going on here?

PJ: Analysis was developed to deal with functions of very few variables, mainly one and two. A systematic method for dealing with very many variables, say 100, exists in probability theory, for example with Monte Carlo methods. But the associated geometry has not received so much attention. What has been missing is the various descriptions on different scales of data sets.

LC: Another question is how to deal with functions of ten variables, or even three. The latter is central for mathematical biology and the related problems of computational chemistry. To illustrate the difficulties inherent in three dimensions, we don't understand the distributions of line segments in \mathbf{R}^3 (the Kakeya Problem), and there is no analytical component of knot theory. Vaughan Jones did, however, make a knot-theoretic breakthrough based partly on his knowledge of operator theory.

PJ: There is also an almost total lack of understanding of the natural fractals that appear in three dimensions. Tom Wolff's theorem on the support of harmonic measure in \mathbf{R}^3 is still very far from understood. We do have the beginnings of an L^2 theory of geometry, and it is interesting to note that this arose from an attempt to understand electrostatic distributions at equilibrium.

LC: In ten variables we know nothing. What are the questions, what are the tools, and what are the right classes of functions? The only thing that is clear is that they are very different from those appearing in one or two dimensions. The Fourier Transform is an outstanding tool in one variable, but it is not clear that it has any importance in ten dimensions. The orthogonal group is way too complicated to be of any use in full generality. A back-of-the-envelope calculation shows that the earth has been able to run some 10^{25} experiments for the simplest mechanisms. This has resulted in the diversity and very involved structures in biology. That is about the time needed to investigate the unit cube in ten dimensions with accuracy 10^{-2} . That means mathematicians have a lot of work left to do to match nature.

PJ: Let me insert a comment about higher dimensional theories and complex analysis. The complex numbers are favoured by nature, and function theory in one dimension is quite successful. But nature does not seem to like the bidisk. One can make the argument that most of several complex variables is abstract mathematics. But this

argument does not apply to symplectic geometry, which has a natural relation to physics.

LC: In this vein, however, complex analysis in connection with operators has not been fully developed. Similarly, Random Matrices has proved to be an exciting area and it has a complex analysis component.

PJ: It is perhaps worth recalling that single operator theory on Hilbert Space is almost a dead subject, because a general bounded operator on Hilbert Space cannot have much structure.

LC: Although I bet an inflated Swedish Crown on this existence of invariant linear subspaces for the Hilbert Space case. Perhaps it is a fixed-point theorem on some Grassmannian!? Let's summarize prospects for the future. Analysis is bound to be of increasing importance in mathematics, and mathematics will be of increasing importance in science. In biology, for example, we are still looking for the right problems that are related to the structure of functions of several variables. Neural Networks and Artificial Intelligence are attempts that have so far failed, exactly because such a theory of functions has been lacking. Coifman has coined the term 'Newton' as the search for (New) (T)ranscriptions (O)f (N)ature, but we also need a new Newton in person.

PJ: One could hope that analysis would become more flexible and curious in their mathematical perspectives of the world. This would lead to a greater number of graduate students in analysis.

LC: We also must accept that analysis in the future will have a greater component of computation and case study. Recent examples are given by Hales' solution of the Kepler Problem, and the work of Gehring and Martin on the minimal volume hyperbolic orbifold. Why not try to use computational methods to study long-term stability in celestial mechanics? It worked for the Lorenz Attractor, as Tucker showed.

PJ: Maybe people still underestimate the obvious ability of computer simulations and numerical calculations to influence mathematical research. Would holomorphic dynamics have been revived in the late 1970s without the pictures? I doubt it.

LC: We have been speculating about the future, but here is a down-to-earth problem I would like to know right now. What is the doubling time for DLA? Is the exponent rational? Can one at least show that it is non-trivial?

PJ: I would like to know how to construct bounded analytic functions in arbitrary domains, which would of course lead to a proof of the corona problem. Perhaps you have heard of that?

LC: Yes, it seems to ring a bell!

Usolv-IT: a web-platform for self-assessment by, and management of, a problems database

Frank de Clerck and Paul Igodt

E-learning and its tools have quickly arisen during the past few years and are increasingly present at almost all levels of education. We introduce a platform that combines a self-assessment tool with a management and sharing system for exercises. It arose from a mathematics competition and has thus been set up with particular attention to the technical needs for presenting mathematical formulas. It is also used today in regular curriculum training and assessment, as well as for mathematics courses and in other disciplines. Moreover, the Usolv-IT assessment tool dealing with Olympiad problems is freely accessible on the world wide web, with a Dutch as well as an English interface. Access is gained through www.usolvit.be.

Background and origin

In 1986 the Vlaamse Wiskunde Olympiade (VWO, for short) was organised for the first time. Since then it has run annually country-wide in the Dutch speaking part of Belgium. The number of high-school students (grades 11 and 12) participating in it increased very quickly to over 10,000, and since last year, when VWO started a Junior mathematics competition for grades 9 and 10, it has been approaching 20,000.

Each competition starts with two contests (the first and second rounds) that consist solely of 30 multiple-choice problems. From the first year the answers have been optically processed and centrally corrected. As a result, VWO have collected over the years an interesting set of mathematics problems and answers for different groups of high-school students.

It was this large database of interesting patterns and attractive problems that made us create an interactive electronic self-assessment tool, now known as USolv-IT. The USolv-IT collection of tools – off-line as well as on-line – now provides a training environment for students and a useful source of problems for their teachers. In the past couple of years, and with the support of the Universities of Ghent and Leuven, USolv-IT has increasingly served as a self-assessment tool for college students, offering them a course specific interface.

Meta-information: key to access problems with USolv-IT

Of key importance to understanding the working of USolv-IT is the concept of the database, describing the exercises available for assessment sessions.

Although the database is conceived to contain multiple types of questions, it is now operational with multiple-choice problems with a varying number of answer alternatives and one correct answer. Each problem has a ‘question’, its answer alternatives, possibly a ‘hint’ to the student, and contains a ‘documented solution’ (if needed). Each of these items can be built up of pieces of HTML-code, LaTeX-code or graphics (jpeg, gif).

In addition to these obvious items, the database adds a lot of meta-information for the problem and its content. It is mostly this extra detailed meta-information that gives a unique strength to USolv-IT as a platform for managing and sharing problems between colleagues in a common ‘domain’ of interest.

Let us briefly explain some of the meta-data that are kept in the system:

Author, organisation, language ... and other ‘info’: author, organisation the author belongs to, language the problem is written in, source describing the origin of the problem, eventual copyright, and some other particular data belong here.

Content of the problem: the content of the problem, according to a domain-specific labelling system. This labelling system has to be agreed upon beforehand, and is simply called a domain-tree. Eventually, in addition to the content labelling, a labelling of the skills/attitudes that a student needs to solve the problem, will also be added.

For example, the problem:

If $f: \mathbf{R} \rightarrow \mathbf{R}$ is a sufficiently differentiable function (with contin-

uous derivatives) satisfying $f(5) = 1$, $f'(5) = 2$ and $f''(5) = 3$ and if $g: \mathbf{R}^2 \rightarrow \mathbf{R}$ maps (x, y) to $g(x, y) = x^2 + 4y^2$, then $D^2_{xy}(f \circ g)(1, 1) + D^2_{xx}(f \circ g)(1, 1)$ equals ...

gets a content description consisting of the three lines below, where each line should be read as ‘zooming in’ by comma-separated steps:

1: Mathematics, Analysis, Functions, Real functions of several variables, Derivatives, Partial Derivatives

2: Mathematics, Analysis, Functions, Real functions of several variables, Derivatives, Chain Rule

3: Mathematics, Analysis, Functions, Real functions of several variables, Derivatives, Higher Order Partial Derivatives

Up to nine similar looking lines of meta-description can be used for a clear and as-sharp-as-possible description.

Group of students: the population of students the exercise is meant for (e.g., high school, 10th grade or first-year college students in bio-engineering or ...)

Course(s) the problem is relevant for: the particular course(s) (taught by the author) the exercise is relevant for;

Answer pattern statistics: statistical information about answer patterns for this exercise by a particular group or population of students (if available);

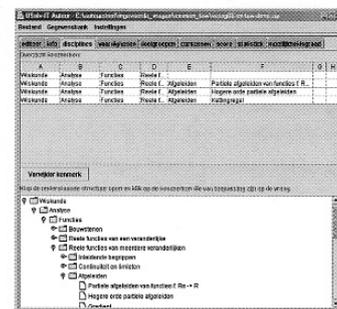
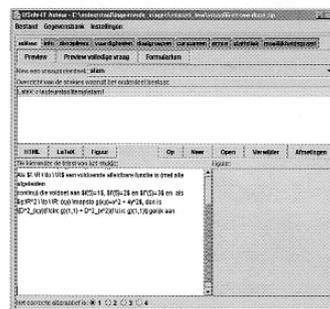
Qualitative difficulty description: a qualitative description of the level of difficulty of the exercise in relation to a particular population.

Stated in simple words, a carefully built set of meta-data to describe an exercise should be sufficient on its own to let teachers in the domain of the exercise decide whether it could be of interest to them, for their course and their students. Once a problem is prepared in full detail, with all meta-data needed, USolv-IT Author allows the author to go on-line and upload the problem-file to the central USolv-IT database manager. After a technical validation by the system manager, the problem will enter the database. Obviously, this immense collection of ‘extra’-information about the exercises allows a powerful way of managing the database. It is precisely this power that gives USolv-IT a particular strength for (e.g.) sharing educational material with colleagues, re-using this material over years, and creating course-specific approaches to assessment.

USolv-IT Author: authoring problems and meta-data

USolv-IT Author is an off-line tool allowing the author to enter problems and their meta-data into a single compressed file that also contains extra XML-code. Currently it is limited to entering multiple-choice problems with one correct answer and only available in a Dutch interface.

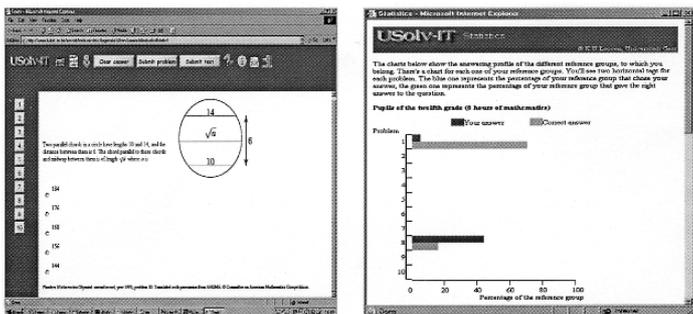
For each of the parts of input needed, USolv-IT Author shows a fill-out form. There is a global preview facility using your preferred web-browser. The following picture on the left shows the main ‘content input’ page, while the picture on the right shows the page where the content-labels will be added (by simple mouse-clicking).



Interfaces for students

Currently USolv-IT offers two types of interface to start a test with: one is oriented to high-school students (and called USolv-IT High School) while the other interface is meant for students in higher education taking a specific course (and called USolv-IT Student).

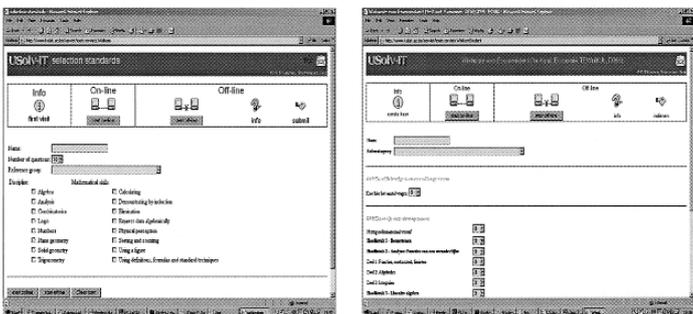
Although both interfaces look different from the entrance point of view, the effective assessment session is running very similarly. During the training the student can submit his answers one by one and get immediate feed-back, or he can submit the complete test, getting an overview of his results and the opportunity for feedback, per problem, as well as statistical feedback on his score related to a reference group. During the test, the student can consult a mathematics-formularium and a web-calculator. The following pictures show an on-going training session on the left, and part of a score pattern feed-back on the right.



For high school students

USolv-IT offers high school students access to the Olympiad problems only, for which considerable feed-back information is available. The interface (see the left picture below) allows a student to select a random set of problems from the database or a contents or skills-controlled subset. The student can also enter a 'reference group' with which he wants to compare himself, something that will come back in the feed-back information of the test. This interface is open to the world and appears in Dutch and in English: start from www.usolvit.be

A test can be taken on-line (hint available) as well as off-line (print the test and prepare). The latter scenario may be useful for secondary school teachers wishing to offer all the students the same test, in a rather classical paper-and-pencil setting. Afterwards, students can go on line again, enter their answers to the test, get immediate feedback on their answers, and gain statistical information on their score compared to the reference group chosen. This 'off-line first, then on-line' scenario is also useful if internet access (during long time) is not obvious or cheap.



For students taking a particular course

Students in higher education use USolv-IT with a course-specific training goal. The interface now shows the table of contents of the course (right picture above), as set up by the teacher. The student can request a test with problems selected randomly from any subset of chapters or sections visible in the table of contents: this offers the possibility for selecting exercise sessions that proceed with the student's speed of studying the course. Any particular course-assessment page is accessible via an individual URL, which can be presented on a

teacher's homepage or, more specifically, from within a course management platform (such as a blackboard).

USolv-IT Docent: the teacher management interface

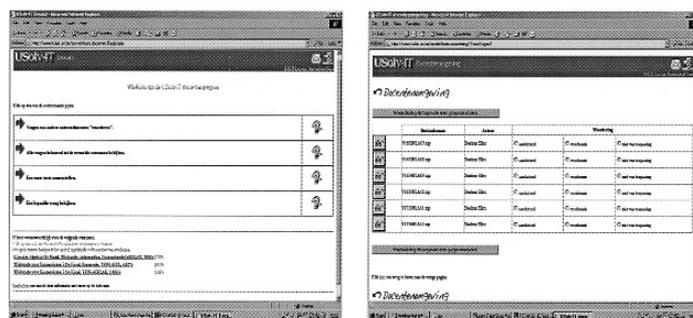
USolv-IT Docent provides a management system for assessment material and courses. In the near future, management facilities of test-sessions will be added. It is a web-interface for which authentication is needed by user-id and password. Teachers will be shown the list of their courses, each with a table of contents and an overview of the number of exercises available, corresponding to each part or section in the course. We summarise some management tasks that are available:

Creating a teacher-determined test: as the student interfaces allow only the generation of randomly composed tests, a teacher might want to build a test to be taken by all students. This is only minutes away with USolv-IT Docent. As a result, a test with teacher-determined composition becomes available via a URL to be announced by the teacher, and accessible during a limited time (e.g., 48 hours).

Adding exercises from other teachers to a course: all exercises uploaded by different teachers in the same domain are available to be shared in the context of another course by another teacher. USolv-IT Docent allows one to browse all exercise materials that match the contents of a particular course. You can look at each of these individual problems in full detail, and assess them in three ways: either accept an exercise as also belonging (from now on) to your course, or reject the exercise, or accept the exercise as being of preliminary importance for your course ('... my students are supposed to know this before they take the course ...').

Changing the exercises belonging to his course(s): Courses, as we all know, may change in content or topics. A teacher might then wish to reconsider all exercises in view of a changed course content, or in view of a changed emphasis on certain topics. USolv-IT Docent offers a browse facility to walk through the problems belonging to one's course, and to reconsider them with simple mouse-clicks.

Look up one particular exercise: The Docent interface allows one to look up in full detail a particular problem from the database. For example, this facility is of relevance for course tutors who want to help students that failed a certain test and need assistance for understanding a problem.



USolv-IT technically

Currently, USolv-IT is implemented with two mirror servers and mirror Oracle databases. As webservers we use Apache on Linux. Almost all USolv-IT tools (either for students or for teachers) are servlets, running on the webserver, questioning the databases and producing dynamically composed web-pages.

If you are interested in this tool and its development, please contact either of the authors.

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The authors are organisers of the Vlaamse Wiskende Olympiade – Flanders Mathematics Olympiad (see <http://www.vwo.be/>)

European Women in Mathematics Web-based Mentoring Scheme

Introduction

In August 2001 the organisation 'European Women in Mathematics' (EWM) was granted funding of €75,000 by the EU to provide web-based mentoring to women in mathematical sciences in Europe. The funding period for the EU scheme is 2 years and the scheme is operated from the School of Technology, Oxford Brookes University, UK. The webpage of the scheme, , was launched on 15 November 2002 by Eryl McNally, UK MEP. If you are interested in volunteering to be a mentor, or wish to be assigned a mentor, please visit the site.

Personnel

The project co-ordinator is Dr Cathy Hobbs, from the Department of Mathematics in the School of Technology, Oxford Brookes University, UK. Cathy has had many years of experience in the area of women in mathematics. She has been a member of EWM since 1994, has edited the EWM *Newsletter* and the Proceedings of the 8th General Meeting of EWM and is currently the Treasurer of EWM. She also chaired the Committee on Women in Mathematics of the London Mathematical Society from 1999 to 2000.

The web designer is Ms Tjitske Kamphuis, a graduate in linguistics from the University of Amsterdam who trained as a web programmer in the Netherlands. Her previous experience has included commercial work, web design for the University of Amsterdam and web programming for Oxford University.

European Women in Mathematics

EWM is an affiliation of women bound by a common interest in the position of women in mathematics. Its 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 organisations, in Europe and elsewhere, with similar goals.

The organisation was conceived at the International Congress of Mathematicians in Berkeley, August 1986. It was formally constituted as a not-for-profit organisation in Finland in 1993. At the time of writing, there are participating members in the following countries: Austria, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Romania, Russia, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom. There are also non-European individual members.

EWM's main activities are to run mathematical meetings, where the speakers are all women, operate an e-mail list connecting women in mathematics throughout Europe and publish an annual newsletter.

The EU and Women in Science

Recent reports have highlighted (yet again) the lack of women in higher positions in academia across scientific disciplines. In particular, the ETAN report commissioned by the EU: *Report on Women and Science: Science Policies in the European Union: Promoting excellence through mainstreaming gender equality, European Communities*, published in 2000, has collected a large amount of data from EU States to illustrate the lack of women at senior levels in all science subjects in Europe.

Since the start of the Fifth Framework Programme, the EU has been taking steps to address issues of gender policies in science. A Women in Science Unit was created in 1999 as a focal point for activities. Their aims were initially to stimulate women's participation in the Fifth Framework Programme, collect statistics from the implementation of the Programme on women's participation and coordinating efforts to develop better indicators on the participation of women in research in Europe.

One aspect of the EU's policy has been to mainstream gender equality in all its calls for proposals. In the Fifth Framework Programme, the Calls for Proposals for Accompanying Measures in the Horizontal Programme of 'Improving the Human Research Potential' specifically mentioned the dimension of gender and encouraged women to participate. EWM, with support from the Women in Science Unit of the European Commission, focused on this area when putting in a proposal to set up a web-based mentoring scheme for women in mathematics.

Aim and scope of project

The aim of the free web-based mentoring scheme is to enable new women mathematical scientists (e.g. graduate students, those considering graduate work, postdoctoral students) to find mentors amongst the mathematical science community. In this context, a mentor is someone who can listen to what their mentee is saying, provide advice on academic issues such as applying for jobs, applying for grants, when and where to publish research work, and also may act as a role-model to the mentee. Mentors may also advise on broader gender-related issues faced by women in a mainly male-dominated environment. The mentors in this scheme are volunteers, not trained counsellors, who are willing to share their own experiences with less-experienced mathematicians.

We have carried out a survey of potential users of the mentoring scheme in order to

find out what issues we should particularly address. The survey indicated a high level of support for the aims of the scheme. It also found that most potential mentees do not mind about the gender of their mentor, but that knowledge of the country-specific academic structure was very important to them. Mentees would like advice on a range of issues, including careers, applying for grants, publishing research and balancing family and career.

Using the web to facilitate the mentoring scheme will enable women to form links with mentors across Europe. It is anticipated that because of the wide distribution of mentors and mentees across Europe, they will mainly communicate by e-mail, but they will have the freedom to structure their own mentoring relationship. This may mean telephone contacts and face-to-face meetings where appropriate.

Similar schemes are now starting up across the world – for example, that run by the American Women in Maths organisation. We will link with them to provide mentors for European women, and also to provide US mentors for those considering studying in the US. We hope that schemes of this nature will contribute to the support network for women in mathematical sciences and encourage women to progress in their mathematical science careers.

Web Site

On the home page of the website the basic idea of the scheme is outlined. Users can then go to sections on signing up to be a mentor, signing up to request a mentor, profiles of existing women in mathematics and information on careers, education and on mentoring generally.

The sign-up pages give further information about the role of a mentor and guidelines on the time commitment required to be part of the scheme. There are links to guidelines on being a mentor and being a mentee, as appropriate, and guidelines on electronic communication. The mentor or mentee can then fill out an online form. The data provided goes directly to a database which is only accessible to the administrators of the site. Matching of pairs is then done, paying particular attention to the aspects the mentor and mentee have highlighted. For example, for some people the subject area is most important, whereas others would feel that geographical location is more critical. The mentor/mentee pair will then be informed of the matching and provided with basic details of their partner. They are then free to conduct their mentoring relationship as they see fit.

The website provides a section for feedback. We also hope to collect more structured feedback information from a sample of users. There is also a discussion forum on the site to which any users may contribute.

The website is now active and we would like to have plenty of mentors and mentees signing up. You are encouraged to sign up and also to tell others about the site. We hope it can really contribute to helping new women in mathematics to stay in the subject. Dr Cathy Hobbs [cahobbs@brookes.ac.uk], School of Technology, Oxford Brookes University, UK.

EMS Committee for Developing Countries (CDC)

Where we stand and where we'll go
Herbert Fleischner (Chair)

At its annual meeting in April, this year, CDC formulated its policy as follows.

CDC policy

The EMS CDC should assist developing countries (DCs) wherever and whenever possible. For practical reasons, our main activities during the next years will see us focussing on African and Asian DCs. The EMS CDC is in a position to assist DCs at the following levels:

- (1) Developing mathematics curricula for schools and for universities.
- (2) Cooperating with local staff in conducting MSc and PhD programmes; holding special courses in areas of mathematics where there is no local expertise.
- (3) Helping to build up libraries through donations from colleagues in developed countries; mobilising funds to buy books for postgraduate studies and research purposes; supplying mathematical literature upon request by institutions and/or individual researchers in DCs; negotiating with publishers on special book rates for DCs.
- (4) Helping to build up regional centres and networks of excellence: these are centres directly or semi-attached to universities, which provide expertise in areas and on levels that regional universities are in need of.
- (5) Providing information about where students from DCs (who already have an MSc) can do their PhD, and what possibilities for PhD grants exist. At the same time, in order to minimise a brain drain, we will support efforts to build up PhD programmes in DCs according to international standards (regional centres of excellence could serve this purpose).
- (6) Mobilising funds for junior and senior researchers to attend conferences in developed countries, and also helping (both on an academic and financial level) to organise conferences in DCs.

In each of these topics (1)–(6), several CDC members and others within the EMS have already considerable experience. It is our intention to build up these activities to the full extent.

CDC members

CDC now consists of eleven 'regular' members: Herbert Fleischner (Vienna), *fleischner@oeaw.ac.at*; Leif Abrahamsson (Uppsala), *leifab@math.uu.se*; Lars Døvling Andersen (Aalborg), *lda@math.auc.dk*; Georg Bock (Heidelberg), *Bock@ivr.uni-heidelberg.de*; Doina Cioranescu, (Paris) *cioran@ann.jussieu.fr*; Michel Jambu (Nice),

Michel.Jambu@unice.fr; Angel Jorba (Barcelona), *angel@maia.ub.es*; M. S. Narasimhan (Trieste), *narasim@ictp.trieste.it*; Bernt Oksendal (Oslo), *oksendal@math.uio.no*; Andrzej Pelczar (Krakow), *pelczar@im.uj.edu.pl*; Tsou Sheung-Tsun (Oxford), *tsou@maths.ox.ac.uk*. H. Fleischner is CDC Chair, Tsou Sheung-Tsun his deputy, and Doina Cioranescu is the EMS EC member connected with the CDC.

Apart from CDC members, we also have colleagues whom we call CDC associates, who are involved in various CDC activities. CDC associates contribute to CDC activities on a more-or-less regular basis, but may be involved in DCs independently (which makes it rather desirable for CDC to assist them, whenever possible).

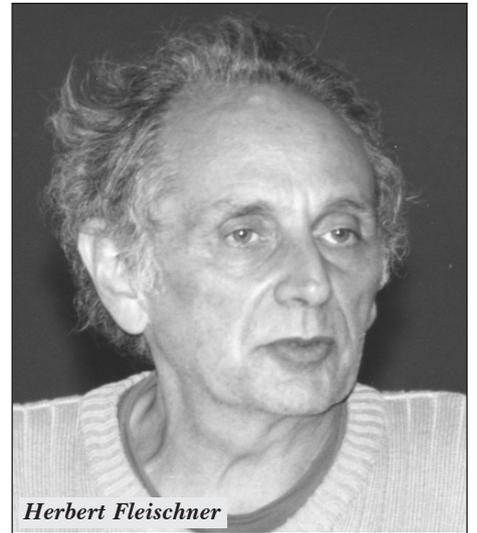
It may be that the CDC will be enlarged in the future: time and experience will show whether such enlargement will be needed. For the moment, however, we have not yet reached cruising height and cruising speed – to use airline language. We are still in the state of climbing to gain height, and still have to unfold activities where they are needed, combine efforts, build on the experiences of each other (that is, create synergies), so a lot of work lies ahead of us.

However, given the fairly short time since the end of April, when the CDC was re-activated, we have been quite successful – it is on track, anyway. On top of that, as the CDC's work progresses, it might get support from new CDC associates: offers of assistance have been considerable so far.

CDC subcommittees

The following CDC subcommittees have existed since the April CDC meeting.

- *Subcommittee on Africa*
Originally consisting of A. Pelczar and H. Fleischner, it was later joined by B. Oksendal and L. Abrahamsson, so this subcommittee comprises much experience gathered in large parts of this continent. On top of this, ICTP and CIMPA activities in Africa and direct assistance given by these two institutions to CDC make this subcommittee the most viable one at present.
- *Subcommittee on Asia*
The members are G. Bock and S.-T. Tsou. Through Bock's connections to Vietnam, and the CDC book donation programme (see *EMS Newsletter* 44 and below), we may consider Southeast Asia relatively covered by the CDC's current activities. Unfortunately, this subcommittee is currently the weakest – both in terms of members and (probably as a



Herbert Fleischner

consequence) in terms of EMS assistance given to this region.

- *Subcommittee on scientific literature*
Originally staffed by H. Fleischner only, he and S.-T. Tsou (on the basis of their above-mentioned article 'Can you spare books?') are the most directly involved CDC members. In addition, B. Wegner has provided a lot of information about e-journals and electronically available scientific literature, otherwise available in print. Likewise, ICTP can be used as a source for scientific literature available on-line, and Bordeauxtheque is a source for research papers as well. This information still needs to be conveyed to our colleagues in DCs. However, as soon as we published the article in the *EMS Newsletter*, this book donation programme consumed most of the time dedicated to this subcommittee's work. This programme will continue (see below), and we will also include all the information on electronically available literature. This rapid development forces an expansion of this subcommittee, and this has already happened.

So much for the subcommittees which have existed since April. In addition, initial steps have been taken for establishing the following committee.

- *Subcommittee on Latin America* (including the Caribbean region).
Ultimately, A. Jorba will head this subcommittee, and L. Andersen will assist him in the leadership of this subcommittee, at least initially. However, other EMS members have ample experience in, and connections to, this region. Some are CDC associates, some are not (yet). Not only are such individual activities *per se* a valuable contribution to development cooperation, but such connections can help enormously in establishing a network of links between the CDC and the region (see below, concerning distribution centres).

We are aware of the fact, however, that due to historical developments, the needs of African, Asian and Latin American DCs may differ considerably. Here we are still in a learning process as a group, based on the connections between the CDC and corresponding partners in DCs. So much for

the subcommittees.

M. S. Narasimhan (ICTP) and M. Jambu (CIMPA) are not directly members of any subcommittee: they are active on a more global level within their respective organisations. Their expertise and connections as such, together with assistance (including financial aid) by ICTP and CIMPA for our activities, are of great help for the overall success of the CDC. Thus we may call ICTP and CIMPA the 'cornerstones' of the CDC's activities.

The CDC also needs money!

So far, CDC doesn't have its own budget which it might dispose of immediately. However, it does have an account – it's an EMS account, but it is a special account for the CDC. Here are the details: Account holder: European Mathematical Society Bank: Nordea Bank Finland Plc Acc. no. 157320-381160 (EUR) with SWIFT code (BIC) NDEAFIHH; IBAN: FI7815723000381160; Address: Branch 1572 Senaatintori, Aleksanterinkatu 30, FI-00020 Nordea, Finland.

Note that any convertible currencies can be transferred to this account. Unfortunately, transferring smaller amounts (stemming from individual donations, say) from outside Finland may be too costly in comparison to the donated amount. We are aiming therefore at a situation where the mathematical societies of individual EU-member countries act as a go-between, in that they collect small donations from individuals and transfer corresponding lump sums to the CDC's Helsinki account (the Austrian Mathematical Society is about to open an account for donations on the CDC's behalf; and as of 2004, donations for the CDC can be combined with payment of the annual membership fee).

With regard to shipping expenses in the framework of its book donation programme, the CDC has no financial worries at the moment. Transportation costs have been covered so far by donors' universities, ICTP and the University of Zimbabwe (that is, the receiver's side itself); we may also rely on EMS to some extent, and possibly CIMPA. However, fundraising will be an important activity for our immediate future.

CDC activities

Through our book donation programme, and also through establishing new contacts in DCs, the CDC has gained already considerable publicity in quite a few DCs, and also in the developed world. In fact, our book donation programme underwent a snowball effect, and as soon as our article 'Can you spare books?' appeared in the June issue of the *EMS Newsletter*, response by colleagues in Europe set in – practically immediately afterwards – and we even obtained books from the Institute of Advanced Study in Princeton. Some colleagues even offered to collect books on our Programme's behalf; the *London Math Society (LMS) Newsletter* reprinted our article in its September issue, and a retired Canadian colleague, becoming aware of

our programme on the basis of our article as published by the LMS (!), has privately donated a large amount of books, almost exclusively of high standard. He has then initiated that the Canadian Mathematical Society publishes a modified version of our article (produced by CDC associate Gert Sabidussi with Herbert Fleischner) in the November issue of the *CMS Notes*. Practically simultaneously, Gert Sabidussi, Université de Montreal (UdeM), declared his readiness to act as a collecting point and 'clearing house' for book donations from Canada – that is, UdeM will not only provide space for storing the incoming parcels, but Sabidussi will sort the incoming books by quality. This help is not only a great support for the programme's logistics, but will also make the programme more effective from a global point of view; and towards the end of October, a colleague from Kent State University (having become aware of our programme by the same *LMS Newsletter* article), offered to donate several hundred advanced books; he also offered additional assistance for our programme.

By the time we turn to the AMS to join us in this book donation programme, in early 2003, we'll already have some contact persons in the USA. So, through the book donation programme and the preceding articles, we are already well known in large parts of Europe and Canada, and in smaller parts of the USA. Matters are developing in a self-propelling way. Later on, we may also turn to Australia and New Zealand to join this programme. Connections between the CDC members and associates and the SADC region (Southern Africa Developing Countries), and also other sub-Saharan African countries have already existed for some years. The book donation programme enriches these connections considerably, and through e-mail contacts with Jan Persens (President of the AMU) we are connected with all of Africa on a more general level: it is not an overstatement to say that we are already known in large parts of Africa. For Asia, the picture seems to be quite different. We are only represented in Vietnam through G. Bock's work, and some of the books donated to our programme went there. Likewise with Latin America and the Caribbean, the CDC as such doesn't seem to be known there yet.

The preceding remarks have already covered the book donation programme from various angles. However, there is an important aspect to this programme which is of relevance for our future work, far beyond the donation and distribution of scientific literature – establishing networks, whose nuclei are (in this case) the distribution centres in DCs through which we reach whole regions with our book donation programme.

At the very beginning of the book donation programme it became clear that it would not be practically feasible to supply individual universities, or centres of excellence, on a one-by-one basis. So, the idea of establishing distribution centres serving entire regions, or all universities of a pop-

ulous country (such as in Nigeria or South Africa), was soon born. First, the University of Zimbabwe (having been the first to obtain a donation) declared its readiness to serve as such a distribution centre for the SADC region, except for South Africa (SA). Soon afterwards, AIMS (the African Institute of Mathematical Sciences) likewise declared its readiness in the same direction. So, AIMS will serve South Africa in its entirety, whereas the University of Zimbabwe will distribute literature throughout the rest of the SADC region. We are about to establish formal contacts with new potential distribution centres, such as the Nigerian Mathematical Centre (NMC) in Abuja, which would serve all of Nigeria, and Senegal, serving West Africa (both anglo- and frankophone). A regional network embracing Tanzania, Uganda and Kenya might also be a potential distribution centre. So, in Africa, we soon will have four or more distribution centres, covering large parts of the continent.

In Asia, the only distribution centre so far is Vietnam, and in Latin America and the Caribbean region, we have at present two centres, in Venezuela and in Guatemala. More centres in both regions will be established in the future, we hope. Ultimately, the aim should be to establish a network of distribution centres which covers all DCs. In the long run, the distribution centres might also serve as focal points for the respective regions, in connection with other regional programmes, such as MSc or PhD programmes.

Other CDC activities involve individual CDC members and associates in the MSc and even PhD programmes in Africa and/or Asia, be it on the level of organising such programmes and/or in a teaching capacity and/or on the level of supervising the writing of theses. In future articles, we might describe the working of such programmes in more detail. Right now, plans are under way to organise a summer workshop at the University of Zimbabwe or in South Africa in 2004, involving CDC, CIMPA and MSISA (Southern Africa Mathematical Sciences Institute) as organising institutions, with mathematicians from European countries other than France, and African colleagues giving lectures to students. The CDC has also been asked to be a co-sponsor for a series of workshops in West Africa, or at least to assist them in finding additional funds (ICTP and CIMPA are the main sponsors). A closer cooperation between AIMS and CDC (apart from the book donation programme) might very well develop in the future.

As far as cooperation between the CDC and Asian countries is concerned, corresponding contacts still need to be established (apart from Vietnam). With regard to Latin America, the situation is not so 'grim', since we have 'dormant' contacts there, which will soon be activated by the CDC's corresponding subcommittee. The annual CDC meeting (8-9 February 2003, to be hosted by CIMPA in Nice) will pay particular attention to these questions.

The Portuguese Mathematical Society – Sociedade Portuguesa de Matemática



Graciano de Oliveira, Coimbra (Past president)

The Portuguese Mathematical Society (SPM) was founded in December 1940 and its first chairman was Professor P. J. da Cunha. At that time, many countries had mathematical associations of long standing. The SPM thus came into existence relatively late and in an environment far from favourable, as the country lived under a dictatorship.

The founding and activities of the SPM have to be understood within the political situation of the country. In the 1930s and 1940s there appeared a large number of scientists (now known as the Generation of the Forties) who understood and stressed the importance of science, culture and knowledge in general, for the development of the country. They were determined to take concrete steps to change the situation. Moreover, they also thought that democratisation was an essential issue, closely linked with education and the spread of knowledge. These views would bring them much trouble and many difficulties.

Immediately after the founding of the SPM, a number of decisions were taken with the aim of attracting members to the new association and spreading its activities nationwide. The intention was to bring into the association not only research mathematicians, of which there were very few at the time, but also teachers and students of mathematics. There were grave deficiencies both in research and education. Several committees were set up: a Pedagogical Committee, a Committee for Pure Mathematics, another for Applied Mathematics, and another for the History and Philosophy of Mathematics. It was decided to publish a Bulletin and an editorial board was appointed. The founders and their collaborators were energetic and hopeful. They launched a campaign of talks and seminars, including radio broadcasts, and planned action to counter the scientific isolation of the small Portuguese mathematical community. To achieve this end, contacts were established with foreign mathematicians, some of whom were invited to visit. One of them was Maurice Fréchet, who was soon elected an honorary member of the Portuguese Mathematical Society. In July 1942, the SPM approved the publication of a series of books under the name *Biblioteca de Matemática*. Much effort was spent in branches of science that made frequent use of mathematics, such as physics and economics, and students were not forgotten. Indeed, it was clear to the Generation of the Forties that the future lay in the students' hands, and so it was considered of the utmost importance to foster their imagination, thirst for novelty and interest in mathematics.

Several mathematics clubs were founded in the schools, the first being on 7 July 1942. Everything seemed to be going well and some financial support was occasionally

obtained from governmental sources. However, the authorities were paying close attention to the deeds of the citizens and started to become suspicious of so much activity. Normally, dictators are not happy when citizens act on their own initiative or try to think for themselves. In the case of the Portuguese scientists, it was true that many of them, if not all, believed that without democracy it would not be possible to go far, and did not conceal their opinions. Moreover, some of them (this is well known today) had connections with underground political movements that aimed to overthrow the regime. Distrust by the government increased and soon serious attacks were made upon science and the universities. The mathematics clubs were declared illegal and banned. In the year 1946-47 an offensive against the universities was launched with disastrous results. A large number of professors, not only of mathematics, lost their jobs. Many had to make their living in different walks of life and ceased their scientific work altogether, while others went abroad to continue their work. The Portuguese Mathematical Society was prevented from holding its normal meetings because gatherings of many people displeased the political authorities. Moreover, it was forbidden to elect another executive committee. This was a great blow to the association but it was not the end. Of course, activities were drastically curtailed, but the association lingered on down the years until it could fully wake after the 1974 revolution. The second elected Chair, in 1943, was A. Mira Fernandes who could not take office for personal reasons, and was replaced by Bento Caraça. In 1945, A. Ferreira de Macedo was elected Chair, and in 1947 M. Zaluar Nunes took over. Nunes was the last chairman elected before democratisation in 1974.

After Nunes, a long period of hibernation followed, the existence of the association being hardly noticed. Even so, it was possible to continue several periodical publications, which had been founded by people belonging to, or connected with, the Generation of the Forties. In 1937 *Portugaliae Mathematica*, a journal dedicated to research papers, was founded by A. Monteiro, H. Ribeiro, J. S. Paulo, M. Z. Nunes and R. Luís Gomes. Its publication has continued uninterrupted until the present day: it still exists and is in very good health. During the difficult years it counted distinguished mathematicians of many nationalities amongst its contributors.

In 1939 another periodical, *Gazeta de Matemática*, was founded by A. Monteiro, B. Caraça, H. Ribeiro, J. S. Paulo and M. Z. Nunes. Its target was students and teachers, thus publishing articles that could be read by a large audience. The *Gazeta de Matemática* came out without interruption until 1976.

After a long break, a single issue was published in 1990, and finally regular publication was resumed in 2000, the World Mathematical Year. It still exists and Volume 144 is planned for January 2003.

In 1974 democracy was at last established, and life became easier. The Portuguese Mathematical Society finally became a legal association in 1977, and could resume normal activities, which spread throughout the country. *Portugaliae Mathematica* became the property of the SPM. National meetings were held, local seminars were organised and publications increased. The SPM has organised summer schools addressed to either research issues or pedagogical questions of interest to teachers. In addition, several prizes have been established to distinguish achievements in mathematics: perhaps the most important of these are the José Anastácio da Cunha Prize and the José Sebastião e Silva Prize. The names were chosen to pay homage to two mathematicians: the former, who was also a distinguished poet, lived in the 18th century, while the latter lived in the 20th century. The Da Cunha Prize, awarded every four years, rewards authors of doctoral dissertations. The Sebastião e Silva Prize is awarded every two years to authors of secondary school textbooks.

In the early 1980s it was noticed that Portugal had never held National Olympiads, nor participated in International contests. The Portuguese Mathematical Society started mathematical Olympiads in 1980, first restricted to certain regions of the country, and in 1983 nationwide. 1989 saw the first regular participation by a Portuguese team in the International Mathematical Olympiad and also in the Ibero-American Mathematical Olympiad. The SPM recently collaborated in the commemoration of the World Mathematical Year. This commemoration created the conditions for a number of new initiatives, one example being the launching of an international series of advanced mathematics texts. The first volume in this series has already appeared, with the title *Introduction to Random Time and Quantum Randomness*, by Kai-Lai Chung and Jean-Claude Zambrini. In recognition of the role it played, the President of the Republic admitted the Sociedade Portuguesa de Matemática as an Honorary Member of the Order of Public Instruction (Membro Honorário da Ordem da Instrução Pública) at a ceremony held during World Mathematical Year.

This has been an abbreviated, therefore incomplete, history of the Portuguese Mathematical Society. There have been two phases: the hard times from 1940 to 1974, and thereafter when the SPM did what a mathematical association is supposed to do. We hope others will add more details.

Forthcoming conferences

compiled by Vasile Berinde

Please e-mail announcements of European conferences, workshops and mathematical meetings of interest to EMS members, to one of the addresses or vasile.berinde@yahoo.com. Announcements should be written in a style similar to those here, and sent as Microsoft Word files or as text files (but not as TeX input files). Space permitting, each announcement will appear in detail in the next issue of the Newsletter to go to press, and thereafter will be briefly noted in each new issue until the meeting takes place, with a reference to the issue in which the detailed announcement appeared

January 2003

10 – March 10, 2003: Research period on Interacting Particles and Computational Biology, Centro di Ricerca Matematica Ennio De Giorgi, Scuola Normale Superiore, Pisa
Theme: Interacting particles and computational biology

Aim: The research period will focus on an understanding of collective behaviours in particle and biological systems, with emphasis on the mesoscopic approach. The activity will consist mainly in advanced lectures on probability and biology, the main topics being patterns, interaction, and kinetics. It will also include several advanced seminars in biology and lectures on mathematical problems raised by biology

Scope: to allow researchers from different areas to discuss the frontiers of these subjects; to give the opportunity to Ph.D. and postdoctoral students to learn advanced subjects and address their researches

Topics: Pattern formation in nature. Self-organisation, interaction, taxonomy of patterns (metrics), geometry and kinetics of patterns, connection to biology. models, predictions and control. Mathematical problems raised by biology

Main speakers: P. Blanchard (Bielefeld), S. Camazine (Pasadena), V. Capasso (Milan), A. Carbone (IHES), R. Cerf (Paris), J. P. Crutchfield (Santa Fe), F. Cucker (Hong Kong), P. de Kepper (Bordeaux), J.-L. Deneubourg (Brussels), J.-D. Deuschel (Berlin), M. Giacca (Scuola Normale Superiore), G. Giacomin (Paris), T. Haubin (Paris Sud), P. de Kepper (Bordeaux), M. Isopi (Roma), P. Malliavin (Paris), A. Martinoli (Caltech), Hans Meinhardt (Max-Planck-Institut), R. Turner (Wisconsin), Tamás Vicsek (Budapest)

Format: advanced lectures, seminars
Organisers: Centro di Ricerca Matematica Ennio De Giorgi, Scuola Normale Superiore, Università di Pisa, Scuola Sant'Anna
Scientific committee: J.-L. Deneubourg (Brussels), Yu. Manin (Max-Planck-Institut), H. Meinhardt (Max-Planck-Institut), P. Mathieu (Brussels), F. Flandoli (Pisa)

Organising committee: F. Flandoli, M. Giaquinta, P. Mathieu, G. Tomassini
Location: Centro De Giorgi and Scuola Normale Superiore

Grants: A limited number of grants to participate in the research period will be awarded to PhD students, PostDocs and young researchers
Deadline: for grants 15 December
Information: www.crm.sns.it/particles03

February 2003

5-7: 4th IMACS Symposium on Mathematical Modelling, Vienna, Austria

Information: web site: <http://simtech.tuwien.ac.at/MATHMOD>
 [For details, see EMS Newsletter 41]

5-7: 4th MATHMOD Vienna 4th IMACS Symposium on Mathematical Modelling, Vienna, Austria

Information: e-mail: inge.troch@tuwien.ac.at, web site: <http://simtech.tuwien.ac.at/MATHMOD>
 [For details, see EMS Newsletter 44]

10-13: Applied Mathematics and Applications of Mathematics, First EMS-SMAI-SMF Joint Conference, Nice, France (AMAM2003)

Themes: Applications of number theory, including cryptography and coding; control theory, optimisation, operational research and systems theory; applications of mathematics in biology, including genomics, medical imaging, models in immunology, modelling and simulation of biological systems; scientific computation, including *ab initio* computations and molecular dynamics; meteorology and climate, including global climate change; financial engineering; signal and image processing; non-linear dynamics; other applications, probability and statistics, inverse problems, fluid dynamics, material science

Main speakers: A. M. Bruckstein (Israel), R. S. Eisenberg (USA), R. Glowinski (USA), L. Greengard (USA), E. Kalnay (USA), R. Keunings (Belgium), C. D. Levermore (USA), P. Massart (France), M. Musiela (UK), B. Prum (France), R. Schoof (Italy), E. Zuazua (Spain)
Conference presidents: R. Jeltsch (EMS), M. Théra (SMAI), M. Waldschmidt (SMF)
Scientific committee: P.-L. Lions and S. Novikov (Chairs), L. Birgé, J.-M. Coron, M.-F. Coste-Roy, A. Damllamian, N. El Karoui, O. Faugeras, F. Golse, M. Gromov, M. Merle, J.-F. Mestre, E. Pardoux, O. Pironneau, F. Poupaud (all from France), A. Fasano (Italy), A. Frank (Hungary), B. Gustafsson (Sweden), E.Ya. Khruslov (Ukraine), P. A. Markowich (Austria), D. Roose (Belgium), Z. Schwus (Israel), J. T. Stuart (UK), E. Tadmor (Israel/USA), V.V. Vasin (Russia)

Organising committee: D. Cioranescu and M. Martin-Deschamps (Chairs), J. Blum, D. Chenais, C. Walter

Location: Nice-Acropolis convention centre in the center of Nice.

Information: e-mail: , web site: <http://acm.emath.fr/amam>

13-15: 4th WSEAS International Conferences on Neural Networks and Applications (NNA '03), Fuzzy Sets and Fuzzy Systems (FSFS '03), Evolutionary Computation (EC '03), Lanzarote Island, Spain

Information: web site:

24-26: 2nd International Conference on Functional Spaces, Differential Operators, and Problems of Mathematical Education, Moscow, Russia

The conference is dedicated to the 80th

anniversary of Lev Dmitrievich Kudryavzev, Corresponding Member of the Russian Academy of Sciences

Sessions: Theory of functions and functional spaces (co-chairs A. V. Arutyunov, M. L. Goldman); Differential operators and applications (co-chairs E. G. D'yakonov, A. L. Skubachevsky); Problems of mathematics education (co-chairs V. I. Mikheev, N. Kh. Rozov); Education and ethics (co-chairs Yu. M. Kolyagin, V. A. Gusev); History of mathematics and science (co-chairs V. M. Tikhomirov, S. S. Demidov)

Organising and Programme Committee: V. M. Filippov (Honorary Chair), S. M. Nikolsky (Chair); Vice-Chairs: S. A. Rosanova, A. G. Yagola, G. N. Yakovlev. Committee: A. V. Arutyunov (Russia), B. Bojarski (Poland), O. M. Belotserkovsky (Russia), A. A. Bolibrukh (Russia), A. Buikis (Latvia), D. N. Bulgakov (Russia), V. I. Burenkov (UK); A. D. Gadjiev (Azerbaijan), P. Galayda (Slovakia), V. A. Il'in (Russia), Yu. I. Khudak (Russia), I. T. Kiguradze (Georgia), A. I. Kirillov (Russia), Yu. M. Kolyagin (Russia), A. Kufner (Czechia), I. K. Lifanov (Russia), Yu. D. Pletner (Russia), A. S. Pospelov (Russia), Ya. V. Radino (Byelorussia), N. H. Rozov (Russia), V. A. Sadovnichy (Russia), A. M. Samoilenko (Ukraine), B. Sendov (Bulgaria), A. S. Sigov (Russia), A. L. Skubachevsky (Russia), A. I. Stankevich (Russia), K. Tahir Shah (Italy), G. M. Vainikko (Finland), A. A. Zhensybaev (Kazakhstan), G. S. Zhukova (Russia).

Local Committee: Co-Chairs: V. I. Mikheev, E. S. Polovinkin, V. M. Savchin, P. P. Bogharov, Ya. Gondo, A. I. Gromov, E. I. Kabin, A. G. Kisunko, T. A. Kuznetsova, V. A. Lazarev, R. A. Mukharlyamov, A. Yu. Potapova, A. A. Puntus, N. A. Romanchenko

Sponsors: Ministry of Education, Russian Federation, Steklov Mathematical Institute (SMI), Russian People Friendship University (RPFU), Moscow Institute of Physics and Engineering (State University) (MIPE), Moscow Institute of Radio Engineering, Electronics and Automatics (MIREEA), Moscow State Social University (MSSU), Moscow Institute of Electronics Engineering (MIEE), Centre of Modern Education (CME)

Location: Russian People Friendship University (RPFU), Moscow, Russia
Languages: Russian and English.

Deadline: for completed registration forms and abstracts, 1 February. Papers should be submitted on floppy discs in WORD and in hard copy, or by e-mail; the paper must not exceed two A4 sheets, 1.5 spacing between lines, left margin 30 mm, right margin 10 mm, upper and lower margins 20 mm. Font size for the text should be 12 pt, headers no less than 14 pt. Abstracts of the conference will be published before the conference. Editing of presented papers will not be provided.

The conference fee is \$15 (500 Russian roubles), and can be paid at the conference desk.

Contact: Mailing address of the Organizing Committee: 117198, Russia, Moscow, Miklucho-Maklay str., 6, room 240a; e-mail:

April 2003

27- May 3: Spring School on Analysis: Variational Analysis, Paseky nad Jizerou, Czech Republic

Topics: eigenvalue optimisation, non-smooth analysis, analysis of value functions, variational analysis in metric spaces, sequential variational analysis in infinite dimensions

Main speakers: A. Ioffe (Israel), A. Lewis (Canada), B. S. Mordukhovich (USA),

CONFERENCES

J.-P. Penot (France)

Organisers: J. Lukes, M. Fabian, J. Outrata (Charles University and Academy of Sciences, Prague, Czech Republic)

Deadlines: for a reduced fee, 15 January; for support, 15 January

Grants: probably support for a limited number of students

Information: e-mail: ,
<http://www.karlin.mff.cuni.cz/katedry/kma/ss/apr03/ss.htm>

May 2003

2-3: X Encuentro de Topologia, Bilbao, Spain

Topic: Topology

Main speakers: M. Alonso Moron (Spain), C. Elvira Donazar (Spain), S. Romaguera Bonilla (Spain), J. I. Royo Prieto (Spain), J. J. Rubio Garcia (Spain), M. Saralegi Aranguren (France)

Format: Lectures by the main speakers and poster sessions

Language: Spanish

Organising committee: M. Macho Stadler, M. A. de Prada Vicente, J. L. Navarro Segura, N. Blasco Mardones (Spain)

Location: Aula de la experiencia of the EHU in Bizkaia (Bilbao)

Grants: Support for students

Information: e-mail: , web site:
<http://www.ehu.es/xet>

11-16: International Conference on General Control Problems and Applications (GCP-2003), Tambov, Russia

Information: e-mail: aib@tsu.tmb.ru,
uaa@hmb.nnn.tsu.ru,

web site: <http://www.opu2003.narod.ru>

[For details, see EMS Newsletter 44]

11-18: Conference on Topological Algebras, their Applications, and Related Topics, Bedlewo, Poland

Information: e-mail: ta2003@amu.edu.pl,
web site:

[For details, see EMS Newsletter 44]

12-17: 23rd International Seminar on Stability Problems for Stochastic Models, Pamplona, Navarra, Spain

Aim: to bring together those working in probability theory, statistics and stochastic models

Topics: Limit theorems in probability theory, asymptotic methods in mathematical statistics, characterisations of stochastic models, probability metrics, renewal theory, insurance and financial mathematics, reliability theory, special processes, teaching of statistics and probability

Organising committee: V. M. Zolotarev (Russia), F. Mallor (Spain), V. Korolev (Russia), E. Omev (Belgium)

Sponsors: Public University of Navarra (Pamplona), Moscow State University, Steklov Mathematical Institute, Economische Hogeschool EHSAL

Location: Public University of Navarra, Pamplona, Spain

Deadline: for Abstracts, 15 February

Information: e-mail: stochastic@unavarra.es
web site: <http://www.unavarra.es/stochastic>

26-30: Fifth International Conference on Sampling Theory and Applications (SampTA03), Strobl, Austria

Information: web site:

www.invie.ac.at/NuHAG/SampTA03/

[For details, see EMS Newsletter 45]

June 2003

01-07: Spring School in Analysis: Function Spaces and Applications, Paseky nad Jizerou,

Czech Republic

Topics: function spaces, integral inequalities, Schrödinger operator, rearrangement estimates, Sobolev inequalities

Main speakers: I. Verbitsky (USA), L.-I. Hedberg (Sweden)

Organisers: J. Lukes, L. Pick (Charles University, Prague, Czech Republic)

Proceedings: Lecture notes containing main talks: to be published

Deadlines: for a reduced fee, 15 February; for support, 15 February

Grants: probably support for a limited number of students

Information: e-mail: ,

<http://www.karlin.mff.cuni.cz/katedry/kma/ss/jun03/ss.htm>

13-22: Poisson Geometry, Deformation Quantisation and Group Representations (PQR2003), Brussels, Belgium

Aim: to bring together specialists in the three themes in the title for a summer school and a conference

Topics, format and main speakers: The summer school (13-17 June) will consist of short courses (four or five hours each) by A. Cattaneo (Formality and star products), I. Moerdijk (Lie groupoids and Lie algebroids), W. Schmid (Geometric methods in representation theory) and A. Weinstein (Morita equivalence in Poisson geometry), together with a broad presentation of Deformation quantisation by D. Sternheimer. The conference (18-22 June) will consist in lectures and informal interactions. The invited participants are D. Arnal, M. Bertelson, R. Brylinski, H. Bursztyn, A. Cattaneo, A. Connes, B. Fedosov, R. Fernandes, C. Fronsdal, E. Getzler, Y.

Karshon, M. Kontsevich, B. Kostant, Y. Kosmann-Schwarzbach, P. Lecomte, J.-H. Lu, Y. Maeda, I. Moerdijk, R. Nest, T. Ratiu, J. Rawnsley, W. Schmid, L. Schwachhoefer, C. Simpson, D. Sternheimer, D. Tamarkin, C. Torossian, K. Vilonen, S. Waldmann, A. Weinstein, P. Xu. There will be poster sessions.

Programme committee: A. Connes, S. Gutt, M. Kontsevich, Y. Kosmann-Schwarzbach, P. Lecomte, T. Ratiu, J. Rawnsley, W. Schmid, D. Sternheimer, A. Weinstein.

Location: Université Libre de Bruxelles

Grants: This conference is supported by an EU grant; a limited number of young European researchers (under 35 years old at the time of the conference) can be supported for travel, hotel and subsistence. The conference fee is 40 euros for the Euroschool and 60 euros for the Euroconference; any researcher can apply for some financial support to attend the meeting. Applications for support should be addressed to

pqr2003@ulb.ac.be before 15 December; later applications will be considered if possible.

Deadlines: A special price of 90 euros per night at the Astrid Hotel in Brussels can only be guaranteed for registration before the end of December.

Information: e-mail:
web site: <http://homepages.ulb.ac.be/~pqr2003/>

20-27: Intermediate Problems of Model Theory and Universal Algebra, Novosibirsk, Russia

Theme: Model theory and algebra

Organising committee: A. G. Pinus, V. D. Mazurov, K. N. Ponomarev, S. V. Sudoplatov, V. G. Puzarenko

Proceedings: to be published in the book *Model theory - 4* in 2003

Location: the Mountains of Altai on the bank of Chermal river

Deadlines: March 2003

Information: web site:

WWW2.nstu.ru/deps/algebra/erlogol

23-27: Workshop on Extremal Graph Theory (Miklos Simonovits is 60), Lake Balaton, Hungary

Information: e-mail: extgr03@renyi.hu,
web site:

[For details, see EMS Newsletter 45]

23-28: Tools for Mathematical Modelling, St Petersburg, Russia (MATHTOOLS'2003)

Topics: mathematical modelling, fuzzy theory, control theory, mathematical physics, computer algebra, computer simulation, design techniques, numerical methods, parallel and distributed algorithms, computer modelling in dynamical systems, mathematical models in biology, medicine etc., applications to physics, mechanics, electrotechnics and electronics, dynamic economic models, general macro-economic models, market models, tools for mathematical education

Languages: English and Russian

Call for papers: A collection of abstracts will be printed before the conference. Participants must send two copies of their abstract as a complete typewritten page in camera ready format to the Organising Committee by normal mail. Deadline for abstract submission: 30 March

Organisers: St Petersburg State University, St Petersburg University of Aerospace Instrumentation, Institute for Informatics, Ioffe Physical-Technical Institute, Institute of Mechanical Engineering Problems, St Petersburg Mathematical Society, Pavlov Institute of Physiology, Editorial Board of the Electronic Journal *Differential Equations and Control Processes*

Organising committee: G. S. Osipenko (Chair), V. F. Zaitsev, E. K. Ershov, L. V. Linchuk (Secretary), all from Russia

Proceedings: to be published

Location: St Petersburg State Technical University

Deadlines: for registration and abstract submission: 30 March; for hotel reservation is 30 January, since 2003 is the 300th anniversary of St Petersburg and we expect many visitors and guests

Information: e-mail: , web-site:

www.neva.ru/journal/;
Mailing address: Lidiya Linchuk, MATH-TOOLS'2003, Department of Mathematics, State Technical University, Polytechnicheskaya st. 29, St Petersburg, 195251, Russia

24-27: Days on Diffraction '03, St Petersburg, Russia

Information: e-mail:
grikurov@mph.phys.spbu.ru,

web site: <http://mph.phys.spbu.ru/DD>

[For details, see EMS Newsletter 45]

25-28: International Congress: Mathematics in the XXI Century. The Role of the Mathematics Department of Novosibirsk University in Science, Education, and Business, Novosibirsk, Russia

Aims: Realisation of the role and the place of mathematics and mathematical education in modern society; orientation of public opinion towards recognition of the dominating role of mathematics; support of international cooperation, and strengthening the connection between graduates of the MMD of NSU

Topics: Foundational and philosophical problems of pure and applied mathematics; the perspectives of applications of mathematics in industry, economics, etc.; mathematics and information technologies; business management and mathematics; the role of mathematical education in ordinary school and universi-

ties; mathematical departments yesterday, today and tomorrow; the Novosibirsk Akademgorodok and mathematics

Main speakers: to be announced
Format: plenary talks, section talks, discussions, round tables

Languages: English and Russian

Call for papers: Abstracts prepared with a new version of LaTeX or as plain text should be sent to the organisers before 15 March; on-line submission via the internet is also possible

Programme committee: Chair: Yu. L. Ershov, Co-chairs: V. P. Golubiatnikov, A. S. Morozov, Yu. M. Laevskii, A. P. Chupakhin, S. Golushko, S. S. Goncharov, A. M. Fedotov, V. M. Fomin, S. Foss, K. L. Komarov, I. B. Kuznetsov, B. G. Mikhailenko, V. N. Monakhov, A. A. Nikitin, A. G. Pinus, P. I. Plotnikov, Yu. I. Shokin, S. P. Sverchok, E. I. Timoshenko, V. V. Vaschenko, D. B. Verkhovod, A. G. Marchuk (all from Novosibirsk), B. N. Apanasov (USA), S. A. Badaev (Kazakhstan), A. V. Borovik (UK), K. A. Borovkov (Australia), A. I. Budkin (Barnaul), V. V. Chueshev (Kemerovo), M. G. Gavriluk (France), A. I. Kamishnikov (Hanti-Mansiisk), V. K. Kharchenko (Mexico), Yu. D. Korolkov (Irkutsk), A. G. Kusraev (Vlidikavkaz), N. Ya. Medvedev (Barnaul), A. M. Meirmanov (Portugal), A. Miasnikov (USA), I. Nikolaev (USA), V. B. Nikolaev (Omsk), B. A. Rogozin (Omsk), V. K. Sabelfeld (Germany), V. V. Shaidurov (Krasnoyarsk), V. P. Stepanov (Khabarovsk), A. A. Voronkov (UK), S. D. Zakharov (Tumen).

Sponsors (preliminary list): Russian Foundation for Fundamental Research, ALEK-TA Ltd., Non-commercial Partnership 'Foundation for Mathematical Department of the Novosibirsk State University'

Proceedings: to be published

Location: Novosibirsk State University,

Deadlines: 15 March for registration (1 March for those who need a visa to enter Russia); 15 March for submitting abstracts

Information: e-mail , web site <http://www-sbras.nsc.ru/ws/MMF-21/index.en.html>

25-28: 7th WSEAS CSCC International Multiconference on Circuits, Systems, Communications and Computers, Corfu Island, Greece

Information: web site:

July 2003

9-12: XV Italian Meeting on Game Theory and Applications, Urbino, Italy

Topics: all the main areas of game theory and applications: non-cooperative games, cooperative games, dynamic games, evolutionary games, learning games, repeated games, coalition formation, game practice and economics, game practice and transportation, game practice and the environment, voting games, oligopoly games, well-posedness and stability in games, stochastic games.

Main speakers: K. Binmore (UK), I. Garcia-Jurado (Spain), J. Y. Halpern (USA), S. Hart (Israel), J. Hofbauer (Austria), L. A. Petrosjan (Russia), F. Valenciano (Spain), G. Owen (USA)
Programme committee: P. Battigalli (Italy), A. Battimelli (Italy), J. Mario Bilbao (Spain), G. Bischi (Italy), M. Dardi (Italy), G. Gambarelli (Italy), I. Garcia-Jurado (Spain), J. Morgan (Italy), F. Patrone (Italy), C. Rafels (Spain), A. Urbano (Spain), F. Valenciano (Spain), S. Vannucci (Italy)

Proceedings: to be published in *International Game Theory Review*

Location: Faculty of Economics, University of Urbino, via Saffi n. 42, 61029 Urbino, Italy

Notes: The meeting is part of a series of alternating Italian and Spanish conferences on game theory

Deadlines: for registration, 30 April; for abstracts, 15 March: submission before 15 March of an extended (up to two pages) abstract via ; abstract acceptance will be communicated before 15 April

Information: e-mail : , web site :

14-18: International Conference on Algebras, Modules and Rings, Lisboa, Portugal [In memory of António Almeida Costa, on the centenary of his birth]

Topics: Algebras and their representations, module theory, ring theory

Keynote speaker: M. Van den Berg (Limburgs-Diepenbeek)

Main speakers: W. Crawley-Boevey (Leeds), K. Goodearl* (California-Santa Barbara), S. Koenig (Leicester), L. Levy (Wisconsin-Madison), O. Mathieu (Claude Bernard-Lyon), B. Osofsky (Rutgers-New Brunswick), C. M. Ringel (Bielefeld)

M. Saorín (Murcia), J. Trlifaj (Karlova-Praha)
Plenary speakers: J. A. de la Pena (UNAM-Mexico City), N.V. Dung* (Ohio-Zanesville), I. Gordon (Glasgow), P. A. Guil Asensio (Murcia), O. Iyama (Himeji)

J. Okninski (Warsaw), C. Santa-Clara (Lisboa), A. Tonolo (Padova) (* provisional acceptance)
Call for papers: we are using the facilities of Atlas Mathematical

Abstracts: before 30 April (either plain ASCII or TeX) via <http://at.yorku.ca/cgi-bin/amca/submit/caju-01>. Those accepted by the organising committee will become available at <http://at.yorku.ca/cgi-bin/amca/caju-01>.

Scientific committee: A. Facchini (Padova), K. Fuller (Iowa), M. L. Galvão (Lisboa) (coordinator), J. L. Gómez Pardo (Santiago de Compostela), J. A. Green (Oxford/ Warwick), C. M. Ringel (Bielefeld), D. Simson (Torun), P. F. Smith (Glasgow)

Organising committee: A. P. Alexandre (Nova de Lisboa), P. Carvalho Lomp (Porto) A. V. Fonseca (Lusófona-Lisboa, Leicester), M. L. Galvão (Lisboa), C. Lomp (Porto), M. T. Nogueira (Lisboa), C. Santa-Clara (Lisboa) (coordinator)

Confirmed sponsors: Centro de Algebra da Universidade de Lisboa (CAUL); Faculdade de Ciências da Universidade de Lisboa (FCUL); Departamento de Matematica da FCUL; Fundacao para a Ciencia e a Tecnologia (FCT).

Proceedings: publication of proceedings will be announced shortly.
Location: Faculdade de Ciências da Universidade de Lisboa, Portugal.
Grants: probably support for participants from countries in a difficult economic situation and young mathematicians.

Deadlines: Registration and submission of communications: 30 April
Information: Conference web site: <http://caul.cii.fc.ul.pt/lisboa2003/> e-mail: Subscribe to the conference mailing list at <http://caul.cii.fc.ul.pt/alg.announce.html>

August 2003

18-22: 7th International Symposium on Orthogonal Polynomials, Special Functions and Applications, Copenhagen, Denmark

Main speakers: R. Askey (USA), P. Deift (USA), A. J. Duran (Spain), U. Haagerup (Denmark), M. Ismail (USA), E. Koelink (Netherlands), M. Noumi (Japan), F. Peherstorfer (Austria), S. Ruijsenaars

(Netherlands), J. Felipe van Diejen (Chile), Y. Xu, (USA)

Organisers: C. Berg, J. S. Christiansen, H. L. Pedersen

Scientific committee: A. Duran, M. E. H. Ismail, E. Koelink, P. E. Ricci, V. Totik, C. Berg, H. L. Pedersen

Information: e-mail: opsfa@math.ku.dk, web site:

September 2003

2-5: Symposium on Cartesian Set Theory, Paris, France

Theme: the theory of accessible cardinals

Topics: Search of new axioms for set theory, Brouwerian conceptions revisited, continuum hypothesis, well-ordering on the Continuum, non-standard analysis, Conway's numbers, applications to computer science, quantum theory, biology, cosmology.

Organising committee: F. Collot, R. Saumont and F. Anceau (all France)

Call for papers: Extended abstracts (at most 6 pages) of papers to be presented at the conference to be sent to F. Collot (4 rue Mayet, 75006 Paris, France). Abstracts or papers will be published in the journal *Bio-Math*

Deadlines: for abstracts, 1 June

Information: e-mail: editions.europeenne@wanadoo.fr

2-6: Barcelona Conference on Asymptotic Statistics, Bellaterra (Barcelona)

Aim: to open a new line of international events devoted to asymptotic methods in statistics

Topics: Inference for continuous-time stochastic processes, linear and non-linear time series, wavelets and theory of extreme values

Main speakers: D. Boscq (France), R. Cao (Spain), A. V. Ivanov (Ukraine), I. Johnstone (USA), R. Khasminkii (USA), U. Küchler (Germany), Y. Kutoyants (France), A. Le Breton (France), T. Mikosch (Denmark)

Scientific committee: Vladimir Zaiats (Coordinatoc), Y. Kutoyants, U. Küchler, F. Utzet

Organising Committee: F. Utzet, P. Puig, W. González, V. Zaiats

Grants: a limited number of grants for registration and accommodation for young scientists and scientists from less favoured countries

Deadlines: For applications for financial support, 23 May; for registration and payment, 30 June

Information: e-mail: bas2003@crm.es, web site: <http://www.crm.es/bas2003>

16-20: Barcelona Conference on Set Theory, Bellaterra (Barcelona)

Aim: to present the latest developments and results in all areas of set theory and their applications to other areas of mathematics

Topics: Descriptive set theory, inner model theory, forcing, infinite combinatorics, applications to analysis

Main speakers: M. Dzamonja, I. Farah (UK), J. Hirschorn (Austria), R. Schindler (Austria), O. Spinas (Germany), J. Zapletal (USA)

Programme committee: J. Bagaria (coordinator), A. Blass, Sy. Friedman, S. Todorcevic, W. Hugh Woodin

Local organising committee: D. Asperó, J. Bagaria, R. Bosch, J. Llopis, J. López-Abad

Grants: a limited number of grants for registration and accommodation for young scientists and scientists from less favoured countries

Deadlines: For applications for financial support, 23 May; for registration and payment, 30 June

Information: e-mail: , web site: <http://www.crm.es/set-theory>

Recent books

edited by Ivan Netuka and Vladimír Souček

Books submitted for review should be sent to the following address:

Ivan Netuka, MÚUK, Sokolovská 83, 186 75 Praha 8, Czech Republic.

L. Barbieri-Viale and V. Srinivas, *Albanese and Picard 1-Motives*, Mémoires de la Société Mathématique de France 87, Société Mathématique de France, Paris, 2001, 104 pp., FRF 150, ISBN 2-85629-113-9

Let X be an n -dimensional algebraic variety over a field k of characteristic 0. The authors construct algebraically 1-motives $\text{Pic}^+(X)$, $\text{Pic}^-(X)$ and their duals $\text{Alb}^+(X)$, $\text{Alb}^-(X)$. For $k = \mathbf{C}$, the Hodge realisations of these 1-motives are given by $H^{2n-1}(X, \mathbf{Z}(1-n))$, $H^1(X, \mathbf{Z}(1))$, $H^{2n-1}(X, \mathbf{Z}(1-n))$ and $H^1(X, \mathbf{Z}(1))$. The authors also investigate functorial properties of Pic^\pm , Alb^\pm and construct a motivic Abel-Jacobi map for zero cycles on a projective variety. (jnek)

A. Berger, *Chaos and Chance. An Introduction to Stochastic Aspects of Dynamics*, de Gruyter Textbook, Walter de Gruyter, Berlin, 2001, 245 pp., DM 99,90, ISBN 3-11-016990-6 and 3-11-016991-8

Dynamic systems have lived comfortably in two rather separated compartments of contemporary mathematics. The theory of chaos, its complexity and unpredictability as a topic in topology and the statistical ergodic theory as an important part of probability labelling the corresponding compartments. Recent research on the interplay of chaos and probabilistic chance, which is reviewed in the present book in a pioneering manner, clarifies the matter considerably.

The main topics of the book are: bifurcation, full and transient chaos and symbolic dynamics on the topology side, and ergodicity, mixing and entropy on the probability side. Markov chain apparatus then enters as a bridge between two approaches. The final chapter on the general dynamics of measures delivers a possible outlook for future developments.

The text is designated as an introductory one for mathematics students. It provides a concise mathematical theory, a number of illustrative examples and a collection of challenging exercises. The author claims that the only prerequisite is a good knowledge of calculus and provides a toolbox of the basics of measure theory. (jste)

D. E. Blair, *Inversion Theory and Conformal Mapping*, Student Mathematical Library 9, American Math. Society, Providence, 2000, 118 pp., US\$19, ISBN 0-8218-2636-0

This text is designed for advanced undergraduate level and is suitable for independent study as well as for lectures and seminars. Standard university courses in differential geometry and complex analysis are not essential prerequisites.

The class of conformal mappings form a very rich family in Euclidean spaces of dimension 2. On the other hand, the group of conformal motions is finite-dimensional

for $n > 2$. In these dimensions, similarities and inversions with respect to spheres (together with Euclidean motions) generate the whole group. This is well known, (proved for $n = 3$ by Liouville in 1850), but its proof is not part of standard courses. To present a proof is a principal aim of the text. In fact, two proofs are described: an analytical one for any $n > 2$ (following Nevanlinna) and a classical one for $n = 3$. Another interesting feature is the reprint of a paper by Carathéodory for $n = 2$, showing that any circle-preserving transformation is necessarily continuous and is a Möbius transformation. The first chapters contain interesting properties and theorems concerning inversion in the plane, including a simple model of hyperbolic (non-Euclidean) geometry. The book is written in an interesting and readable style, and presented in a compact form. The final chapter is devoted to a related problem, where the image of a convex body under an inversion is also a convex body. (zv)

K. Bichteler, *Stochastic Integration with Jumps*, Encyclopedia of Mathematics and its Applications 89, Cambridge University Press, 2002, 501 pp., £70, ISBN 0-521-81129-5

A very advanced and complex treatment of stochastic integration for right continuous semi-martingale integrators and random measures is presented here in a unified manner. An elementary stochastic integral is extended using a semi-norm, under which it is a continuous map. The method, in fact the Daniell extension procedure, allows for smooth proofs of standard results, such as the dominated convergence theorem and the Itô formula. The highlights of the monograph are: Girsanov-Meyer theory on shifted martingales, which covers both the Wiener and Poisson setting; a Doob-Meyer decomposition statement providing really deep information that the objects that can go through the Daniell-like construction of the stochastic integral are necessarily semi-martingales. Considerable attention is given to error estimates of the stochastic integral, and to solutions of stochastic differential equations: this brings new and non-trivial results. Chapter V on stochastic differential equations with a general semi-martingale driver is distinguished by an excellent study of stability and pathwise computations of solutions.

Readers are expected to be familiar with the basics of topology, functional analysis and general integration theory. An appendix provides information (mostly proved) on less standard concepts and techniques from probability and measure theory. Numerous and sometimes tricky exercises form an integral part of the book, and most of them must be solved for the reader to be informed about the development of the theory. This is an excellent and informative monograph for a general mathematical audience. (jste)

J.-B. Bost, F. Loeser and M. Raynaud

(eds.), *Courbes semi-stables et groupe fondamental en géométrie algébrique*, Progress in Mathematics 187, Birkhäuser, Basel, 2000, 289 pp., DM 118, ISBN 3-7643-6308-8

This book comprises written versions of talks given at an instructional conference at CIRM at Luminy in 1998. The eighteen expositions present a reasonably self-contained exposition of all important topics on classical as well as recent developments and advances in the area, which includes semi-stable reduction theorem for curves, Tamawaga's proof of Grothendieck's abelian conjecture for affine hyperbolic curves, and Raymond's and Harbater's solution of Abhyankar's conjecture on coverings of affine curves.

The book can be recommended to readers interested in the fundamental group of algebraic curves with special attention to curves over finite and local fields. Readers can find here carefully compiled material (partly still unpublished in book form) with detailed proofs by leading experts in the field. It should be of interest to research students in this part of algebraic geometry, and to readers working in neighbouring parts of number theory. (spor)

A. Bressan, *Hyperbolic Systems of Conservation Laws. The One-Dimensional Cauchy Problem*, Oxford Lecture Series in Mathematics and its Applications 20, Oxford University Press, 2000, 250 pp., £45, ISBN 0-19-850700-3

This book presents an excellent and self-contained treatment of the mathematical theory of hyperbolic systems of conservation laws. After some preliminaries and generalities, the author studies in detail strictly hyperbolic systems in one space dimension with the usual assumption on genuine non-linearity or linear degeneracy of each characteristic field. Using mainly the front-tracking philosophy, the author shows for the Cauchy problem with small BV data the global existence and uniqueness of the entropy solution (for the general system case), together with the stability result. For the Kruzkov-type solutions, moreover, a contractive semigroup of generalised solutions in a domain of L^1 functions is obtained for a large class of initial data.

The author is one of the leading specialists in the field. The book contains mainly his results and results obtained with co-authors. It is written in a clear and self-contained way and will be of great value for graduate students and specialists in the field. (mr)

J. Cabrera and A. McDougall, *Statistical Consulting*, Springer, New York, 2002, 390 pp., EUR 84,95, ISBN 0-387-98863-7

Statistical consulting is a frequent activity for many statisticians, and for this purpose good communication skills are essential. However, this aspect of statistician's training is often neglected in universities. This book is written for students and statisticians who are interested in consulting activities.

It has three main parts. First, the methodology of statistical consulting is discussed. After a short introduction, problems of communication are addressed. Part I concludes with a consultation project, starting with the initial contact with the client and finishing with the final written report. Case

studies, the heart of statistical consulting, are described in Part II. Simple case studies requiring only standard statistical methods form group I, more complicated case studies belong to group II, and research-oriented case studies define group III. Of course, a general problem for presenting case studies is that original data is often confidential. The appendices provide information on resources, on the SAS® and S-PLUS® software packages, and present tables of distributions and some statistical tests. All statisticians are familiar with the errors of the first and second kinds. The authors recall that Kimball in 1957 also introduced an error of the third kind: the case when the client is given the right answer to the wrong question.

Although the book gives a detailed overview of the skills that a statistician needs for consulting, I stress the sentence on p. 197: 'The best way to learn about statistical consulting is to do it!' (ja)

S. Carl and S. Heikkilä, *Nonlinear Differential Equations in Ordered Spaces, Monographs and Surveys in Pure and Applied Mathematics 111, Chapman & Hall/CRC, Boca Raton, 2000, 323 pp., £46.99, ISBN 1-58488-068-6*

This monograph is written as a source book for pure and applied mathematicians interested in the theoretical framework, allowing a new treatment of a variety of discontinuous initial and boundary value problems for both ordinary and partial differential equations.

At the beginning of the book, the authors present a fixed-point theorem in an ordered normed space, and describe its applications on existence and comparison results for extremal solutions of an abstract ordinary or partial differential equation. The generality of their treatment lies in the fact that non-linearities of differential equations and corresponding initial and boundary conditions are allowed to depend discontinuously on the solution of the problem. Existence and comparison results for extremal solutions of first-order ordinary and functional differential equations are proved in Chapter 2. The next chapter is devoted to comparison and uniqueness studies, including some general maximum principles. Existence and comparison results for second-order ordinary and functional differential equations are presented in Chapter 4 – in particular, explicit Sturm-Liouville differential equations with separated boundary data and phi-Laplacian functional equations in implicit or explicit form. The existence of extremal solutions within an interval of upper and lower solutions of the Dirichlet problem for general quasi-linear elliptic equations is proved in Chapter 5. Chapter 6 deals with differential inclusions of hemivariational type in an abstract setting of reflexive Banach spaces: the aim of this chapter is to develop an appropriate method for upper and lower solutions for such kinds of inclusions, and to prove existence and enclosure results. Applications of results of Chapters 1 and 5 are presented in Chapter 7. The main goal is to provide extremality results for discontinuous implicit elliptic problems, and for some parabolic initial-boundary value problems. Basic facts and results from partially ordered spaces,

Sobolev spaces, pseudomonotone and quasi-linear elliptic operators and fixed-point results in ordered normed spaces are collected in an Appendix.

This self-contained presentation, with numerous examples and complete proofs, makes the monograph accessible for specialists and for researchers in engineering, as well as for advanced students in these fields. (jsp)

J. H. Conway, *On Numbers and Games, second edition, A K Peters, Natick, 2001, 242 pp., \$39, ISBN 1-56881-127-6*

This is the second edition of the book that was first published in 1975. It consists of two parts, the first called *On Numbers* and the second with the title '*... and Games*'. The roots of the book are in the book *Winning ways* (with E. R. Berlekamp and R. K. Guy).

In the 0th part, a theory of surreal numbers is developed. These form a class containing both real and ordinal numbers, and are defined recursively. They have the form $\{L|R\}$, where L and R are sets of surreal numbers such that no element of L exceeds an element of R . The operations of $+$, $-$, \cdot and $:$ are defined and various properties of these numbers are listed and proved; for example, it is shown that they form a field \mathbf{No} . In the last chapter of this part, the idea to abolish the asymmetry between L and R (inspired by games in which players have the same move options) leads to a 'characteristic 2' analogue of \mathbf{No} with Nim-addition and Nim-multiplication. For instance, in the Nim-addition, the sum of distinct powers of 2 is their ordinary sum, but the sum of two equal numbers is 0: thus $13 + 7 = (8+4+1) + (4+2+1) = 8 + 2 = 10$. In the second part, the surreal numbers are used to analyse winning strategies of games between two players with full information. Two opponents *Left* and *Right* play a game, where position P is completely determined by the *Left options* L and *Right options* R . After *Left* moves, they reach a new game position $\{L'|R'\}$ in L . Games are supposed to have a winning strategy and be finite. A player who cannot move when called upon to do so is the loser. An analysis of what the author calls *partisan games* is provided, together with many examples.

The book can be recommended to those who wish to become acquainted with some unconventional ideas. (spor)

A. Corti and M. Reid (eds.), *Explicit Birational Geometry of 3-Folds, London Mathematical Society Lecture Note Series 281, Cambridge University Press, 2000, 349 pp., £27.95, ISBN 0-521-63641-8*

This book comprises seven papers centred around a study of 3-folds based on the Mori theory. A paper by K. Altmann describes deformations of toric Gorenstein singularities. J. Kollar treats non-rational covers of the product of two projective spaces. The question of birational rigidity is treated in next four contributions: A. Pukhlikov discusses the method of maximal singularities developed by Yu. I. Manin and V. A. Iskovskikh. The principal paper by A. Corti, A. Pukhlikov and M. Reid discusses the case of 95 families of Fano 3-fold weighted hypersurfaces. A review of weighted projective spaces and their subvarieties can be found in the paper of A. Iano-Fletcher. A.

Corti's contribution contains proofs of the criteria for birational rigidity of 3-fold Mori fibre spaces. A history of the last 25 years of research in the area is summarised in the paper of M. Reid. (vs)

S. Czerwik, *Functional Equations and Inequalities in Several Variables, World Scientific, New Jersey, 2002, 410 pp., £49, ISBN 981-02-4837-7*

This book outlines a modern theory of functional equations and inequalities in several variables. The author combines the classical theory and examples with recent results.

It contains three parts. Part I is devoted to additive and convex functions defined on linear spaces with semi-linear topologies. Basic results concerning important functional equations are also included here. In the second part, the problem of stability of functional equations, in the sense of Ulam-Hyers-Rassias and in some function spaces, is considered. In the last part, the functional equations for set-valued functions are dealt with, for the first time in the mathematical literature. This book contains many fresh results concerning these problems. (kn)

S. Dineen, *Functions of Two Variables, 2nd ed., Chapman & Hall/CRC, Boca Raton, 2000, 191 pp., £31.99, ISBN 1-58488-190-9*

While standard textbooks aim at a more mathematically oriented audience, this little book is a gentle introduction to multivariate calculus in a two-variable context. It is accessible to students with a diverse and modest background and interest in mathematics, science or engineering. Unlike many modern presentations, this book begins with the particular and works its way to the more general, helping the student to develop an intuitive feeling for the subject.

After an elementary treatment of basic concepts, the subsequent chapters carefully introduce Lagrange's multipliers, the chain rule, curvature, quadratic approximation, etc. The author has saturated the text with illustrations and with many interesting and explicitly calculated examples; there are also many inspiring exercises. The work ends with double integrals and Green's theorem. This edition includes a rearrangement of several chapters, new examples and exercises. The whole text is nicely written, and can be strongly recommended as an excellent and comprehensive source, suitable for self-study or classroom use at the undergraduate level. For students demanding motivation, its study will be a rewarding experience. (kz)

C. Doss-Bachelet, J.-P. Francoise and C. Piquet, *Géométrie différentielle, Mathématiques pour le 2-e cycle, Ellipses, Paris, 2000, 200 pp., ISBN 2-7298-0321-7*

This book belongs to a series of texts for students in the second cycle of French universities. It covers the basic topics in differential geometry needed for various more advanced courses. In particular, it includes chapters on curves, surfaces (including the *Theorema egregium* of Gauss and the Gauss-Bonnet theorem), differential forms, differential systems, vector fields, Lie derivatives of differential forms, Hamiltonian systems and symplectic geometry, Lagrangians and calculus of variations, manifolds and fibre

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bundles, linear connections and the Levi-Civita connection. Each chapter contains a summary of needed results, mostly with proofs (which are worked out only in special cases) and many exercises. Their detailed solutions form the last third of the book. An important feature of the book is its systematic use of pictures to appeal to the geometric intuition of readers: the pictures are well chosen and nicely presented. The attention paid to the careful preparation of solved examples and graphic illustrations gives the book a particular value, helpful to teachers as well as to students. (vs)

J.-P. Escofier, *Galois Theory*, Graduate Texts in Mathematics 204, Springer, New York, 2001, 280 pp., DM 119, ISBN 0-387-98765-7

This textbook on the Galois theory of algebraic equations assumes only a knowledge of standard algebra (groups, rings, fields), and is suitable for an undergraduate course on Galois theory. It covers standard basic material: symmetric polynomials, field extensions, normal and Galois extensions, Galois correspondence, cyclotomic extensions, solvable groups, finite fields, and separable and inseparable extensions. It also contains chapters that are not always covered: a historical background, ruler and compass constructions, an account of the life of Évariste Galois, and a review of recent developments in Galois theory. There are many exercises and problems. Because of its lively style and human approach, it can be recommended to all students interested in mathematical ideas that helped to solve many problems of classical mathematics. (jtu)

E. Frenkel and D. Ben-Zvi, *Vertex Algebras and Algebraic Curves*, Mathematical Surveys and Monographs 88, American Mathematical Society, Providence, 2001, 348 pp., \$55, ISBN 0-8218-2894-0

The aim of this book is to provide a consistent introduction to vertex algebras. Designed to formalise local operators describing the propagation of string states, vertex algebras play an important role in various parts of mathematics and mathematical physics.

There exist two basically different approaches to vertex algebras. The classical one is in terms of power series acting on vector spaces, while the second one is the theory of chiral algebras that interprets vertex algebras as algebraic objects encoding the local geometric structure of various moduli spaces associated with algebraic curves. This book tries to combine these approaches by making vertex operators 'coordinate-independent'. This is achieved by attaching, to a vertex algebra, a vector bundle with a flat connection on the (formal) disc.

The first four chapters are devoted to the algebraic theory of vertex algebras, while Chapters 5-9 present a more geometric approach to vertex algebras. In the following chapters, various constructions and applications, such as the free field realisation of affine Kac-Moody algebras, solutions of the Knizhnik-Zamolodchikov equations, and the Drinfel'd-Sokolov reduction, are reviewed. The last three chapters are devoted to the construction of the Beilinson-Drinfel'd chiral algebras. In this approach, the main objects of study are D -modules on

powers of algebraic curves equipped with certain operations.

This book provides an essentially self-contained introduction to vertex algebras and related topics. It is addressed to researchers and students from the graduate level onwards. (mm)

I. M. Gelfand and V. S. Retakh (eds.), *The Gelfand Mathematical Seminars, 1996-1999*, Birkhäuser, Boston, 2000, 154 pp., DM158, ISBN 0-8176-4013-4 and 3-7643-4013-4

A distinguished tradition of the Gelfand Moscow seminar has its continuation in recent years at Rutgers University. The book covers the main topics from the period 1996-99, and contains seven contributions.

The strong theme of recent decades, non-commutative geometry, is the topic of contributions by M. Kontsevich and A. L. Rosenberg (non-commutative smooth spaces) and A. L. Rosenberg (the existence of fibre functors). The book is dedicated to Ch.-H. Sah, and the paper by him and J. Dupont contains a discussion of a generalisation of the third Hilbert problem. Combinatorial geometry is the theme of the contribution by T. V. Alekseyevskaya, A. Borovik, I. M. Gelfand and N. White (matroid homology). The traditional topic of the representation theory of Lie groups and algebras is treated by V. G. Kac and A. Radul (Poisson structure for restricted Lie algebras) and by A. Kazarnovski-Krol (a cycle for integration yielding the zonal spherical function of type An). The paper by G. Cherlin (sporadic homogeneous structures) contains a discussion of the Lachlan classification theory for finite homogeneous structures.

This book brings together many important new ideas in different fields and is a valuable contribution to mathematical libraries. (vs)

I. Gohberg, S. Goldberg and N. Krupnik, *Traces and Determinants of Linear Operators, Operator Theory, Advances and Applications 116*, Birkhäuser, Basel, 2000, 258 pp., DM178, ISBN 3-7643-6177-8

This book gives an up-to-date account of the theory of traces and determinants of linear operators in Banach spaces. It includes a systematic discussion of the classical examples of traces and determinants due to Hill, von Koch, Fredholm, Poincaré, Ruston and Grothendieck and their modern generalisations as regularised determinants or Hilbert-Carleman determinants. Much attention is paid to determinants of integral operators with semi-separable kernels.

The book is well organised and essentially self-contained. Starting at a relatively elementary level, it progresses gradually to the most recent results. Much of the text presents the original research work of the authors: their deep and interesting results give a good insight into current research interests. The book is written for postgraduate students and mathematicians interested in the field, but can be warmly recommended to graduate students, lecturers and researchers, since its contents are unique in the existing literature. For its quality, it should be included in every mathematical library. (kz)

G. Grimmett and D. Stirzaker, *One Thousand Exercises in Probability*, Oxford University Press, 2001, 438 pp., £27.50, ISBN 0-19-857221-2

This is an expanded version of the authors' *Probability and Random Processes: Problems and Solutions*, first published in 1992. In fact, there are more than 3000 questions in the book, since many exercises have multiple parts. The exercises and problems are divided into following chapters: Events and their probabilities; Random variables and their distributions; Discrete random variables; Continuous random variables; Generating functions and their applications; Markov chains; Convergence of random variables; Random processes; Stationary processes; Renewals; Queues; Martingales; Diffusion processes. The exercises range from the purely technical to tricky ones: the authors present them in an attractive form. Some problems are also of historical interest. The solutions are carefully prepared and presented with all necessary detail and mathematical rigour.

The book is a useful source of exercises and problems from probability theory and random process. I have read it with great pleasure and can recommend it to students and teachers. (ja)

Ch. Guilpin, *Manuel de Calcul Numérique Appliqué*, EDP Sciences, Les Ulis, 1999, 577 pp., FRF290, ISBN 2-86883-406-X

The target audience of this book is undergraduate engineering and science students of physics, chemistry, biology and economics who need a readable textbook of numerical mathematics. It presents a comprehensive description of fundamental tools and explains how the computer 'black box' works. The text is centred around topics that form the essentials of numerical mathematics: solutions of the equation $f(x) = 0$, interpolation, matrix calculus, evaluation of integrals, solution of ordinary and partial differential equations, Fourier transform and convolution equations. Unlike standard numerical textbooks, it explains some elements of probability and statistical data processing with applications, e.g., to signal processing. The author uses a practical approach based upon solving model problems, and all ideas are introduced from this viewpoint. Moreover, the book is completed by source texts in C language, which can be easily modified by users. The text contains solved exercises as a bridge between theory and applications. (jfel)

O. Häggström, *Finite Markov Chains and Algorithmic Applications*, London Mathematical Society Student Texts 52, Cambridge University Press, Cambridge, 2002, 114 pp., £14.95, ISBN 0-521-89001-2 and 0-521-81357-3

The topic of the book is the Markov Chains Monte Carlo (MCMC) method, known in applied probability as a tool for simulation from complex distributions: the target distribution is obtained as a stationary distribution of a Markov chain. Even if the limit cannot be achieved in a computer, recent perfect simulation techniques made it possible to obtain the exact limiting distribution in some special cases. The MCMC became useful in Bayesian and spatial statistics, sto-

chastic geometry, graph theory, electrical networks, physics of phase transitions, etc.

This textbook is recommended for undergraduate and postgraduate students in mathematics, probability and mathematical statistics and computer algorithms. One third is devoted to basic probability and Markov chain theory, restricted to finite state spaces: this restriction suffices to making the book subtle and fulfilling the main aim of describing the algorithms developed for various applications. The Metropolis chain, Gibbs sampler and Propp-Wilson algorithm are developed, and rate of convergence, Ising model, simulated annealing are studied. There are enough exercises and problems for readers, categorised by difficulty. At the end, recommendations for further studies in the topic are given. (vb)

J. Haigh, *Probability Models*, Springer Undergraduate Mathematics Series, London, 2002, 256 pp., EUR 29.95, ISBN 1-85233-431-2

This is a nice textbook on elementary probability to accompany an undergraduate course. Only a sound knowledge of calculus is assumed, measure theory having been avoided by treating the discrete and continuous models separately. This well-established approach finds here its maximum value in developing the reader's skill to recognise a good probability model to be employed when solving an applied problem. The models offered include the standard probability distributions (with a discussion of their origin) and also those more sophisticated, such as branching processes, random walks, Markov chains, queues and Brownian motion. The theory covers the standards for the sums of i.i.d. random variables: central limit theorem and laws of large numbers. The presentation is supported by many fully worked exercises and about 200 set exercises with sufficiently detailed solutions. (jste)

M. Harris and S. Zucker, *Boundary Cohomology of Shimura Varieties, III: Cohesive Cohomology on Higher-Rank Boundary Strata and Applications to Hodge Theory*, Paris, 2001, 116 pp., FRF150, ISBN 2-85629-107-4

This is a continuation of the author's investigations into Hodge theoretical properties of boundary cohomology of (pure) Shimura varieties. The main result states that the nerve spectral sequence computing the cohomology of the Borel-Serre boundary of a Shimura variety Sh (with coefficients in an automorphic vector bundle) is a spectral sequence of mixed Hodge-de Rham structures over the field of definition of the canonical model of Sh . The proof involves a comparison with the similar statement for toroidal compactifications of Sh . (jnek)

A. Hatcher, *Algebraic Topology*, Cambridge University Press, Cambridge, 2002, 544 pp., £20.95, ISBN 0-521-79540-0 and 0-521-79160-X

This textbook on algebraic topology prefers a geometrical style of explanation of the theory. It can be used as an introduction into algebraic topology, but there are also additional parts in which more advanced material is presented.

The book is divided into five chapters.

The first is introductory, explaining the basic parts of homotopy theory. The second chapter is devoted to a study of the fundamental group of a space; van Kampen's theorem is proved here and used for a description of fundamental group of cell complexes: there is also a part devoted to properties of covering spaces. In Chapter 3, simplicial and singular homologies are introduced and compared, together with many examples and applications of the theory. Cohomology theory is studied in the fourth chapter, including cup and cap products and the Poincaré duality with applications. The final chapter contains advanced homotopy theory and its connection with cohomology theory. It also includes stable homotopy groups and Postnikov towers, as well as the basics of obstruction theory. Each chapter contains additional topics that are very interesting and often contain further applications of algebraic topology. As additions to cohomology theory, we find the theory of H -spaces and Hopf algebras and computation of cohomology of $SO(n)$. As additions to homotopy theory, there are the cohomology of fibre bundles, glueing constructions and Steenrod squares and powers.

The book includes many interesting exercises. It is well written, and can be used for a basic course as well as for advanced study of algebraic topology. It can be strongly recommended to anyone interested in algebraic topology. (jbu)

P. Hilton, D. Holton and J. Pedersen, *Mathematical Vistas. From a Room with Many Windows*, Undergraduate Texts in Mathematics, Springer, New York, 2002, 335 pp., EUR 69.95, ISBN 0-387-95064-8

Some problems in mathematics have attracted wide attention, by being easily understandable but difficult to solve. The attempts to solve them have lasted sometimes for centuries. Well-known examples are Fermat's last theorem and the four-colour problem. Although their proofs are long and complicated, there are authors who describe the key ideas of such proofs and the whole history of the solution of such problems very attractively.

This is the case for the present book, which consists of nine chapters devoted to different mathematical problems. It starts with a few paradoxes in mathematics: some of these represent versions of Simpson's paradox, others show that comparisons may not be necessarily transitive. Then we find chapters describing the above topics, Fermat's last theorem and the four-colour problem. Interesting and rich material is collected in chapters dealing with Fibonacci, Lucas and Catalan numbers. Further chapters contain material about paper-folding, polyhedra-building, and symmetry. In the final chapter, 'Parties', we learn about cliques and anticliques, birthdays and coincidences, and about dance problems when the girls decide that they'll only dance with a boy they already know.

One of the special features of the text is that a number of 'breaks' are included in each chapter; these consist of problems so that the reader can test their understanding of the presented material. Selected answers to breaks are given at the end of the book. A complete set of answers is available on request from one of the authors.

The book can be recommended for students and for all people who consider mathematics as a part of human culture. This fully corresponds to the dedication at the beginning of the book: 'A further tribute to those who showed us how enjoyable mathematics can be, especially as one penetrates deeper.' (ja)

K.-H. Hoffmann and Q. Tang, *Ginzburg-Landau Phase Transition Theory and Superconductivity*, International Series of Numerical Mathematics 134, Birkhäuser, Basel, 2001, 383 pp., DM198, ISBN 3-7643-6486-6

This monograph summarises and refines mathematical research in superconductivity and isothermal phase transition of Ginzburg-Landau type during the past decade – in particular, in Munich and Oxford. The primary interest is in understanding the co-dimension two phase transition problem (vortex-structured phase transition problem), with particular interest to physical applications. After presenting the physical background, the mathematical scaling is treated in a systematic way and various limit problems are analysed – in particular, asymptotical analysis of vortex motion. Chapter 2 deals with a simplified Landau phase-transformation model, where the magnetic potential is identically 0. Chapter 3 then addresses the full system with magnetic potential which allows vortices like in an inviscid fluid: an asymptotical analysis is presented. Chapter 4 deals with the steady-state problem, showing existence of its solution and demonstrating rigorously the breakdown of superconductivity due to a strong magnetic field. Chapter 5 continues with the evolutionary problem, showing existence, uniqueness, regularity, asymptotics (in the sense of \tilde{u} -limit set and a global attractor) of the solution. Chapters 6-8 then address complex Ginzburg-Landau phase transition, slow motion of vortices, and thin plates and films. Chapter 9 deals with pinning (due to material inhomogeneities), in particular with existence, regularity, and the vortex location and law motion, derivation of dimensionally reduced models, and a study of pinning vortices. The book ends with numerical analysis and two-dimensional computational simulations.

Altogether, the book presents rigorous mathematical answers to interesting physical questions arising in superconductivity, and offers a comprehensive introduction and a survey of the state-of-the-art in the subject. As such, it will be found useful not only by advanced students wishing to start research in qualitative description of superconductivity, but also by applied mathematicians, theoretical physicists and engineers interested in this area. (trou)

M. Kashiwara and P. Schapira, *Ind-Sheaves*, Astérisque 271, Société Mathématique de France, Paris, 2001, 136 pp., FRF150, ISBN 2-85629-099-X

'Sheaf theory is not well suited to the study of various objects in Analysis which are not defined by local properties. The aim of this paper is to show that it is possible to overcome this difficulty ...', claim the authors in the abstract. The authors used the word 'paper' so that they themselves characterized the style of their monograph. Although the first and the second chapters are devoted

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ed to a brief review of Grothendieck topologies and the indisation of categories (completion of categories with respect to filtered colimits called 'inductive limits of filtrants'; the standard modern terminology of category theory is not mentioned), the potential reader is supposed to be well acquainted with the sheaf theory. The overcoming of the above difficulty consists of the extending of the machinery of sheaves to the ind-sheaves. The ind-sheaves are just objects of the indisation of a category of sheaves of k -modules, where k is a commutative ring, with compact support over a locally compact space X .

After developing the basic machinery, the authors present constructions of specific sheaves by means of specific Grothendieck topologies and they clarify the situation concerning the corresponding ind-sheaves. In the final chapter, they apply their constructions to functions on real or complex manifolds, such as the tempered C^∞ -functions, the Whitney C^∞ -functions and the tempered distributions for real manifolds and some kinds of holomorphic functions for complex manifolds. A specialist in sheaf theory will enjoy the ideas of the authors. In a concluding remark, the authors promise a forthcoming paper with an application of the theory of ind-sheaves to Sato's microlocalisation and other constructions. (vt)

J. W. Kay and D.M. Titterton (eds.), *Statistics and Neural Networks. Advances at the Interface*, Oxford University Press, 1999, 260 pp., £40, ISBN 0-19-852422-6

This book may be looked on as an interface between artificial neural networks (ANN) and multivariate statistical analysis (MSA), and the reader can find the connections between the classical and the most recent methods of MSA and ANN. The contributors are well-known scientists in both fields.

The chapters are: Flexible discriminant and mixture models; Neural networks for unsupervised learning based on information theory; Radial basis function networks and statistics; Robust prediction in many-parameter models; Density networks; Latent variable models and data visualisation; Analysis of latent structure models with multidimensional latent variables; Artificial neural networks and multivariate statistics. Carefully chosen examples, many of them arising in practice, illustrate the ideas and methods. This nicely written book is recommended to all wishing to gain knowledge of the current status and trends in the area. (jh)

V. Kodiyalam and V. S. Sunder, *Topological Quantum Field Theories from Subfactors*, Research Notes in Mathematics 423, Chapman & Hall/CRC, Boca Raton, 2001, 124 pp., £53.99, ISBN 1-5848-8241-7

These lecture notes are devoted to Ocneanu's construction of 2+1-dimensional topological field theories (TFTs) from finite-depth subfactors. The book starts with the notion of quantisation functors (a weak version of TFTs) and with conditions that make a quantisation functor a TFT. The authors then discuss Frobenius algebras with intertwiners and give a simplicial construction of 2+1-dimensional TFTs using these algebras. In the next chapter

the reader becomes acquainted with type III von Neumann factors (including such matters as ' M -valued inner products'), contragredients and 'Connes fusion', and finally describes Ocneanu's construction. The final chapter then gives a simple example involving the crossed product of a III factor by the outer action of a finite group.

The book is short and self-contained, and can be used as a good introduction to TFTs and subfactors. (pše)

M. Kohlmann and S. Tang (eds.), *Mathematical Finance, Trends in Mathematics*, Birkhäuser, Basel, 2001, 374 pp., DM196, ISBN 3-7643-6553-6

This volume in the series *Trends in Mathematics* collects about 35 contributions to a workshop. There is a wide range of the topics discussed, from historical remarks to detailed stochastic analysis of financial instruments, from practically oriented articles to purely theoretical ones.

A brief list of subjects is as follows: portfolio strategies and selection, transaction considerations, price volatility, stochastic volatility, interest rates models, arbitrage, investment-consumption strategies, risk sensitive asset management, stochastic control, instalment options, passport options, Asian options, fractional Brownian motion, mutual debts compensation, quantile and mean-variance hedging, continuous CAPM, risk considerations. There are some misprints. The book should be of interest to specialists in continuous financial mathematics. (jh)

Kolmogorov in Perspective, *History of Mathematics 20*, American Mathematical Society/LMS, Providence, 2000, 230 pp., \$49, ISBN 0-8218-0872-9

This fascinating book is a translation of two volumes *Kolmogorov in Remembrance* (1993) and *Mathematics and its Historical Development* (1991), and describes the life and scientific achievements of one of the greatest mathematicians of the 20th century. At the same time, it gives a vivid picture of the lifestyle of Soviet and international mathematical community in that period, which in spite of the brutal regime in power in USSR for most of the time turned out to be a golden age of Russian mathematics. It is amazing to read numerous stories documenting the extraordinary strength, creative and physical, of A. N. Kolmogorov, as reflected in the memories of his colleagues and pupils, mostly also famous mathematicians. Just to select two examples. In his memories of P. S. Alexandrov, Kolmogorov describes their joint summer trip on the Volga river in 1929, continuing on to the Caucasus. Finally they settled on an island in Lake Sevan, Armenia. While Alexandrov worked on his joint topological monograph with Hopf, Kolmogorov worked on an article on the theory of integrals and on the analytical methods, known from then as 'Kolmogorov equations', in the theory of Markov processes. They had brought a portable typewriter, which Alexandrov had just bought in Göttingen. And much later, Kolmogorov proudly remembered his swimming on a late autumn day (he was already about 70) in the Moscow river near the University. The stony embankment of the river was already slippery with ice, so that it was

almost impossible to climb out... In his village house 'Komarovka', A. N. of course liked to swim regularly with his guests in the local river and this entertainment was typically combined with long walks or ski tours in the neighbouring landscape.

In addition to quoting numerous examples of such physical strength, the book's primary aim is to document the extraordinary intellectual strength of Kolmogorov – in particular, its enormous scientific work. This is the main goal of the introductory article by A. N. Shiryayev which offers illuminating reading, giving a detailed exposition of Kolmogorov's work and putting it into historical perspective. In the following parts of the book, V. I. Arnold, S. M. Nikolskii, Ya. G. Sinai, P. L. Ulyanov and P. S. Alexandrov add their personal reminiscences. All this gives an impressive picture of his incomparably rich and influential scientific, pedagogical and organisational activities. His enormous influence is best documented by the astonishingly large list of his pupils, mostly famous and influential mathematicians. The contributions to the book give an adequate description of the outstanding personality of Kolmogorov and present an interesting picture of 20th-century mathematics, expressed in the thoughts of many of its prominent representatives. The second part of the book consists of Kolmogorov's memories on P. S. Alexandrov, his 1982 article on Isaac Newton, and his impressive bibliography. This is one of the best books written on great mathematicians and their personalities. (mzahr)

H.-O. Kreiss and H. U. Busenhardt, *Time-dependent Partial Differential Equations and their Numerical Solution*, *Lectures in Mathematics*, Birkhäuser, Basel, 2001, 82 pp., DM44, ISBN 3-7643-6125-5

In these lecture notes the authors study time-dependent partial differential solutions: Cauchy problems and half-plane problems for systems with constant coefficients, linear systems with variable coefficients, and non-linear problems of a special type, illustrating the main difficulties arising in these. The numerical approximation by the difference method is then studied, with special emphasis on the well-posedness of the problem, together with the linear and non-linear stability of difference approximations. Basic error estimates are developed, the boundary conditions are studied by the energy estimates and Laplace transform techniques, and the question of the admissibility of these is touched on.

These lecture notes provide a concise overview of the topic and should be of value for students and for those interested in appropriate introductory reading in the field. (mr)

J. S. Lomont and J. Brillhart, *Elliptic Polynomials*, Chapman & Hall/CRC, Boca Raton, 2001, 289 pp., £56.99, ISBN 1-58488-210-7

This research monograph deals with a special type of polynomials arising from the theory of elliptic functions and integrals. They are generated by special exponential functions with connections to both elliptic functions and orthogonal polynomials. The origin of the topics lies in two papers by

Carlitz.

The book is highly technical and is interwoven with an enormous number of formulas, and it is almost impossible to describe its content without using them. The elliptic polynomials are generated by certain elliptic integrals and elliptic functions (the Jacobi elliptic functions sn , sc and sd) and are motivated by examples suggesting that there exists a class of functions where the polynomial coefficients in the Maclaurin expansion possess certain divisibility patterns.

Readers of the book should be technically able to work with already mentioned elliptic functions and with other classical parts of the analysis, such as orthogonality, weight functions and measures. The invested energy results in a wealth of wonderful formulas and surprising results. Number theorists and those working in complex or real analysis or combinatorics will certainly find here points for further research. (spor)

R. Luus, *Iterative Dynamic Programming, Monographs and Surveys in Pure and Applied Mathematics 110*, Chapman & Hall/CRC, Boca Raton, 2000, 324 pp., £54, ISBN 1-58488-148-8

Optimisation problems solvable via dynamic programming procedures are generally limited to those with very low dimensions. The author of the monograph invented and analysed an iterative modification of the procedure that has later been made more feasible from a computational point of view by other authors. Thus, dynamic programming has become an effective method for solving high-dimensional optimal control problems.

This book is the first to present the method, to review recently published results, to provide the necessary background with the insight that motivated the research, and to give a possible view of future developments. It recommends itself to applied mathematicians, theoretical physicists and computer scientists by its following merits: a carefully built exposition that provides the reader with the necessary foundations of the optimisation procedures and dynamic programming, a deep and inspiring treatment of their iterative modifications, a rich collection of true applications and a collection of ready to run FORTRAN programs. (jste)

S. Lynch, *Dynamical Systems with Applications Using Maple*, Birkhäuser, Boston, 2001, 398 pp., DM 130, ISBN 0-8176-4150-5 and 3-7643-4150-5

This book provides an introduction to the theory of dynamical systems, both continuous (using differential equations) and discrete, using the computer algebraic manipulation package Maple. From a theoretical point of view, it can be considered more as an overview, listing known facts with examples, than as a systematic mathematical treatment, and in this aspect, is closer to calculus books than to monographs on the topic.

The book uses the concept of 'experimental mathematics', with examples illustrating the behaviour of dynamical systems arising in the theory of mechanical systems, electric circuits, chemical reactions, meteorology and biology, all studied with the help of

Maple. Numerous examples and exercises are included. The book will be of value for students and researchers in mathematics and engineering. It would have been even more valuable if a diskette or CD with programmed examples had been included. (mr)

N. Madras, *Lectures on Monte Carlo Methods*, Fields Institute Monographs 16, American Mathematical Society, Providence, 2002, 103 pp., \$30, ISBN 0-8218-2978-5

This book is a modern concise introduction to Monte Carlo methods. Chapter 1 is a brief introduction to MCM, and random number generators are discussed in Chapter 2. Chapter 3 reviews variance reduction techniques. Almost one third of the book (Chapter 4) is devoted to a recent field, Markov Chain Monte Carlo and related topics (simulating annealing and the Gibbs sampler). In Chapter 5, the author concentrates on the statistical analysis of simulation output. The final chapter briefly describes the Ising model. The bibliography contains 57 items.

This book is carefully written and rich in the selected material. Its style of presentation enables beginners to understand, and more advanced researchers to mine, a lot of fresh ideas, and the reader will also find many interesting examples. The book is recommended to anyone interested in the field. (jh)

M. Majewski, *MuPAD Pro Computing Essentials*, Springer, Berlin, 2002, 456 pp., EUR 39,95, ISBN 3-540-43574-3

This book is written especially for those who wish to explore mathematics in a new exciting way by computer. There are several powerful, but expensive, mathematical tools such as Maple and Mathematica for this purpose, but beside them is MuPAD which has appeared recently, and whose high performance is in contrast to its low price. Free MuPAD licences can be obtained for educational purposes, so this book could be extremely useful for teachers and high-school and colleges students.

In the first chapter the author explains the 'birth' of this tool and presents the philosophy of MuPAD authors. Chapter 2 describes the MuPAD user interface and gives a first view of its features and power. Chapters 3-5 present an excellent short course of the MuPAD programming language for beginners. Probably the most beautiful part of the book consists of Chapters 6-9, devoted to MuPAD graphics, where the author demonstrates a wide range of possibilities for visualising mathematical objects: some of the examples of 3D graphs are especially fascinating. In Chapter 9 the author presents MuPAD functions designed for number theory – for example, using functions for factorising numbers, searching for primes, converting rational numbers to continued fractions, and manipulating complex numbers. Chapter 10 is devoted to elementary algebra and trigonometry in MuPAD: the reader can see how powerful this tool is in symbolic manipulations with polynomials, rational and algebraic expressions, trigonometric, logarithmic and exponential functions. Chapter 11 starts with logic. The author demonstrates how to create truth tables for

the logical operations not, and, or, and shows how to check tautologies. Chapter 12 is devoted to using MuPAD to explore calculus – finding limits, derivatives and asymptotes and sketching the graph of a function of one variable. Other undergraduate problems concern working with integrals, including the definition of the Riemann integral. The reader also learns how to manipulate infinite series and products. The final chapter covers linear algebra.

All the chapters contain interesting exercises, which can be used by teachers. At the end of the book are two appendices: in the first is a complete tabular index of libraries, operators and commands in MuPAD version 2.5; in the second is a short list of the main internet resources. We strongly recommend this book to all who want to use MuPAD during their study, and especially to those who enjoy computers and have not yet met this type of software. (mcja)

Y. Meyer, *Oscillating Patterns in Image Processing and Nonlinear Evolution Equations*, University Lecture Series 22, American Mathematical Society, Providence, 2001, 122 pp., \$25, ISBN 0-8218-2920-3

This book consists of three parts, corresponding to three lectures by the author: the Jacqueline Lewis Memorial Lectures at Rutgers University. These parts deal with three topics which seem at first to have nothing in common: image processing and compression, non-linear PDEs, and frequency modulated signals in the theory of gravitational waves. What unifies these topics is the concept of oscillating patterns, together with the analytic tools to identify and study these patterns: wavelet analysis, spaces of BV functions and Besov norm estimates.

In the first chapter an image processing is studied – image compression and denoising, with special emphasis on the JPEG standard of image coding. It is shown that the 'texture + noise' splitting of the image contains oscillating patterns, in the sense of some Besov norm definition. In Chapter 2, the Navier-Stokes equations are studied, especially their localised and oscillating solutions. The third chapter discusses gravitational waves – detecting the relevant frequency modulated signals that would experimentally prove the existence of such waves relies on describing and analysing oscillating patterns.

The book is an interesting contribution to the interdisciplinary aspects of mathematics and should be of value for all interested in the field. (mr)

D. Mumford, C. Series and D. Wright, *Indra's Pearls: The Vision of Felix Klein*, Cambridge University Press, 2002, 395 pp., £29.95, ISBN 0-521-35523-3

This unique book can serve as a pedagogical and visual introduction to group theory for schoolchildren, and yet is just as suitable for professional mathematicians: I believe that both of them would read the book from the beginning to the end.

The book is about finitely generated groups of Möbius transformations of the Riemann sphere, a classical topic going back to Klein and Poincaré. It contains marvellous computer-generated pictures of

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these groups (their limit sets, tessellations, orbits of a certain Dr. Stickler, etc.), together with detailed explanations of the algorithms: they are especially beautiful in those cases when the classical means of proving discreteness do not work.

The book takes the reader through all the necessary mathematics: it introduces groups as a language for describing symmetries, complex numbers and free geometry, Möbius transformations, their groups, Schottky circles, limit sets, the modular group, Hausdorff dimension of fractals, Farey series, and much more. There are many exercises (called projects) to get the reader acquainted with these things, but also to have a lot of fun while solving or programming them. Finally, it can be used as a book for popularising science, but is very different from most fashionable books on strings, black holes, etc.: it gives you the joy of seeing, thinking and understanding. (pše)

G. L. Naber, *Topology, Geometry, and Gauge Fields. Interactions, Applied Mathematical Sciences 141*, Springer, New York, 2000, 443 pp., DM139, ISBN 0-387-98947-1

This book presents a continuation of the programme started in the author's *Topology, Geometry and Gauge Fields: Foundation*. The main idea is to show how mathematics and physics can combine in a study of common problems. As examples, we find Dirac magnetic monopoles and principal $U(1)$ -bundles over S^2 , Yang-Mills equations and smooth four manifolds.

In the first chapter, an overview of geometrical material is given. Chapter 2 presents the physical theories, including such classical gauge theories as classical electromagnetic theory, Dirac monopoles, Klein-Gordon and Dirac equations and Yang-Mills theory. Chapter 3 gives further properties of space-times and spinor structures on these manifolds. The theory of differential forms, integration and Stokes's theorem are studied in Chapter 4, also the covariant derivative on principal fibre bundles over a manifold are discussed with relations to field equations in physics. The de Rham cohomology as a main tool is used in Chapter 5, with relations to the Higgs fields. The next chapter contains topological notions, such as Chern-Weil homomorphism, Chern classes and their application in physics, giving the magnetic charge and instanton number. Also found here are the first and second Stiefel-Whitney classes of a manifold, as obstructions to the existence of orientation and spinor structure on a given manifold. A brief Appendix introduces the Seiberg-Witten equations. There are many examples and more than 200 exercises in the book.

Let me strongly recommend the book to all mathematicians and physicists interested in the problems presented. (jbu)

L. I. Nicolaescu, *Notes on Seiberg-Witten Theory, Graduate Studies in Mathematics 28*, American Mathematical Society, Providence, 2000, 484 pp., \$59, ISBN 0-8218-2145-8

This book treats the mathematical aspects of Seiberg-Witten theory. This physical theory, developed by N. Seiberg and E. Witten in 1994, suggests the form of low-energy

Wilsonian effective action of $N = 2$ supersymmetric Yang-Mills theory. Witten's method of twisting was applied originally to $N = 2$ Yang-Mills theory, in order to obtain a kind of topological field theory whose correlation functions are precisely the famous Donaldson's invariants – but it can also be applied to this low-energy effective case. Topological field theory arising in this way has as its correlation functions a new type of invariants: the Seiberg-Witten invariants.

The book starts with a good survey of the necessary background from differential geometry and the theory of Seiberg-Witten invariants. These invariants are then analysed for several important manifolds including algebraic surfaces. The book contains many examples and is self-contained. It is well written and offers a good introduction to the field. (ov)

B. Perrin-Riou, *Théorie d'Iwasawa des représentations p -adiques semi-stables*, Mémoires de la Société Mathématique de France 84, Paris, 2001, 109 pp., FRF150, ISBN 2-85629-106-6

The author develops local Iwasawa theory for semistable Galois representations in the cyclotomic tower over an unramified extension of \mathbf{Q}_p . The main results include the construction of the exponential / logarithm maps and the determination of the universal norms for H^1_g . The proof generalises those used by the author in her earlier articles on the crystalline case. The main technical difference is the appearance of rings of functions analytic in an annulus, as opposed to functions analytic in the unit disc in the crystalline case. (jnek)

I. Rahman and G. Schmeisser, *Analytic Theory of Polynomials*, London Mathematical Society Monographs New Series 26, Clarendon Press, Oxford, 2002, 742 pp., £90, ISBN 0-19-853493-0

This book consists of an introduction and three parts. In Chapter 1 (Introduction), the authors present three basic results on polynomials and an introduction to orthogonal polynomials, harmonic and subharmonic functions and matrix analysis, presenting mainly those results needed in subsequent chapters.

Part I (Chapters 2-7) is devoted to a study of the critical points, with fundamental results on critical points (Gauss-Lucas theorem, Jensen's theorem, extensions, etc.), more sophisticated and specific results (location of some critical points), and multiplicative compositions. Chapter 6 is devoted to polynomials with real zeros, and Chapter 7 contains a discussion of conjectures of Smale and Sedov, which are among the most interesting open problems concerning polynomials.

Part II (Chapters 8-11) deals with locating zeros in terms of the coefficients. As a novelty, the authors admit the coefficients of the standard representation of a polynomial, and consider the coefficients of certain other expansions, mainly Newton expansions and orthogonal expansions. Cauchy's 1829 bound and techniques for its estimation are presented in Chapter 8. Improved estimates for some zeros are studied in Chapter 9, and Chapters 10 and 11 are concerned with counting the number of zeros.

Part III (Chapters 12-16) is devoted to

extremal properties. In Chapter 12 the authors present three methods for solving a variety of extremal problems for polynomials and trigonometrical polynomials, and illustrate their usefulness by applying them to obtain several interesting results. This chapter contains proofs of Turán's lemma, the Botroux-Cartan lemma, etc. A self-contained account of some remarkable results of V. V. Arestov is presented in Chapter 13; this chapter also contains applications of the Lagrange multiplier rule and the fundamental theorem of linear programming. Chapters 14 and 15 are about various forms of Bernstein's and Markov's inequalities for the derivative of a trigonometrical polynomial and a polynomial on the unit interval, respectively. Finally, Chapter 16 is about various estimates for the coefficients of polynomials and trigonometrical polynomials.

Each chapter ends with notes that describe the historical background, disclose sources, and give references to related work and suggestions for further study. This is a nicely written book that will be useful for scientists, engineers and mathematicians from other fields. It can be strongly recommended as an undergraduate or graduate text and as a comprehensive source for self-study. (kn)

J. R. Shoenfield, *Mathematical Logic*, A. K. Peters, Natick, 2001, 344 pp., \$35, ISBN 1-56881-135-7

This book is a classical introduction to mathematical logic, and is a photographic copy of the second edition of *Mathematical Logic*, published by Addison-Wesley in 1973. The basic concepts and results are presented in an economical, unusually clear and accessible fashion. Chapters 1 to 4 present the fundamental notions and results of the syntax and semantics of first order-theories, including the completeness theorem and Herbrand's theorem. Chapter 5 can be seen as a short classical model theory, while Chapter 6 (Incompleteness and Undecidability) treats each theme in a classical way, with recursiveness playing a crucial role: this is advanced deeply in Chapter 7 (Recursion Theory). Chapter 8 (Natural Numbers) treats Peano arithmetic P , an important axiomatic first-order theory of natural numbers; the unprovability of consistency of P in P is proved, and a constructive proof of the consistency of P is presented; second-order arithmetic is also included. In the last chapter an axiomatic set theory is developed, including the axiom of constructibility, the method of forcing, and large cardinals. The solutions of problems, appended to the chapters and equipped with hints, extend the ideas in the main text. (jmlc)

A. Skorobogatov, *Torsors and Rational Points*, Cambridge Tracts in Mathematics 144, Cambridge University Press, 2001, 187 pp., £35, ISBN 0-521-80237-7

The central motivating idea of the book is the solvability of Diophantine equations in the field of rational numbers, or in a general number field k . One class of equations, where an algorithm for deciding the solvability over the rationals is known to exist, is the class of projective varieties defined over rationals satisfying the Hasse principle: this principle states that the obvious necessary

condition for the solvability of a system of homogeneous polynomial equations (solvability in all completions of rationals) is also sufficient. More generally, the existence of rational points on a smooth projective variety X over a number field k reduces to the existence of points over each completion of k . Manin found a first general obstruction to the Hasse principle and the author gave the first variety, where the Manin obstruction does not explain the failure of the Hasse principle.

This book presents a clear exposition of the theory built up in this field by Colliot-Thélèn, Sansuc and the author. The first part consisting of three chapters is devoted to the basic theory of torsors; readers interested only in the fundamentals of this theory can also use it. The theory is then applied to specific classes of varieties. The titles of chapters in the second part are: Obstructions over number fields, Abelian descent and Manin obstruction, Abelian descent on conic bundle surfaces, Non-abelian descent on bielliptic surfaces, and Homogeneous spaces and non-abelian cohomology.

The book is written in a clear and lucid manner with detailed examples that balance the abstract theory with concrete facts. It is reasonably self-contained and can therefore be recommended to newcomers to the theory, as well as to those interested in the recent development of the descent method in diophantine geometry. (spor)

G. V. Smirnov, *Introduction to the Theory of Differential Inclusions*, Graduate Studies in Mathematics 41, American Mathematical Society, Providence, 2002, 226 pp., \$34, ISBN 0-8218-2977-7

This textbook is intended for graduate students as an introduction to the theory of those differential inclusions $\{x'\} = F(x)$ on \mathbf{R}^n for which the values of the set-valued map F are convex subsets of \mathbf{R}^n . Particular attention is paid to applied problems, and only a basic knowledge of mathematical analysis and ordinary differential equations is required.

The necessary prerequisites from convex analysis, analysis of convex-valued maps, and the non-smooth analysis of Mordukhovich are presented in Part 1. Existence results for Lipschitz or for upper semi-continuous right-hand sides F , including optimal solutions, are given in the first section of Part 2. Then several special problems, forming the main content of the book, are discussed. Necessary and sufficient conditions for the existence of a solution with $x(t)$ in a subset C of \mathbf{R}^n are interpreted as the viability problem. Conditions on controllability ensure the existence of solutions reaching a given point from any initial position. Necessary conditions for some optimal problems are derived. The final sections are devoted to stability theory. Besides sufficient conditions for the stability (asymptotic stability) of the equilibrium state, the problem of stabilisation is studied. This is a specific problem for differential inclusions, where one looks for selections $f(t)$ in $F(t)$ such that the equilibrium state of the ordinary equation $\{x'\} = f(x)$ is stable. The technique common for many proofs is approximation by simpler differential inclusions, or discrete-time difference inclusions,

and corresponding limiting procedures. (ph)

J. M. Steele, *Stochastic Calculus and Financial Applications*, Applications of Mathematics 45, Springer, New York, 2001, 300 pp., \$69.95, ISBN 0-387-96016-8

During the last decade the stochastic analysis part of probability has attracted, due to its ability to model and analyse the dynamics of financial processes, the qualified interest of a steadily growing community of mathematically educated students and researchers not specialising in stochastics. This book offers rich information and a mathematically honest treatment of stochastic calculus and of its use in the theory of finance to those with a knowledge of standard probability and statistics.

This readable and precise, but not pedantic, text covers the following topics: random walks, discrete martingales, Brownian motion and continuous time martingales, the Itô integral and formula, stochastic differential equations, the Black-Scholes model, partial differential equations, Brownian representations and the Girsanov theorem, arbitrage and options' valuations, and the Feynman-Kac connection. The author gradually builds the reader's ability to grasp stochastic concepts and techniques in their discrete-time form. The continuous time probabilistic dynamics is then presented in its Brownian and martingale setting, in a generality that allows one to study highlights of the stochastic analysis, such as Brownian representations or diffusions. With this as background, the author's presentation of stochastic models in finance and economy is precise and extensive enough to include an investigation of the concepts of attainability and complete markets.

Each chapter is accompanied by a collection of rather challenging exercises that are, as the author admits, 'well worth the investment of some part of a nice fall afternoon'. (jste)

P. J. Vassiliou and I. G. Lisle (eds.), *Geometric Approaches to Differential Equations*, Australian Mathematical Society Lecture Series 15, Cambridge University Press, 2000, 227 pp., £29.95, ISBN 0-521-77598-1

The main topic of this book is the role played by geometry in the study of differential equations. This is a broad and very active field of research in recent decades. The book is based on a workshop held in Canberra in 1995. Additional invited contributions were added to written versions of the lectures with the aim of covering certain basic topics in the subject.

The first introductory chapter (by P. Vassiliou) offers a brief and elementary introduction to the subject. The paper by C. Rogers, W. K. Schief and M. E. Johnston concentrates on the Bäcklund transformation and its role in completely integrable systems. Bäcklund transformations appear also in the paper by A. Calini on integrable curved dynamics, which treats the vortex filament equation and its relations to certain integrable systems. The next topics in the book go back to É. Cartan, who created the theory of exterior differential systems, which give an elegant geometrical language for a study of differential equations of cer-

tain types: a brief and elementary introduction to this theory is given by N. Kamran. This language is then used by I. G. Lisle and G. J. Reid in a description of infinite Lie pseudogroups. The Cartan method of equivalence is discussed in the paper by D. H. Hartley. The inverse problem in the calculus of variations asks when a given system of second-order ordinary differential equations can be related to the Euler-Lagrange equations of a suitable Lagrangian; a review of such questions can be found in the paper by G. E. Prince. The last contribution by M. K. Murray describes the twistor methods for description of solutions of certain linear and non-linear PDEs on \mathbf{R}^4 by methods of complex geometry (the wave equation, the Bogomolny equation).

The authors have helped to create a coherent presentation of chosen parts of the subject. This is a small book, but is worth having in the library, as it contains nice descriptions of rich and important material. (vs)

V. A. Yurko, *Inverse Spectral Problems for Differential Operators and Their Applications*, Analytical Methods and Special Functions 2, Gordon and Breach, Singapore, 2000, 253 pp., \$110, ISBN 90-5699-189-2

This book studies spectral properties of higher-order ordinary differential operators on an interval or half-line. In particular, an inverse problem for such an operator means recovering the differential operator from its given spectral properties.

The first part of the book treats the problem of recovering the differential operator from a given Weyl matrix, both in the self-adjoint (the easier case) and non-self-adjoint cases, on a finite interval and a half-line. In the second part, incomplete inverse problems are studied: only a part of the Weyl matrix is given, together with certain *a priori* information. In the final chapters, more general operators are considered, covering inverse problems for certain difference or integro-differential operators. Inverse problems appear in many practical problems and have many interesting applications in mathematical physics and other natural sciences. (vs)

List of reviewers for 2002

The Editor would like to thank the following for their reviews this year:

J. Andel, J. Antoch, R. Bashir, J. Becvár, V. Beneš, L. Bican, L. Bocek, J. Bureš, M. Cihák, K. Cuda, J. Drahoš, A. Drápal, E. Fašangová, J. Felcman, D. Hlubinka, P. Holický, Š. Holub, J. Horejší, J. Hric, J. Hurt, M. Hušek, J. Jelínek, M. Klazar, D. Král, J. Kratochvíl, P. Lachout, J. Machek, J. Málek, J. Malý, M. Markl, J. Matoušek, J. Milota, J. Mlček, K. Najzar, J. Nekovář, J. Nešetřil, I. Netuka, P. Pyrih, Š. Porubský, M. Rokyta, T. Roubíček, R. Škrekovský, P. Somberg, J. Souček, V. Souček, J. Štěpán, J. Trlifaj, V. Trnková, J. Tuma, O. Vána, J. Vanžura, J. Veselý, Z. Vlášek, L. Zajíček, M. Zahradník, M. Zelený, K. Žitný.

All of the above are on the staff of the Charles University, Faculty of Mathematics and Physics, Prague, except M. Markl and J. Vanžura (Mathematical Institute, Czech Academy of Sciences), Š. Porubský (Technical University, Prague) and J. Nekovář (University Paris VI, France).