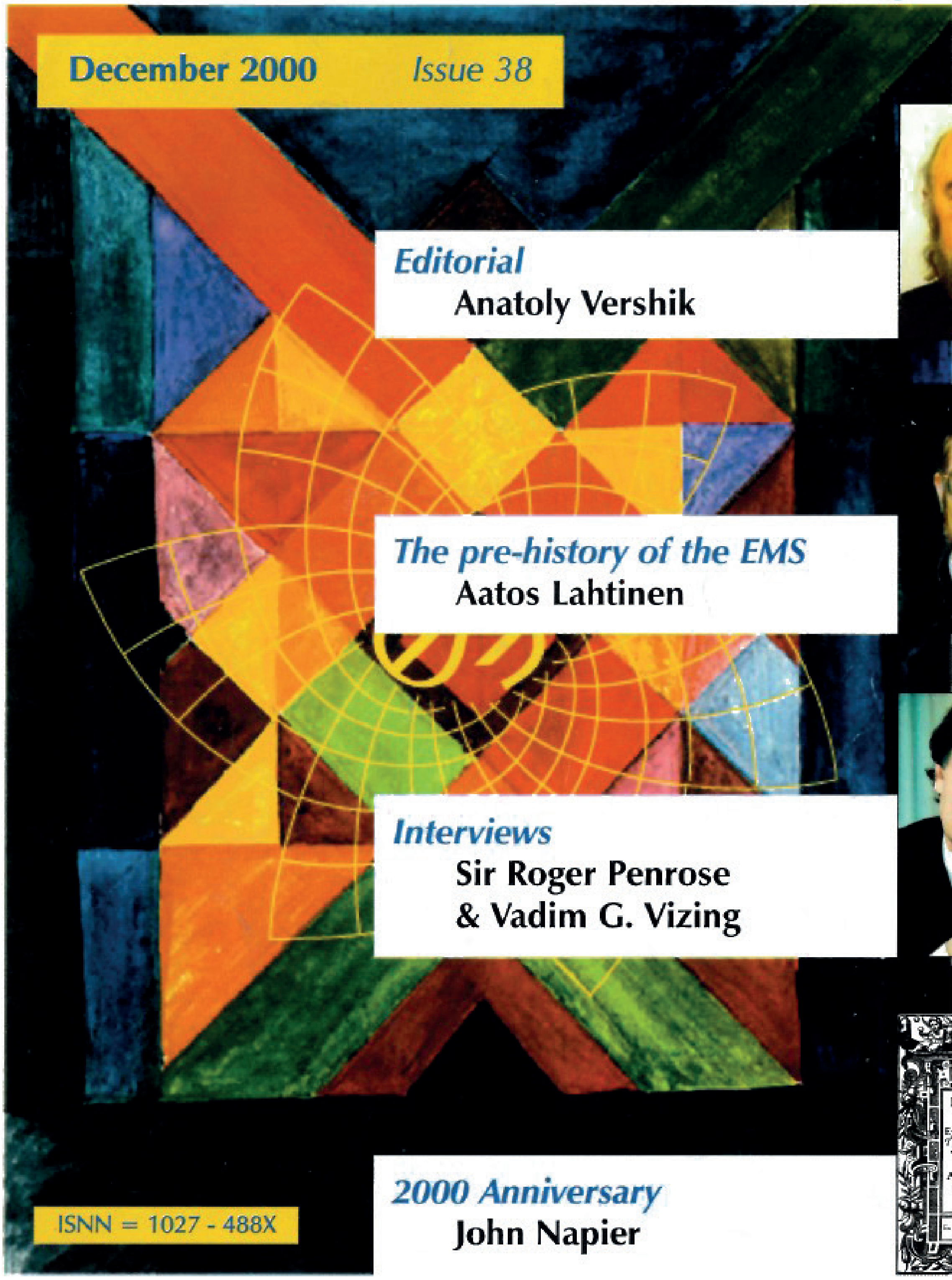
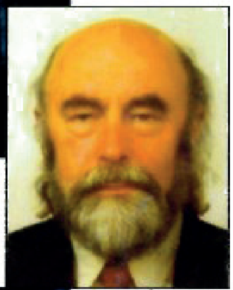
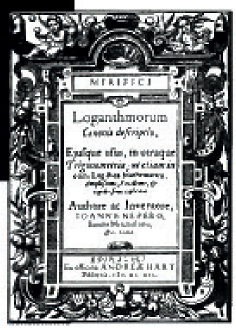
European Mathematical Society

December 2000 Issue 38







ISNN = 1027 - 488X

NEWSLETTER

EUROPEAN MATHEMATICAL SOCIETY

NEWSLETTER No. 38

December 2000

Designed and printed by Armstrong Press Limited
Crosshouse Road, Southampton, Hampshire SO14 5GZ, UK
telephone: (+44) 23 8033 3132   fax: (+44) 23 8033 3134
Published by European Mathematical Society
ISSN 1027 - 488X

NOTICE FOR MATHEMATICAL SOCIETIES

Labels for the next issue will be prepared during the second half of February 2001. Please send your updated lists before then to Ms Tuulikki Mäkeläinen, Department of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland; e-mail: makelain@cc.helsinki.fi

INSTITUTIONAL SUBSCRIPTIONS FOR THE EMS NEWSLETTER

Institutes and libraries can order the EMS Newsletter by mail from the EMS Secretariat, Department of Mathematics, P. O. Box 4, FI-00014 University of Helsinki, Finland, or by e-mail: (makelain@cc.helsinki.fi). Please include the name and full address (with postal code), telephone and fax number (with country code) and e-mail address. The annual subscription fee (including mailing) is 60 euros; an invoice will be sent with a sample copy of the Newsletter.

EMS Committee

EMS Agenda

2001

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*

10-11 March
Executive Committee Meeting in Kaiserslautern (Germany) at the invitation of the Fraunhofer-Institut für Techno- und Wirtschafts Mathematik

4-6 May
EMS Workshop, *Applied Mathematics in Europe*, Berlingen, Switzerland
Contact: R. Jeltsch, *e-mail: jeltsch@math.ethz.ch*

11-12 May
EMS working group on Reference Levels in Mathematics:
Conference on *Mathematics at Age 16 in Europe* (venue to be announced)
Contact: V. Villani or A. Bodin,
e-mail: villani@gauss.dm.unipi.it or *bodin@math.univ-fcomte.fr*

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*

9-25 July
EMS Summer School at St Petersburg (Russia)
Asymptotic combinatorics with applications to mathematical physics
Organiser: Anatoly Vershik, *e-mail: vershik@pdmi.ras.ru*

19-31 August
EMS Summer School at Prague (Czech Republic)
Simulation of fluids, and structures interactions
Organiser: Miloslav Feistauer, *e-mail: feist@ms.mff.cuni.cz*

24-30 August
EMS lectures at the University of Malta, in association with the 10th International Meeting of European Women in Mathematics
Lecturer: Michèle Vergne (Ecole Polytechnique, Palaiseau, France)
Title: Convex polytopes
Contact: Dr. Tsou Sheung Tsun, *e-mail: tsou@maths.ox.ac.uk*
These lectures will also be given at University of Rome, jointly arranged by 'Tor Vergata' and 'Roma Tre', at dates to be announced.
Contact: Maria Welleda Baldoni, *e-mail: baldoni@mat.uniroma2.it*

1-2 September
EMS Executive meeting in Berlin (Germany)

3-6 September
1st EMS-SIAM conference, Berlin (Germany)
Organiser: Peter Deuflhard, *e-mail: deuflhard@zib.de*

30 September
Deadline for proposals for 2002 EMS Lectures.
Contact: David Brannan, *e-mail: d.a.brannan@open.ac.uk*

30 September
Deadline for proposals for 2003 EMS Summer Schools
Contact: Renzo Piccinini, *e-mail: renzo@matapp.unimib.it*

2002

1-2 June
EMS Council Meeting in Oslo (Norway)

Editorial

Anatoly Vershik (St Petersburg)

Member of EMS Executive Committee (1997-2000)

President of St Petersburg Mathematical Society

The EMS and cooperation in mathematics

Cooperation in science, and in mathematics in particular, can be discussed from several points of view – first as exchange of scientific information, then as cooperation in joint research projects or other kinds of scientific activity (organisation of conferences, schools, etc.), and finally as social cooperation between different communities. All three types of cooperation are very important for Eastern European countries. Below I discuss them and give my view on the role of the EMS in encouraging them.

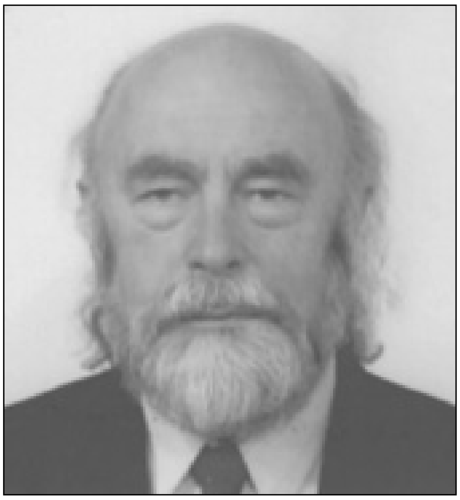
I have spent many years organising the St Petersburg Mathematical Society, as a member of the committee (1970-78), as Vice-president (1978-97) and as President (1997-now), so I can present some conclusions about the role of local societies in the mathematical life in Russia, looking in particular at the activities of the Moscow and St Petersburg Mathematical Societies.

Mathematical work is mainly very individual (in contrast to the experimental and technical sciences), so the tendency to separation is rather strong. The principal role of the local mathematical societies in Russia is to provide regular meetings with interesting talks, discussions, information, etc. In mathematics departments in the West (for example, in the US), part of this role is played by regular colloquiums, because most mathematicians are employed in the universities. In contrast, for many reasons, professional mathematicians in Russia were (and are) dispersed over various institutes and centres, sometimes without any mathematical environment. So the meetings of local mathematical societies play the role of scientific centres, and provide almost the only opportunity for mutual discussions on mathematics and the place for exchanging information.

Another role of mathematical societies is publishing activity: some of our societies have their own journals or proceedings. To my mind this is important, but less so than the reason above, because there are many journals and many possibilities for publication. A much more important function of local societies is to represent its communities in other scientific organisations and international societies.

The last has a direct connection with the role of the EMS and other international organisations, but before I discuss this connection I want to emphasise the new role of the internet and electronic media which step-by-step are changing the type of cooperation between individual mathematicians and has forced a change in the daily behaviour of scientists.

Let me give an example. As everybody knows, Russia has fewer computers than the West and access to the internet is not common. Nevertheless, these new forms of communication between people have raised all discussions on the transmission of scientific and administrative information to a completely new level. In our mathematical society, almost all of the 350 members use the internet, and so all information about meetings, special and regular lectures, new books, jobs, prizes, problems, and even discussions on special areas (such as education) can be propagated by e-mail or the web. The role of local mathematical societies now becomes a little different from before. The societies now have new duties – to present information about mathematical life to individual members, to help them avoid long trips on the internet in order to find links, web-pages, etc., and to support fast contact with other societies.



As an aside, I believe that the EMS still does not fully use the possibilities of the internet. Doing so could help to solve some problems that have appeared with individual members, or to discuss other urgent questions. One could even vote on issues via the internet. The EMS's web-page is still too short.

As with all kinds of progress, there are both positive and negative aspects to the internet. To some extent, cooperation and exchange of information using the internet deprive us of more vivid forms of communication. But at the same time we have (in our country) no other way of finding needed information, especially because in recent years there has been a decrease in the subscriptions on our journals, in buying mathematical books, and so on. Under these circumstances it is very important for us to have access to MatSciNet, Zentralblatt, and other such systems. Ultimately we will need to use the internet instead of printed matter, because it will be impossible to maintain enough subscriptions, even for the main journals and books, in our libraries.

The EMS as a mediator between East and West

The creation of the EMS in the early 1990s has had several consequences, especially for Eastern Europe after the collapse of the Soviet block. The original goal was to establish an organisation that could unify cooperation between mathematical communities in the different European countries.

I think that it is wrong to compare the EMS with the American Mathematical Society, because their functions and roles are very different. First of all, unlike the European situation, the US has no local (state) mathematical societies. In contrast, Russia has no national mathematical society (although we tried to organise one in the 1980s!), but we have about ten local ones (Moscow, St Petersburg, Kazan', Voronez, Niznii Novgorod, Ural, Novosibirsk, etc.). Also each new state, such as the Baltic states Ukraina, Belorussia, Armenia and Georgia, has at least one mathematical society. Some of these are now very active, while others have many difficulties but try to keep going.

Cooperation between former Soviet Union states, as well as cooperation with other countries, now helps with these problems. I believe that one of the essential roles of the EMS is to assist former Iron Curtain mathematical communities to become incorporated in the European and World mathematical communities.

This is not only a question of financial help – indeed, I don't even think that it's the main thing. A more delicate problem is to mediate with European organisations and other communities. In order to do this, it is important to understand better the situation in the scientific life of Eastern Europe. I will mention at least two serious current problems: scientific cooperation and the survival of mathematical schools.

It is useful to recall how the activities of most mathematicians were previously suppressed by official institutions (the problems of having a job, defending a thesis, travelling abroad, having contact with Western colleagues, and so on), especially for some categories of mathematicians. Even admittance to the main mathematical departments was forbidden to many people before the 1990s, and few Soviet mathematicians were able to participate at mathematical congresses and conferences: even Fields Medallists and invited speakers were denied permission to go to the ICMs!

The situation has now changed drastically. At the Zurich, Berlin and Barcelona Congresses there were hundreds of participants from Russia. But we are now faced with new problems. On the one hand there are now no serious obstacles to going abroad and having contact with colleagues from the West; indeed, many mathematicians from Russia and the former Soviet Union, as well as many emigrants of the 1970 and 1980s, now have permanent or temporary positions in the West, and this must simplify and intensify contact and cooperation. On the other hand the problem is how to make this cooperation more efficient and, most importantly, how to preserve mathematics in the Eastern countries.

Moreover, there are now many special grants for Eastern Europe, such as those organised by the Sorosz Foundation, the AMS and Promatematika (France). They were rather small, but well organised. There are also a few local grants in Western countries such as Germany and Holland which are given to mathematicians from both East and West – a great and disinterested form of support that has provided a good illustration of the solidarity of mathematicians. At the same time there have been many complaints about the INTAS-system from Brussels; for example, one of the INTAS grants finished two years ago but participants from Moscow, St Petersburg and Niznii Novgorod did not obtain their salaries and nobody from Brussels answered their e-mail messages. I think that one of the roles of EMS and its East European Committee is to help with this. It is important to understand that it is still very difficult for Eastern Europeans to communicate with bureaucrats from the EC.

I believe that there must be more joint research teams in various areas, as well as more visits to Russia from the West; there are now fewer visits than during the years of stagnation. But during the last decade the mathematical community in Russia and the Eastern European countries has undoubtedly started to return step-by-step to World community, although they have made only the first few steps.

Another very serious problem relates to visas for visits to other countries. I understand that this is a question for bureaucracy at the very highest level, but my impression is that the scientific community can at least raise the question. The procedures for obtaining visas to many countries is very complicated and humiliating, and remains one of the worst Soviet legacies. Invitations from universities to respectable scientists (including young ones) must be given preference and must be freed from such procedures.

But the main problem is still the problem of how to prevent decay in our mathematics. The traditions of the Russian mathematical schools are distinguished and different from the West. It is completely wrong to say, as I have heard many times (especially from some former Russians), that there are now no serious mathematicians in Russia – we have many outstanding mathematicians and most seminars and schools are still active.

But what is true is that we are in a critical situation, and the essential question is about young mathematicians. Russia had, and still has, an excellent mathematical education in the elementary and high schools, and particularly in the special mathematical schools. So we still have enough young and talented people who want to study mathematics. But the miserable stipends awarded to students (undergraduate and graduate) as well as some living difficulties have forced most students who have already finished university either to drop mathematics for other things (computing or business) or to go abroad. My colleagues and I have received many letters from the West requesting us to send our former students to other countries for graduate school or postdoctoral positions. Indeed, the students from Russia have a high reputation.

In a sense, the brain drain is a natural thing. But we must pay attention to the fact that the collapse of Russian mathematics would be catastrophic for world mathematics. In order to prevent this disaster we need to keep at least some young mathematicians in our community. If most of them leave just after finishing at university, it is bad for both sides. It is clear why it is bad for the Russian mathematical schools, but it is now clear – and we have some statistics – that in general they will not stay in mathematics in the West either. They arrive without sufficient grounding from their Russian mathematical school, so they need to start their education from the beginning. At the same time difficulties arising from their first period abroad forces many of them to go to computer centres or banks.

There are many solutions to this paradox. First, it is possible to establish common graduate schools – say, between a university in Russia and another in Germany, with two advisors whose areas are close to each other, so that a student can share his/her time between the two countries. Alternatively, one could establish a few special sufficiently high stipends for our graduate students enabling them to make short visits to a western university. The absence of such special programmes for short visits by young mathematicians is a major deficiency of our interrelations. We must try to correct this – for example, we recently held a special conference for young mathematicians from Moscow, St Petersburg and Stockholm on dynamical systems and combinatorics. It would be good if such meetings could become a frequent occurrence in Europe.

In July 2001 we will hold the first European summer school in Russia, which should provide opportunities for contacts between young mathematicians (see *EMS Newsletter* **37** or the website: *http://www.dmi.ras.ru/EIMI/2001/emschool/index.html*).

At the round table during the Barcelona Congress I suggested the establishment of 30-40 stipends (from UNESCO, the EC, UNTAS, etc.) to be awarded to the best Russian (and other Eastern European) graduate students, so that they can spend time in their countries and can devote themselves to mathematics for 2-3 years, without having to search for a job. In our dramatic situation this gives a chance for our mathematics to survive during a difficult period.

In conclusion, I wish to say that the role of EMS and EC should be more constructive in all these aspects. My impression is that recently we have concentrated too much on technical questions, such as links between EMS and other organisations, institutes, and so on. It is more important to work with local societies to encourage contacts and interrelations by organising appropriate European conferences.

It is also very important to pay much more attention to the organisation of the four-yearly European Mathematical Congresses. In future, they must be more balanced – both geographically, and by subject area – and more original, and must provide a real forum for all European mathematicians. It is important to have a better financial base for the EMS, and I think there are possibilities for this. There is a similar question about the EMS council meetings which take place each two years. They must be more widely based and less technical; it is better for the EMS Executive Committee to discuss and solve such technical problems previously.

EMS Committee for Women and Mathematics

Correction

The September issue of the *EMS Newsletter* contained a short account of the EMS Committee for Women and Mathematics. Unfortunately, the author's name and e-mail address given there were incorrect, for which the Editor apologises. The contact details of the author and Committee Chair are: Emilia Mezzetti, Dipartimento di Scienze Matematiche, Università di Trieste, Via Valerio 12/1, 34127 Trieste, Italy; *e-mail: mezzette@univ.trieste.it*

New Members of the Executive Committee

At the Council Meeting in Barcelona, Victor Buchstaber and Mina Teicher were elected to the Executive Committee, and Marta Sanz-Solé was re-elected. A mini-biography of Marta Sanz-Solé appeared in EMS Newsletter 32; biographies and statemnts of the others appear below.
Thanks were given to Andrzej Pelczar and Anatoly Vershik who leave the Committee after several years of service.

Victor M. Buchstaber (*e-mail: buchstab@ftri.extech.msk.su*) graduated from the Moscow State University (MSU) in 1969 and went on to postgraduate study there, with advisors Sergei P. Novikov and Dmitri B. Fukhs. He received a Ph.D. in 1970 and a Dr.Sc. in 1984. He has been Research Leader of the Topology Division of the Steklov Mathematical Institute of the Russian Academy of Science, Professor in Higher Geometry and Topology at the MSU, and Head of the Mathematical Modelling Division at the National Scientific and Research Institute for Physical, Technical and Radio-technical Measurements.
He has been on the Council of the Moscow Mathematical Society, Deputy Editor-in-Chief of *Uspekhi Mat. Nauk*, and Head of the Expert Committee in Mathematics in the Russian Foundation for Basic Research.

Statement: I represent the Moscow Mathematical Society (MMS), one of the oldest in Europe (1864). I believe that the EMS must play an important role in developing and deepening the relations between its corporate members, leaning on the best achievements of the national mathematical societies. The eminent achievements of the MMS over the past 60 years have undergone a period of rapid fruitful development with a world-wide reputation.
Thinking over the experience of the past, the following approaches to organising the life of a mathematical society seem the most significant:
- *strong relations between mathematical schools working in different directions, maintenance of generation succession in mathematics, and involvement of new young talent;*
- *stimulating interest in modern achievements of mathematics, while nourishing a love for, and respect towards, its classical results. The importance of this approach can be demonstrated by the bright and deep applications of classical Abelian function theory and algebraic geometry to the top modern problems of mathematical physics;*
- *raising an interest in the sciences related to mathematics, considering them both as spheres of application and as important motive forces and grounds for further development. As a convincing example, ideas from physics, especially quantum field theory, have affected the modern state of mathematics.*

I see my participation in the work of the EMS Executive Committee, in connection with promoting and putting into life these approaches.

Mina Teicher (*e-mail: teicher:macs.biu.ac.il*) is Chair of the Mathematics and Computer Science Department and Director of the Emmy Noether Research Institute for Mathematics (Minerva Center) at Bar-Ilan University in Ramat-Gan, Israel.
She received her Ph.D. from Tel-Aviv University for a thesis entitled 'Factorization of birational morphisms between 4-folds'. Since then, her research interests have developed into geometry and topology, group theory, artificial vision, and mathematical models in brain research. She has travelled widely, spending the year 1981-82 at the Institute for Advanced Study, Princeton, and paying short-term visits to countries ranging from China, Japan and Tibet, to India and South Africa.

Statement: The EMS should acquire the financial means to enable it to support a broad spectrum of activities on a large scale, and should work to enhance governmental and public attitudes towards mathematics. To achieve this we should:
- *establish The Society of Friends of the EMS to promote donations, public awareness, government contacts, etc.;*
- *strengthen the scientific relationship with European-based industries and encourage their financial investment in basic research via the EMS (and individual institutions);*
- *convince Ph.D. students to join the EMS;*
- *work, through governmental and other means, to influence the EU to develop new programmes better suited to mathematics and to non-governmental organisations like the EMS.*

Concerning Mathematics Education, we should work towards:
- *a unified curriculum based on the current advanced high-school European programmes;*
- *programmes for the identification and education of especially talented high school students (where they do not already exist), especially in underprivileged regions.*

Executive Committee meeting

London, 11-12 November 2000

Tuulikki Mäkeläinen and David Brannan

Present: Rolf Jeltsch (President, in the Chair), David Brannan (Secretary), Olli Martio (Treasurer), Bodil Branner, Doina Cioranescu, Luc Lemaire, Andrzej Pelczar, Renzo Piccinini, Marta Sanz-Solé and Anatoly Vershik; (by invitation) Victor Buchstaber, Tuulikki Mäkeläinen, David Salinger, Mina Teicher and Robin Wilson; and (by invitation to a portion of the meeting) Chris Lance, Ari Laptev, Anders Lindquist, Ulf Persson and Bernd Wegner. Apologies were received from Carles Casacuberta.

The President thanked the *London Mathematical Society* for its hospitality.

Officers' reports

The *President* reported that Volker Mehrmann had moved to the Technical University of Berlin, allowing closer cooperation with Bernd Wegner. He had visited Nigeria's first national mathematical centre in July; IMPA in Rio de Janeiro for the Latin American Congress; the University of California at Los Angeles for the opening of its Institute of Pure and Applied Mathematics; and Budapest for the Rényi Institute celebrations. On behalf of the President, Bodil Branner and Bernd Wegner had attended a meeting in Lecce, Italy, on Information Science and Libraries in Mathematics; Luc Lemaire had attended a celebration of the French EMS Prizewinners in Paris; and Jean-Pierre Bourguignon had represented the EMS at the RPA event on 11 November in Portugal.

It was agreed to accept an offer from Oxford University Press (OUP), who publish the journal *Interfaces and free boundaries*, of a discounted price of US$65 instead of US$90, to members of the EMS; the arrangements will be publicised in the *Newsletter* and in EMIS. A section in EMIS will shortly be started outlining EMS members' membership benefits, such as the OUP and International Press discount offers.

The *Secretary* reminded Committee members of the Executive Committee (EC) that the EMS covers the expenses of EC members and others invited to EMS meetings, for expenses incurred in connection with the meeting if they cannot be covered from other sources, but that the local host society pays all local expenses of EC members and others invited to EMS meetings.

The *Treasurer* reported that there are now few complications with collecting corporate member fees, and that the Society now has a well-functioning system for invoicing for advertisements in the *Newsletter*.

Membership

EMS membership currently stands at around 2000. It was agreed that membership drives are needed in various countries.

Several possible new *Corporate Member* applications seemed to be coming into the pipeline. The benefits of the EMS having a contact person with each corporate member were also emphasised.

The reciprocity agreement with the *Australian Mathematical Society* had now been signed, and it was hoped soon to agree a reciprocity agreement with the *Canadian Mathematical Society*. The possibility of the EMS forming reciprocity membership agreements with further societies was also discussed and approved. The EMS routinely exchanges the *EMS Newsletter* with those of its reciprocity societies.

EMS President Rolf Jeltsch (left) and London Mathematical Society President Martin Taylor

Matters agreed by electronic voting since the previous EC Meeting

Laurent Guillopé was elected as Chair of the *Data Base Committee* for the period 2001-2004; Christian Houzel was elected as the EMS representative on the *Abel bicentennial conference programme committee*; the reciprocity agreement with the Australian Mathematical Society was accepted; Bernd Wegner was elected as Chair for the *Electronic publishing committee* for the period 2001-2004; and the meeting *Parallel processing and applied mathematics 2001* (PPAM 01) was accepted as an EMS-SIAM satellite meeting.

European Congresses of Mathematicians (ECM)

A lengthy discussion was held of a possible site for *4ecm, The Fourth European Congress of Mathematicians*, in summer 2004. It was hoped to be able to finalise the site selection by the end of 2000. It was noted that the dates of the meeting must be carefully coordinated with those of ICME (The 10th International Congress of Mathematics Education), which will be held in Denmark, in the week of 4-11 July 2004.

There was a brief discussion of the composition and operation of the Scientific Committee, and of how different aspects could be taken properly into consideration. The Executive Committee felt it important that ECMs attract all active mathematicians in Europe, not just the top mathematicians and new mathematicians. Various ideas to improve the working of the various committees set up for the Congress by the EMS were discussed, and the importance of close collaboration between local mathematicians and the various committees was emphasised.

Among the topics raised in the interesting discussion of a site for *4ecm* were:
– why the ECM should be held in a particular location;
– what was the purpose of the ECMs?;
– possible benefits to the local mathematics community;
– the possibility of many satellite meetings;
– having an accent on young people;
– the differences between an ECM and an ICM, including mini-symposia, round tables, etc.; it was thought that local organisers should be encouraged to think widely as to the actual format of the whole event;
– the possibility of involving the various European Union 'networks'.

The Executive Committee wanted *Scientific Committees* to choose a wide range of topics for speakers; to interest as many people as possible across both pure and applied mathematics; and to discuss whether the lectures should be shorter than in the past, in order to accommodate more lectures and to avoid listeners losing interest after a while.

The Committee agreed that there is a clear need for establishing rules for the *EMS Prizes* for 2004 and later; for the timing of the Prize Committee's activities; for the working of the Prize Committee and selection of candidates, including the age limit (currently 32), gender balance, geographical distribution and definition of 'European' in this context; for the balance between pure and applied mathematics; and for the call for nominations and timetables. The identity of the Chairman of the Prizes Committee will be known publicly from the start, and an open invitation for nominations for prizes will be publicised.

The Committee expressed its thanks to the local organisers of *3ecm*, especially Marta Sanz-Solé, for an efficient and friendly organisation of the *3ecm in Barcelona* in July 2000. The first volume of the Proceedings will include the plenary lectures, section lectures, mini-symposia and presentations of the prizewinners. The second volume will consist of material from the round tables, including contributions from panellists and discussions. The Proceedings are planned to come out in the first part of 2001.

David Brannan and Mina Teicher were appointed as an *ad hoc* Committee to prepare a set of rules and a schedule for the operation of the Prize Committee for EMS Prizes for 2004 and later; they were asked to report to the March meeting of the Executive Committee.

Stop Press: It has just been announced that the European Congress in 2004 will be held in Stockholm (Sweden).

Council Meeting in Barcelona on 7-8 July 2000

There was a discussion of various *possible changes for the following Council meeting in 2002*. Among the topics were:
– should elections be held for individual members' delegates in any case?
– should a Committee member (or its Chair) present the report of each EMS Committee, in order to stimulate a discussion on topics of interest to delegates?
– how could EMS activate people between meetings?
– should delegates be encouraged to start a discussion?
– projects where EMS is a partner, like LIMES and EULER (see below), should be presented; in Oslo a presentation on the proposed EMS publishing house was suggested.
– highlights of the past two years should be put forward;
– of the two days of the Council, perhaps one day could be for business matters and the second day for discussions, or a seminar for planning the future.

The *French delegation* to the Barcelona Council meeting had expressed the wish for EMS to have more interaction with corporate members, and the *Italian Mathematical Union* had also expressed a wish for more frequent exchange of information. It was agreed to discuss these matters at Kaiserslautern in spring 2001.

The next *Council meeting* will be held on Saturday-Sunday 1-2 June 2002 in Oslo, Norway, with the first session starting at 10 a.m. on 1 June.

Changes of EMS Statutes

The Committee discussed various items of the EMS Statutes and EMS By-laws that seemed to require change, noting that any change in the Statutes need the approval of the Finnish authorities, but that changes in the By-laws do not require such approval.

Among the topics were: the possibility of allowing mathematics departments to become EMS members; the notion of a President-elect and a Past President; the need for gender and geographic and pure-applied balance in the EMS; the idea of Officers having 2-year terms, not 4-year terms; whether the President needed to be a Council delegate; how to expel EMS members who do not pay their dues; allowing reciprocity membership; the possibility of joining EMS via the EMS-*Zentralblatt* scheme; and omitting Articles 5.10 and 5.8.

Andrzej Pelczar, David Brannan, Olli Martio and Mina Teicher were elected to an *ad hoc* committee to formulate the changes needed to the EMS Statutes.

EMS Projects

The Committee decided to organise a meeting of its member societies (especially those with a strong interest in applied mathematics), applied mathematics societies outside EMS, European Union mathematics networks, and some influential individual European applied mathematicians in spring 2001 to increase the *visibility and acceptance of EMS among the applied mathematics community*, to involve them in shaping future EMS policy, and to help make them feel at home within the EMS.

The EMS had received encouragement from several sources for the creation of a *publishing house* and preparations had proceeded both by e-mail and at meetings in Zurich and London. The Committee decided that a foundation should be created to be the legal owner of the publishing house, called the *European Mathematical Foundation*, 'EMF', with its seat in Switzerland. Swiss law places no restrictions on the nationalities of the persons involved; in Switzerland a foundation can have tax-free status; it will be a non-profit organisation; and the Statutes must be accepted by the Swiss authorities. The Publishing House will be a legal body separate from the EMS. The EMS logo will be used for the EMF, but inserting the abbreviation EMF instead of EMS.

The Committee decided to commit 10000 euros to be the founding capital of the European Mathematical Foundation. The tasks of the EMF will be to establish and run the publishing house; any surplus could be used to support the work of the EMS.

Rolf Jeltsch and Jean-Pierre Bourguignon had attended the meeting of the *Zentralblatt Consultative Committee* in Berlin at the end of October. It was noted that management of the subscribers' list has now been moved to the editorial office, and that the price of *Zentralblatt* is below the price of *Mathematical Reviews*. The *Jahrbuch* project has now a coverage of 70%, of which 40% has been edited by experts so far.

It was agreed to send a paper to *EU commissioner M. Busquin* describing the importance of the *Zentralblatt/MATH* database as a *Large European Infrastructure*.

The *LIMES project* [Large Infrastructure in Mathematics – Enhanced Services: for details, see *EMS Newsletter* **37** or the website *www.emis.de/projects/LIMES*] started officially in April 2000, and a meeting had been held to divide the tasks: data improvement, input structure and national access nodes. The EMS is a supervising body for the project. The director of the project is Michael Jost; Bernd Wegner and Rolf Jeltsch are the Scientific Directors. The partners are: FIZ Karlsruhe (*Zentralblatt-MATH*, Berlin) (Coordinator); Cellule de Coordination Documentaire Nationale pour les Mathématiques; Eidetica; Coordinamento SIBA, Università degli Studi di Lecce; Danmarks Tekniske Videncenter & Bibliotek; Universidade de Santiago de Compostela; Hellenic Mathematical Society; Technische Universität Berlin; and the European Mathematical Society. There would be a workshop in December for the partners and editorial units, and a later meeting in Copenhagen would be held in April 2001.

The *2000 Mathematics Subject Classification* is a joint project of *Zentralblatt* and *Mathematical Reviews*. It was agreed that the EMS should be one owner of the copyright to the classification, the other being the American Mathematical Society. The reason for ownership of the copyright having to be made clear was in order to avoid abuse of the classification, not in any way to limit its free usage.

The President reported that he had signed the papers for EMS involvement in *Zentralblatt for Didactics of Mathematics*.

Bernd Wegner made a brief presentation to the Executive Committee of the *EULER Project* (European Libraries and Electronic Resources in Mathematical Sciences – for details, see the website *www.emis.de/projects/EULER*) and gave a demonstration of EULER during the lunch break. Its current server is in Göttingen. Its purpose is to provide access via a search engine ('EULER') to access various web resources, including OPAC, databases, preprints, e-journals, and WWW catalogues using a common metadata profile method for providing a homogeneous access to heterogeneous resources. The project has developed a metadata maker with a de-duplication facility, and has tested a beta version. The project had received very high marks from its reviewers.

The *partners in the Euler Project* were: The State Library of Lower Saxony and the University Library of Göttingen; the J. Hadamard Library, University of Orsay; the Centrum voor Wiskunde en Informatica library, Amsterdam; the University of Florence; the library of the Institut de Recherche Mathématique Avancée, University of Strasbourg; NetLab, the Research and Development Department at Lund University Library; MathDoc Cell, Grenoble; FIZ Karlsruhe; Zentralblatt für Mathematik; EMS; and the Department of Mathematics of the Technical University of Berlin.

The EULER Project had formally terminated in September 2000. The Executive Committee felt that there is a need for a product like EULER; that EULER provides good tools; that effort is needed for further development – e.g., to provide searchable data and to become more user friendly; and it decided that the EMS should join the consortium to continue work on the EULER Project – as a 'sponsoring partner', rather than a source of manpower or finance.

It was reported that the EU-funded *Reference Levels Project* will have a final meeting in in May 2001 (a report of the working group was nearly ready), and that the contract on *TOME* [Test of Mathematics for Everybody] would be signed on 16 November 2000.

Bernd Wegner addresses the Committee on the Euler project

EMS Committees

It was decided that the *Electronic Publishing Committee* will be chaired by Bernd Wegner in 2001-2004; and that the other members of the committee will be: Slawomir Cynk, Laura Fainsilber, Aviezri Fraenkel, Eva Bayer-Fluckiger, Laurent Guillopé, Hvedri Inassaridze, Michael Jost, Jerry L. Kazdan, Volker Mehrmann, Peter Michor, Andrew Odlyzko, Colin Rourke, Laurent Siebenmann, Jan Slovak and David Wilkins. The committee will be responsible for all aspects of electronic publication, and will develop a new remit.

The composition of the *Education Committee* will be discussed at the March meeting of the Executive Committee.

It was reported that Laurent Guillopé had accepted to serve as chair to the *Database Committee*, with the term 2001-2004. The Executive Committee agreed that the other members of the Database Committee should be: Francisco Marcell'an, Alberto Marini, Steen Markvorsen, Peter Michor, Marek Niezgodka and Bernd Wegner.

It was agreed to invite *ERCOM* members [Committee on European Research Centres of Mathematics] to write on their web home pages that they are members of the EMS, to use the EMS logo there too, and to keep the EMS fully informed of discussions between themselves and the EU.

The purpose of ERCOM is to enable member institutions to discuss matters of mutual interest, to enable them to approach funding bodies (such as the European Union) with a wider scientific and geographic base than individual institutions can, to facilitate the exchange of information, etc.

It was agreed to add Georg Bock, Tsou Sheung Tsun and Doina Cioranescu to the membership of the *Committee on Developing Countries*.

It was agreed to add George Jaiani and Victor Buchstaber to the membership of the *Committee on Support for Eastern European Mathematicians* (CSEEM). The annual budget of the CSEEM was 10000 euros, and they had supported around thirty mathematicians in 2000. It was felt that there was a continuing need to improve contact between the committee and mathematicians in Russia – but the total resource was of necessity limited. The idea that EMS member societies should help to disseminate information on the Committee's activities was welcomed.

The Committee received a report on a meeting for *Large Infrastructures*, held in Strasbourg, and noted that mathematics is included in six different programmes, going across several DGs. It considered a set of possible future projects with the European Union, including discussion of the Sixth Framework Programme.

It was agreed that a draft of the *Executive Committee agenda* should be circulated beforehand to committee chairs, with an invitation to them to suggest agenda items and supply discussion papers – possibly around three weeks ahead of an EC meeting; and that Committee Chairs should be added to the *Newsletter* mailing list if they are not already EMS individual members.

Diderot Mathematical Forums (DMF)

The Committee held a general discussion of its *Diderot Mathematical Forum* programme, including items such as whether they actually worked well, whether it would be easier to set them up with only two simultaneous sites rather than three, the critical dependence on local organisers, and the need for the dates/locations of DMFs to be advertised well and ahead of time. Plans for the Fifth Diderot Mathematical Forum, probably on Telecommunications, were moving ahead.

Summer Schools

The EMS has two summer schools planned for 2001. The *Prague Summer School* has received funding from the European Science Foundation. The *St Petersburg Summer School* (which will be held at the Euler Institute) has received support from the US National Science Foundation, the American Mathematical Society, and CNRS (France). AMS cooperation in gaining support swiftly and smoothly from NSF for the summer school had been much appreciated. The EMS had given a 5000 euro guarantee to the St Petersburg Summer School.

Applications for Summer Schools in 2002 in *Brasov* and in *Israel* (on Geometry and Coding) were accepted.

The composition of the *Summer Schools Committee* was recalled as: R. Piccinini (Chair 2000-2003), C. Broto, C. Casacuberta, D. Cioranescu and R. Fritsch; M. Teicher was added to this list.

EMS Lectures

It was agreed to invite *Michèle Vergne* to give the EMS Lectures in 2001, possibly in Rome and Malta.

The lecture notes of *Nigel Cutland* (1997 EMS Lecturer) on *Loeb Measures in Practice: Recent Advances* will appear soon as *Lecture Notes in Mathematics* **1751**, published by Springer-Verlag.

Relations with various institutions and organisations

It was reported that the Venice office of *UNESCO* has awarded the EMS a grant of US$25000 to support various EMS activities in 2000.

Plans are in hand for the joint *EMS-SIAM Conference* to be held in Berlin on 2-6 September 2001; full details will appear in the *EMS Newsletter*. There will be a reduction in the conference fee for the meeting for EMS members. The International Conference on Stochastic Programming in Berlin on 25-31 August 2001 (with about 150 participants) was awarded the status of a satellite meeting of the conference.

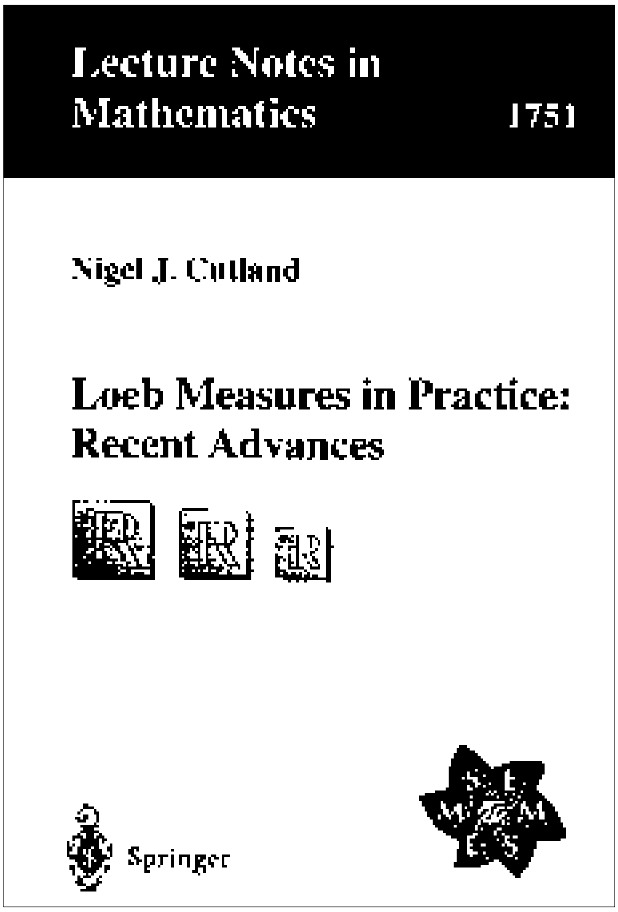
The Committee received a report on the activities of the *Banach International Center* from its representatives on the Center's Scientific Committee: F. Hirzebruch; M. Sanz-Solé; D. Wallace (1998-2001).

The Society had been informed of the intention of establishing an *Institute for Scientific Information at the University of Osnabrück*, devoted to mathematics-related activities, especially in support of the MPRESS project. The institute is to have both institutional and individual members. It was decided that the EMS should be involved in the plans for the Institute, and that Rolf Jeltsch should attend the founding meeting of the Institute on 30 November 2000, if possible.

Rolf Jeltsch was appointed as the EMS representative to *ICIAM* [International Council of Industrial and Applied Mathematics] during 2000-2003.

The *Publicity Officer* reported on the success of the EMS booth at *3ecm* in Barcelona, commenting that the practice of sharing a booth with *Zentralblatt* should be repeated; the Executive Committee thanked Tuulikki Makelainen and Mrs Martio for their invaluable efforts in staffing the EMS booth in Barcelona. It was agreed to produce a number of high-quality posters with the EMS logo, for decoration of EMS booths at various future meetings. The article that David Salinger had written for the LMS newsletter should be sent to all EMS corporate members, for them to adapt to local situations.

At the *GAMM annual meeting* in Zurich on 12-15 February 2001, EMS will share a booth with *Zentralblatt*.


Lecture Notes in Mathematics 1751

Nigel J. Cutland

Loeb Measures in Practice: Recent Advances

Springer

Title page of Nigel Cutland's book (see EMS Lectures, above)

EMS Newsletter

The contents of the *Newsletter* were applauded by the Committee.

There had been repeated requests to have the *Newsletters* on EMIS. The articles of the 1999 issues of the *Newsletter* would shortly be sent as text files to EMIS.

The Committee noted that the question raised at the Barcelona Council meeting about the uneven distribution of the book reviews of different publishers was being studied by the Editor-in-Chief.

Future meetings of the Executive Committee

The following outline schedule was approved:

10-11 March 2001: ITWN Kaiserslautern
1-2 September 2001: Berlin, prior to the EMS-SIAM Conference.

Reciprocity arrangement

Following the reciprocity arrangement signed in July with the American Mathematical Society (see *EMS Newsletter 37*, page 8), a further reciprocity arrangement was signed in Shanghai on 21 October 2000 with the Australian Mathematical Society.

EMS Summer School in Edinburgh

Erkki Somersalo

The European Mathematical Society Summer School on *New Geometric and Analytic Methods in Inverse Problems* was held in Edinburgh, Scotland, from 24 July to 2 August. It was combined with a meeting on *Recent Developments in the Wave Field and Diffuse Tomographic Inverse Problems*, from 3-5 August. Both meetings were supported by the European Commission and the London Mathematical Society. The Organising Committee consisted of Professors Yaroslav Kurylev (Loughborough University, UK), Brian Sleeman (University of Leeds, UK) and Erkki Somersalo (Helsinki University of Technology, Finland). The conference was organised in collaboration with ICMS at Heriot-Watt University.

Why geometry and analysis?

Inverse problems constitute an active and increasing field of applied mathematics. Roughly speaking, in inverse problems the aim is to retrieve information of inaccessible quantities based on indirect observations. A typical inverse problem is an inverse boundary value problem of a partial differential equation, where the objective is to reconstruct the unknown coefficient functions of the equation in a domain, based on a knowledge of the boundary values of its solutions. Application areas of such problems include medical imaging, geophysical sounding and remote sensing.

The whole area of inverse problems is far too wide to be covered in any single summer school or meeting. In the present one, the focus was on modern geometric and analytic methods applied to inverse problems. The role of differential geometry in inverse problems is becoming increasingly significant as more complex systems are studied.

To get an idea, one can consider the inverse conductivity problem. In physical terms, the goal is to reconstruct the electric conductivity of a body by injecting electric currents into the body and measuring the voltages at the surface. In 1980, Alberto Calderón published a groundbreaking article in which he formulated the mathematical problem, and since then, considerable progress has been achieved in the mathematical research of this problem. Despite the efforts, several aspects of this problem are still open, in particular when the conductivity is allowed to be anisotropic (direction dependent). It turns out that the anisotropic problem can essentially be rephrased in terms of differential geometry: can one reconstruct the Riemannian metric of a manifold from the knowledge of the Cauchy data of the Laplace-Beltrami operator? This rephrasing, of course, brings the well-developed machinery of Riemannian geometry to our disposal. Currently, new ideas and techniques are sought in the direction of differential geometry to treat this and other anisotropic inverse problems.

Heriot-Watt University lecture theatre

Erkki Somersalo and Jari Kaipio

The need for new ideas coming from harmonic analysis and control theory is also recognised among the inverse problems community. Almost every boundary measurement carries inherently a boundary control problem: inversion techniques often rely on ideas such as focusing of waves or, more generally, sounding by waves of prescribed form. The need to recover discontinuities and other singularities of the coefficient functions requires techniques for treating partial differential equations with non-smooth coefficients. These are only a few of the problems of interest in this field. The emphasis of the EMS Summer School programme was on harmonic analysis and control theory of partial differential equations.

One of the most important motivations for the choice of the summer school topic was to bridge the gap between the realms of pure and applied mathematics. It is vital for the high quality of mathematical research in Europe that the young generation of applied mathematicians have the most advanced tools at their disposal; it is equally important for pure mathematicians to have some insight into the possibilities in applied areas of their research.

Participants

The summer school lecturers were Professors Victor Isakov (University of Kansas, USA), Dmitrii Burago (Penn State, USA), Vladimir Sharafutdinov (Novosibirsk, Russia), Lassi Päivärinta (University of Oulu, Finland), Anders Melin (University of Lund, Sweden), Gunther Uhlmann (University of Washington, USA), Alexander Kachalov (Steklov Institute, St. Petersburg, Russia) and Dr Matti Lassas (University of Helsinki, Finland). The participants were mostly graduate students and young researchers from the EU area and associated countries. The summer school and the conference also attracted a number of first-rate researchers on inverse problems from all over the world, the total number of participants amounting to over 70. The idea behind arranging the summer school together with a conference was to give the students and young researchers a view of how the newly acquired ideas work in current mathematical research. The written material of the summer school, as well as a selection of the invited talks, will be published as lecture notes.

Erkki Somersalo teaches at the Institute of Mathematics, Helsinki University of Technology.

Joint AMS-Scandinavia meeting June 2000

Hans J. Munkholm
Chair of the Organising Committee

The first joint meeting of the American Mathematical Society and the Mathematical Societies of Denmark, Finland, Iceland, Norway and Sweden took place in Odense, Denmark, from 13-16 June 2000. It was simultaneously the twenty-third in a sequence of Scandinavian Congresses of Mathematicians which started in Stockholm in 1909.

Plenary lectures were delivered by Tobias Colding (New York), Nigel J. Hitchin (Oxford), Johan Håstad (Stockholm), Elliott Lieb (Princeton), Pertti Mattila (Jyväskylä), Curtis McMullen (Harvard), Alexei Rudakov (Trondheim), Karen K. Uhlenbeck (Austin) and Dan-

Virgil Voiculescu (Berkeley). In addition there were more than 100 lectures in twelve special sessions.

Titles and abstracts for (almost) all the lectures are available through the conference home page: *http://www.imada.ou.dk/$\sim$hjm/AMS.Scand.2000.html*

There were 269 registered participants, roughly 25% of whom came from the United States. Another 25% were Danes, while the rest of Scandinavia accounted for 19%. The remaining 31% represented twenty different countries, with France and Germany as the major contributors.

11th ECMI Conference (ECMI2000)

Vincenzo Capasso, President of ECMI

ECMI2000, the 11th Conference of ECMI (The European Consortium for Mathematics in Industry) was held in Palermo (Torre Normanna) from 26 to 30 September 2000. There were about 270 participants from 24 countries, with more than 200 speakers, including nine plenary lectures, 37 mini-symposia (many organised in collaboration with industry) and about 50 contributed talks. About 10% of the participants were industrial delegates. Everybody felt that an ECMI conference provides an excellent forum for discussing the role of mathematics in (and for) industry at a European level.

As usual, the conference was organised around industrial themes, as they are the ECMI's Special Interest Groups. The focus topics of the conference were micro-electronics, glass, polymers, composite materials, fuel pipelines, finance, biomedical, ecosystems, multi-body dynamics, information and communication technologies, automatic differentiation and sensitivity analysis, scientific computing and visualisation. Most of the mini-symposia showed unique examples of scientific coordination and collaboration at a European level for high quality research within the ECMI Special Interest Groups. Selected papers will appear in the newly established ECMI subseries of Springer volumes on *Mathematics in Industry*.

At the conference all appeared happy and enthusiastic; encouraged by the excellent environmental setting, clusters of people could often be seen discussing future collaboration. Particularly relevant was the large participation of young scientists, most of whom had been involved in the ECMI's educational activities – in particular, the modelling weeks that have greatly contributed to establishing long-lasting bridges between European students. Most of those who had participated in these modelling weeks were among the speakers and mini-symposium organisers.

Highlights of the conference included the 'Alan Tayler lecture' delivered by Helmut Neunzert, the 'Wacker prize lecture' delivered by Carl F. Stein, a student from Gotheborg, and the ECMI honorary membership offered to Carlo Cercignani.

A delicious 9-course social dinner was organised in a princely palace in Palermo, after an excursion to the marvellous cathedral of Monreale, where a fusion of Byzantine, Arab and Norman architecture shows how Sicily was one of the fundamental melting pots of modern Europe.

The next ECMI conference will take place in 2002 in Latvia; information about it will be available on the ECMI web page: *http://www.ecmi.dk*.

Update on 3ecm Barcelona

The *Proceedings of 3ecm* were distributed to participants in preliminary form as a compact disc, and will be published in two volumes by Birkhäuser in its *Progress in Mathematics* series. Articles are also accessible as 'pdf' files on the *3ecm* website (*www.iec.es/3ecm*). There will also be a book of *Proceedings of the Round Tables*, edited jointly by the Catalan Mathematical Society and CIMNE. The videos exhibited during the Congress are distributed by Springer-Verlag in their VideoMath series, and are also available in DVD format.

The earlier list of Invited Lecturers omitted Nicolas Burq: *Lower bounds for shape resonance width of Schrödinger operators*.

The full list of participants at the mini-symposium on *Mathematical Finance: Theory and Practice* (Chair: Hélyette Geman) was: M. A. H. Dempster, Stanley Pliska, Dilip Madan, Ernst Eberlein, Tomas Bjork, Ton Vorst, Ezra Nahum and Rainer Schobel.

The talk by Charles H. Bennett in the mini-symposium on *Quantum Computing* was held by video-conference. The talk by Hans Föllmer had the title *Probabilistic aspects of financial risk*.

The Chair of the round table *How to increase public awareness of mathematics* was Vagn Lundsgaard Hansen; sadly, Felipe Mellizo died the week before the Congress. Jean-Pierre Bourguignon was a panellist at the last round table, not Rolf Jeltsch. Rafael de la Llave should be deleted from the list of panellists of the round table *Building networks of cooperation in mathematics*. He was in fact the Chair of the round table *The impact of new technologies on mathematical research*, in which Bruno Buchberger was a panellist.

Journal of the European Mathematical Society

Volume 3, Number 1 of *JEMS* contained:

D. Mucci, *A characterization of graphs which can be approximated in area by smooth graphs*

G. Bouchitté and G. Buttazzo, *Characterization of optimal shapes and masses through Monge- Kantorovich equation*

M. Harris and A. J. Scholl, *A note on trilinear forms for reducible representations and Beilinson's conjectures*

The World Mathematical Year in Europe

Vagn Lundsgaard Hansen (Chair of the EMS committee for the WMY)

with the assistance of Ronnie Brown and Mireille Chaleyat-Maurel

The World Mathematical Year is coming to an end and it is time to look back and ask ourselves: what did we accomplish? what did we learn? how should we proceed? The celebration of the mathematical year has taken place all around

the globe, for the language of mathematics is common to all peoples, and mathematics is independent of nations, religions and races. For good measure, it should therefore be said that when I focus this article mainly on what has happened in Europe, my intention is not to neglect the rest of the world but only to find a way of selecting events where European mathematicians have had the most direct opportunity to influence what has taken place during the year.

Conferences dedicated to the WMY

During the year 2000, several international conferences have been dedicated to the WMY. In most cases, the conferences would have taken place independently of this special occasion. Nevertheless, they have helped to make WMY2000 visible to mathematicians and in many cases they contributed to making mathematicians aware of the need for communicating mathematics to the public, by arranging discussions on this topic during the conferences. In particular, *3ecm*, the Third European Congress of Mathematics, which took place in Barcelona, Spain, from 10 to 14 July, contained a well attended *Round Table on Raising Public Awareness of Mathematics* (RPA).

A very special conference was arranged in Granada, Spain, from 3 to 7 July, as a satellite conference to *3ecm*. This conference was one of the main projects of the EMS-committee of the WMY and had the idea of bringing Europeans and Arabs together in the old city with the famous Alhambra, castle of the Moorish kings, to discuss the historical perspectives of both cultures to our present mathematical knowledge. It was a magnificent conference, and included a visit to the Alhambra, guided by the Spanish mathematician Rafael Pérez-Gómez who in the mid-1980s established that all the seventeen planar crystallographic groups are represented in the fascinating tilings at the Alhambra.

A short list of accomplishments

In almost all European countries at least one poster has been produced, motivated by the WMY, giving suitable links to places where further information about the year can be found. In several countries a series of posters were produced, usually based on ideas submitted for the poster competition, arranged by the EMS and collected in the ems-gallery at *http://www.mat.dtu.dk/ems-gallery/*. Series of posters have been produced in Belgium, Portugal, Spain, Italy, France, Germany, the UK, and other countries, while sets of postcards based on ideas from the EMS poster competition were produced in Denmark, France and Germany. Stamps related to WMY 2000 were issued in the following European countries: Belgium, Croatia, the Czech Republic, Hungary, Italy, Luxembourg, Monaco, Slovakia, Spain and Sweden. Mathematical exhibitions and workshops have been presented in Denmark, Finland, France, Germany, Italy, Portugal, Spain,

Robin Wilson as Edmond Halley at a WMY2000 lecture to schoolchildren at London's Royal Institution.

Sweden and the UK. Mathematical lectures for the general public have been presented in all countries, and there have been many mathematical articles in newspapers and magazines.

It has been interesting to observe the strongly varying degree to which it has been possible to catch the interest of radio and television in various European countries. In most countries it has been very difficult indeed – in fact close to impossible – with a few notable exceptions, like France. It might be useful, although difficult, to study at the European level whether there is a connection between the general status of mathematics in society and schools in the various countries and the willingness to

WMY2000 stamp from Monaco

present mathematics in the media. How can we otherwise explain the rather large variations?

Two projects funded by the European Commission

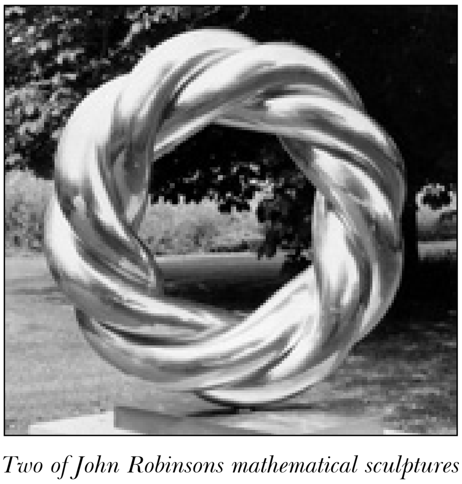
To help in raising public awareness of science and technology in Europe, the European Commission has funded a proposal in mathematics. The contract has three partners: the EMS, represented by its WMY-committee, with a coordinating role, and actual deliveries to be produced by a team based in Paris, and a UK-team based in Bangor. The proposal consisted of two projects for presentation in connection with the European Science and Technology Week (ESTW) from 6 to 12 November 2000. More information can be found at *http:/www.cpm.sees.bangor.ac.uk/rpamath/*.

As a result of the first project, twelve posters were presented during the ESTW in a series with the title *Les mathematiques du quotidien* (Mathematics in daily life), at locations in France, the UK and Denmark, with Paris as the central city. The production of such posters has been of considerable interest to schools, where teachers find it increasingly difficult to motivate and inspire pupils.

One result of the second project has

EMS Vice-President Luc Lemaire with European Commissioner Philippe Busquin and a WMY2000 poster that appeared in fifty Brussels underground stations, in the context of the RPA programme funded by the European Commission and co-organised by the EMS. The picture was taken at a science festival at the Université Libre de Bruxelles.

been the production by the Bangor team of a booklet on *Presenting Mathematics to the Public*, which was distributed to all participants of the *3ecm* with a CD-Rom of John Robinson's *Symbolic Sculptures*, donated by Edition Limitée. The major work has been the production by the Bangor team of a CD-Rom *Raising Public Awareness of Mathematics*, which mainly presents Mathematics and Knots, and Symbolic Sculptures. This was launched officially at meetings in Obidos (Portugal) on 11 November, and at Bangor (UK) on 16 November. The above-mentioned posters were also on exhibit at these occasions, together with posters in the London Underground produced by the Isaac Newton Institute, Cambridge.



Two of John Robinsons mathematical sculptures

What did we learn?

First of all, many more professional mathematicians have now gained first-hand experience that presenting mathematics to the public is non-trivial and difficult. The EMS Committee of the WMY has been deeply impressed by the dedicated work done by many individuals in several European countries, who have taken time out of their usual positions to work for the WMY project. It is important that we all work together in such endeavours and help with encouragement and by supplying good ideas. But everyone should be aware of the fact that realising a good idea usually needs hard work. Among the benefits of such efforts is that it enriches, and puts into perspective, your future work, not only as a mathematical educator but probably also as a research mathematician.

How do we proceed?

The main issue of the WMY has been to raise the public awareness of mathematics. This important task cannot be restricted to one particular year; it is an on-going process which will take time and needs constant attention. To continue the work begun by its committee of the WMY, the Executive Committee of the EMS has appointed a new committee with the acronym RPA; further information can be found at *http://www.mat.dtu.dk/persons/Hansen_Vagn_lundsgaard/rpa.html*

A major concern for the new EMS Committee is to ensure a continuing presence for mathematics at future ESTWs. This needs further support for the meetings involved in the planning and preparation of proposals to the European Commission. The experience gained from the first contract with the European Commission has been very valuable. The RPA-committee will be eagerly looking for good ideas that can form the basis for future proposals.

One of the first tasks of the RPA-committee will be to arrange a competition for the best newspaper article on mathematics. The competition will be announced at the beginning of 2001, allowing authors of articles published in national newspapers during WMY 2000 to submit the best of their work for the competition.

The RPA-committee of the EMS will also investigate the possibilities for establishing a web-site containing eps-files of posters (graphics only, but with open fields where texts in various languages can be added), possibly in connection with the ems-gallery. From the experiences gained in connection with the production of posters during the WMY, it is clear that such an archive will be of considerable value to future producers of mathematical posters.

It is also planned to create a web-site containing a collection of short mathematical web-stories directed towards secondary school pupils and the general public.

Altogether, the EMS Committee of the WMY finds that the year 2000 has been a terrific year for mathematics. Some of the results obtained may not seem impressive right at this moment, but as with many things related to mathematics, the products have lasting value and will have impact in years to come.

The Pre-history of the EMS

Aatos Lahtinen

There is nothing more untrustworthy than an eyewitness, except another eyewitness.
(Sir Walter Raleigh, 1552-1618)

Sir Walter Raleigh was one of the favourites of Elizabeth I. During the reign of James I he fell from grace and was finally imprisoned in the Tower of London. To pass the time Raleigh started to write a history of the world. There is a story that one day while writing he heard noises of tumult from the courtyard. Two other prisoners had started a violent fight which caused others to join in. Later the same day Raleigh tried to find out what had happened and interviewed several fellow prisoners who had been present. Everyone had a different opinion on the course of events. Raleigh, frustrated, tore his manuscript to pieces. (He changed his mind afterwards and started again!)

I have been asked to tell some of my reminiscences on the pre-history of our Society. While making an honest try I am aware that I am only one of the fellow prisoners of Sir Walter Raleigh.

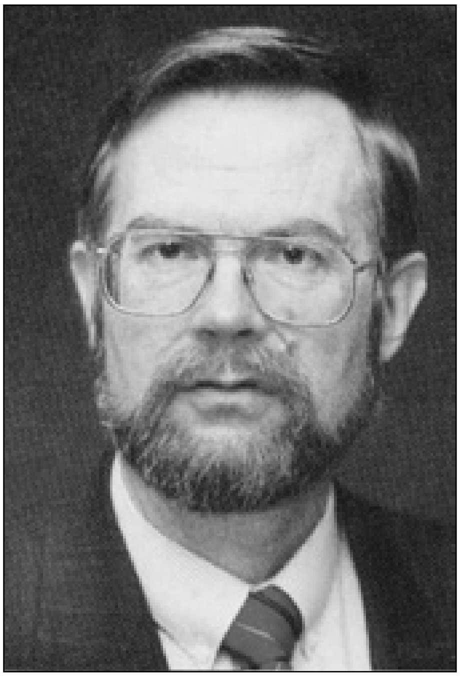
Prelude

The earliest attempt to form a European Society for mathematicians that I am aware of took place in the 1978 ICM in Helsinki. A meeting was organised to consider the foundation of a Federation of European Mathematical Societies. The possibility of founding a European Society with individual membership instead was also discussed, and it was admitted that the latter would give mathematicians a more immediate feeling of being members of the European Mathematical Community. However, a federation was preferred because it would involve considerable less organisation and expense.

One purpose of such a federation would be to provide a forum for exchange of information and for common action – in particular, the following were mentioned: the coordination, planning and publicity of conferences; fellowships and exchange visits; the sponsoring of research centres; the foundation of a Federation *Newsletter*; the fostering of cooperation between mathematical societies in matters of European interest.

During the discussions it turned out that, despite the positive attitude towards such an attempt, it was not possible to realise it. The only outcome was an agreement to form an informal body called the *European Mathematical Council* (EMC), under the chairmanship of Professor Michael Atiyah.

After Helsinki this informal body met in Oberwolfach (1980), in Warsaw (1982 and



1983) and again in Oberwolfach (1984). Representatives of some twenty societies participated at these meetings. Mathematicians from the USSR and DDR were present as observers. True, the ECM provided a forum for the exchange of information, but because of the informality, common action was scarce. The EMC carried out biannual surveys of prices of European mathematical journals, in the hope that these could be used to reduce, or at least maintain, prices of commercially published journals. The Council, however, had no effective means towards this aim.

The most imposing action initiated by the EMC was beyond doubt the *Euromath project*. It was a very ambitious idea for a gigantic mathematical database, together with a sophisticated system of data transfer, storing and editing. The database would contain all the mathematical knowledge in Europe, from preprints to monographs and reviews. In the 1980s this dream was too huge to be realised – even on a greatly reduced scale, the project was so large that it was separated from the EMC to become an independent project, and a legal entity called the *European Mathematical Trust* was founded for its upkeep.

This Euromath project proceeded with substantial financing from the European Community, but not at the pace that had been expected. An Euromath Centre was founded, by a Danish subvention, in Copenhagen. After many delays the project produced its first (and only) product, the *Euromath editor*. A widespread criticism was that this editor did not contain any essentially new features. It did not achieve any substantial success, and little by little the project was closed. As far as I understand, the parent European Mathematical Trust does not exist any more.

The idea of Euromath was attractive and worth trying, but it was before its time. In fact, in spite of the internet and the great progress with EMIS, we are still far away from the goal.

Liblice

I attended the meeting of the EMC in November 1986 at Liblice, near Prague. In addition to such normal items as 'Survey of journal prices' and 'Report of the databank committee (Euromath)', it contained 'Future activities and structure of the EMC'. In introducing this item the Chairman, Sir Michael Atiyah, pointed out that the present informal Council was not intended to be a permanent structure; for instance, the financial contributions to the EMC were on a voluntary basis and therefore small and erratic. Many Societies do not have their own means, and so have to justify the use of their funds to their Government; this makes the formation of a more formal association desirable. Such a body should also include the Moscow Mathematical Society. This formal body should have links with the International Mathematical Union (IMU), but not be dependent on it.

There followed a lively discussion in a positive atmosphere. It was commented that physicists and biochemists already have European organisations and that one would similarly benefit mathematicians. The new association must be so flexible that the participation of all European Countries would be possible. The European Mathematical Trust would be entirely separate, but its relation to the main body should be clarified. A form of federation would allow the formation of subgroups performing independent activities. An alternative to this Federation of European Mathematical Societies could be a European Mathematical Society with individual members.

It was decided that this formalisation of structure needed a more profound investigation before any decisions could be taken. A small committee was appointed to consider the subject, under the chairmanship of Sir Michael Atiyah. A draft of the committee's conclusions should be sent to the ECM member societies as soon as possible. A discussion of the committee's proposals would take place at the next meeting of the ECM in 1988.

Suggestions of the committee
The considerations of the committee were sent out in May 1988. It had decided that the best way to proceed was to formulate certain principles for discussion at the next ECM meeting.

The unanimous view of the committee was that the association would be a Federation of National Mathematical Societies. However, the membership should be defined more flexibly, because some countries have several mathematical societies while others have none. Also, it should be possible for institutional members to join. The membership fee would be related to the size and resources of the societies, but each society would still have only one vote at the Council, which was the supreme authority.

The Federation would be formally registered in some country, but the committee made no suggestion as to the location. They only pointed out three important factors:
– the legal arrangement for charities in the country;
– the stability and convertibility of its currency;
– the initial availability of mathematicians in that country prepared to assist in the establishment of the Federation.

For the problem of paying membership fees with non-convertible currencies, the committee suggested setting up a special East European Secretariat.

Oberwolfach
The next meeting of the EMC took place in Oberwolfach, 15-17 October 1988. In addition to the normal two days, the Chairman Michael Atiyah had reserved an extra day for the meeting. His insight was right as we used all three days, from morning to evening and even more. The focus at the meeting was on the future structure of the EMC.

The question was considered seriously. After a lively debate there was general agreement that the time was now ripe for revival of the idea, from ten years previously, on closer cooperation between mathematicians in Europe, based on a legally accepted structure. There was, however, no mutual agreement on the form of the cooperation. In particular, the French mathematicians opposed a federation of national societies. They wanted to follow the structure of the American Mathematical Society and found a European Mathematical Society of individual members.

Sir Michael Atiyah signing the official charter of the Foundation in Mądralin, 1990. Others from left to right: Fritz Hirzebruch, Lászlo Marki, Aatos Lahtinen, Jean-Marc Deshouillers, Andrzej Pelczar and Chris Lance. (Photo Courtesy of Prof. Ivan Ivansic.)

There was a long and animated debate on the pros and cons of these two alternatives. It became clear that the supporters of each model were not giving up but were digging in. Thus it was not possible to come to a unanimous resolution along these lines, while a non-unanimous decision was out of the question. The only way left was to find some kind of a compromise.

The first agreement was reached on the question on the legal form of the new association. The EMC decided to give it a legal status by registering it under the law of some European country. The next question was which country, and this was tied up with the debate on the form of the association. Each of the mathematically eminent countries France, Germany and Great Britain was firmly behind its own concept and none of them was suggested. Possible alternatives had apparently not been thought of beforehand.

In this open situation I tried to forward the process by suggesting to Michael Atiyah that Finland might be willing to host this new association. I assured him that Finland would fulfil the three conditions of the committee, by giving a short description on the process needed in Finland with a rough timetable and estimation of costs. Fortunately I was aware of the legal requirements in Finland and I could certify that the legalisation would be a fairly simple, and not expensive, procedure.

Sir Michael Atiyah apparently saw possibilities in this proposal because he presented the case to the council, where it was received with interest. After a short discussion the Council decided to accept the suggestion and to place the seat of the future association in Helsinki. This agreement somehow opened the deadlock we were in and progress was also made in other directions. As a compromise it was decided that the future association should have both corporate and individual members. The way the power of decision would be distributed between these two categories was resolved only in principle; the details would be settled at the foundation meeting. The question about the name raised a long debate, too. Finally the Council accepted the name *European Mathematical Society*.

The Council authorised me to take care of the formal registration of the Society in Finland. In practice, this contained also the formulation of a draft of the Statutes of the new Society, according to the guidelines presented and to the requirements of Finnish law. The next Council meeting in 1990 in Poland would make the final decision on the founding of the Society, on its Statutes and on the principles of the actions the Society would undertake.

The response in Finland
My suggestion that the legal office of the Society should be in Finland was at my own initiative; the Finnish mathematical community had not discussed the question of the location at all. I therefore returned to Helsinki with some anxiety. It was, however unnecessary. The Finnish Mathematical Society approved my action and promised its support for the project.

The Chancellor of the University of Helsinki, Olli Lehto, promised the support of the University. All the officials I contacted at the Ministry of Education, Justice and Home Secretary took a very positive attitude and saw no difficulties in the foundation of the Society as a Finnish Learned Society. I also learned in the process that the Government was preparing a Bill for a new law on associations. This would make the registration of the European Mathematical Society even easier.

Thus by October 1988 I could already write a short report to Michael Atiyah, confirming that Finnish mathematicians were ready to take on the task and carry it to a conclusion. The foundation process could be initiated.

Preparing the Statutes

Preparing the Statutes appeared to be an iterative process in the sum of two subspaces. One was the mathematical community and the other the civil servants who were taking care of the legal registration. The iteration was complicated by the multi-dimensionality of both subspaces. In fact, it soon turned out to be impossible to prove that the iteration would converge.

The procedure started with the first draft composed by Atiyah in December 1988, with the Statutes of European Physical Society as a model. The most essential points were:

– the members of the Society could be individuals and organisations other than mathematical societies;
– the supreme authority of the Society was the Council;
– each member society had one, two or three Council delegates;
– the number of delegates of other organisations and individual members was restricted to at most 25% of the total number of Council delegates; the draft did not specify how to elect the Council.

This draft was sent for comments to mathematical societies. Simultaneously I tried to specify the requirements of the Finnish law. A problem was that the registration would be under the future law, and no lawyer was yet willing to make interpretations.

Anyway, in June 1989 we had the second draft of the Statutes ready. There was a small meeting in Oxford in July, with M. Atiyah, J-M. Deshouilles, W. Schwarz, J. Valenca, J. Wright and myself. Based on the received comments and legal requirements, we iterated it to the third draft which was accepted by all present. In particular, the 25% upper limit on the other Council delegates remained intact. We also produced the first draft by-laws. There it was stated that the Council is elected by postal vote where (for example) the number of delegates representing individual members was restricted to at most four. There was also a mention of the Special Secretariat in Prague (by the offer of Professor Kufner). The essential factors seemed to us to be fairly complete.

Armed with a Finnish translation of the third draft Statutes, I approached the department of the Ministry of Justice that took care of the registration of associations, and asked their opinion. They were helpful, but not happy with our draft. The lawyer in charge complained that our style and formulations differed so much from the Finnish praxis that it was difficult to say whether the Statutes were acceptable or not. The most serious point was the lawyer's demand that the Council must be elected by a General Assembly of all members. I pointed out the difficulties of arranging such an assembly in a European-scale society, but it resulted only to a poor compromise where the Assembly may elect the Council by a postal vote without actually meeting. Another difficulty was that the lawyer was not willing to accept that the President would be the chairman of both the Executive Committee and the Council.

I made the alterations that the lawyer demanded and so by November 1989 we had the fourth draft of the Statutes which would be acceptable to the Ministry but which were in some places more cumbersome than the third draft. At the same time we raised the 25% upper limit on the other Council delegates to 40%. In the By-laws we raised the upper limit of delegates representing individual members to 5, and we also added a statement that the upper limit should be reconsidered when the Society had 2000 individual members. The Eastern European Secretariat was removed from the Statues and the By-laws, because Professor Schwabik from Prague considered that the rapid changes in Eastern Europe had made it unnecessary.

This fourth draft was sent once again to the Societies. Not unexpectedly, many questioned the sense in having an Assembly that does not meet. After a discussion with Atiyah I approached the Ministry of Justice once more. By coincidence there was a different official in charge. He took our criticism seriously and admitted that we could as well have a direct postal vote of the Council without a fictitious Assembly.

I was then quite happy to produce in June 1990 the fifth draft, in which the Assembly was deleted. Also the number of delegates of individual members in Council was redefined by the formula $\min\{(n-1)/300)+1,\ 2C/5\}$, where C is the total number of Council delegates. I believed that the convergence of the Statues had essentially taken place, and that only minor adjustments were needed. I was wrong.

Kyoto

As a final check before the foundation meeting in October 1990, a meeting was arranged in August in conjunction with the ICM 1990 in Kyoto. It seemed appropriate that the process that had started at ICM 1978 would essentially also end at an ICM. Michael Atiyah was not present in Kyoto, and therefore I chaired the meeting. There was general contentment at the deletion of the Assembly, and it seemed that the Mathematical Societies were ready to accept this version as final. Unexpectedly the French delegates announced that they were not content and that they would not recommend acceptance of the Statutes. They opposed the upper limit of Council delegates elected by individual members and said that these delegates must be able to have a majority in the Council. They also raised the point that individual members from 'poor' countries may not be able to pay even a modest fee. The first point came as a surprise to me because I had understood that also the French Mathematical Society had accepted the upper limit.

In due course I consulted Atiyah. We decided to treat the latter problem by adding a new By-law giving the Executive Committee the authority to waive temporarily the fee of any member. It was decided that the more serious problem on the upper limit should be left to the foundation meeting.

Mądralin

The foundation meeting of the European Mathematical Society, which started as the last meeting of the European Mathematical Council, was held in Madralin, near Warsaw, on 27-29 October 1990. The meeting of the EMC was chaired, as always, by Michael Atiyah. There was a lively discussion on the purpose and modes of action of the forthcoming Society. Concerning the Statutes there were several comments most of which were of a technical nature. As expected, the only principal question was raised by the French mathematicians. They repeated what they had already said in Kyoto – namely, that they would accept only a society of individual members and not one of Societies. In particular, they wanted the upper limit on delegates of individual members to be removed.

In the discussion they did not get support. However, the unanimous acceptance of the Statutes was considered important, and therefore a small *ad hoc* committee of Michael Atiyah, Jean-Pierre Bourguignon, Fritz Hirzebruch, Lászlo Marki and myself was set up to try to negotiate a compromise. We convened at lunchtime. After some attempts it was agreed to propose a package of four resolutions:

– the member societies should encourage their members to become individual members of the EMS and should be committed to collect individual membership fees for the EMS;
– the statutes of EMS will be reconsidered when the individual membership of the EMS has reached 4000;
– in the formula defining the number of delegates for individual members the denominator 300 should be replaced by 100;
– in the same formula the upper limit $2C/5$ should be retained.

The council accepted the first three resolutions unanimously and the fourth by 28 votes to 12. However, when the French were still unhappy with the upper limit, it was decided to replace it by $2C/3$.

After some minor items the Chairman proposed that the Council should formally establish the European Mathematical Society with its seat in Helsinki, which was agreed. Professor Atiyah was accepted as the first individual member of the Society. The official charter for the foundation (written in Finnish, of course) was signed, a toast was raised, and we had the European Mathematical Society.

What happened after that is another story. A part of this story, told by David Wallace, can be read at the address *http://turn.to/EMSHISTORY99*. It cannot be more than a part, because the story of our Society continues and continues forever, I hope.

Vivat, crescat, floreat!

Interview with Sir Roger Penrose

part 1

Interviewer: Oscar Garcia-Prada

Roger Penrose was formerly Rouse Ball Professor at Oxford University, and currently holds the position of Gresham Professor of Geometry in London.

This interview is in two parts – the second part will appear in the March 2001 issue.

When did you first get interested in mathematics?
From quite an early age – I remember making various polyhedra when I was about 10, so I was certainly interested in mathematics then – probably earlier, but it became more serious around the age of 10.

Are there other mathematicians in your family?
Yes, my father was a scientist – he became a professor of human genetics, but he had broad interests and was interested in mathematics – not on a professional level, but with abilities and genuine interests in mathematics, especially geometrical things. I also have an older brother Oliver who became a professor of mathematics. He was very precocious – he was two years older than I was, but four years ahead in school. He knew a lot about mathematics at a young age and took a great interest in both mathematics and physics; he did a degree in physics later on. My mother also had an interest in geometry; she was medically trained as my father was.

Did you have good teachers at school?
I did have at least one teacher who was quite inspiring. I found his classes interesting, although maybe not terribly exciting.

Where did you go to school?
I was at school in Canada between the ages of 8 and 13. I don't know that I got much mathematics interest from there. Then I was back in England at the age of 14.

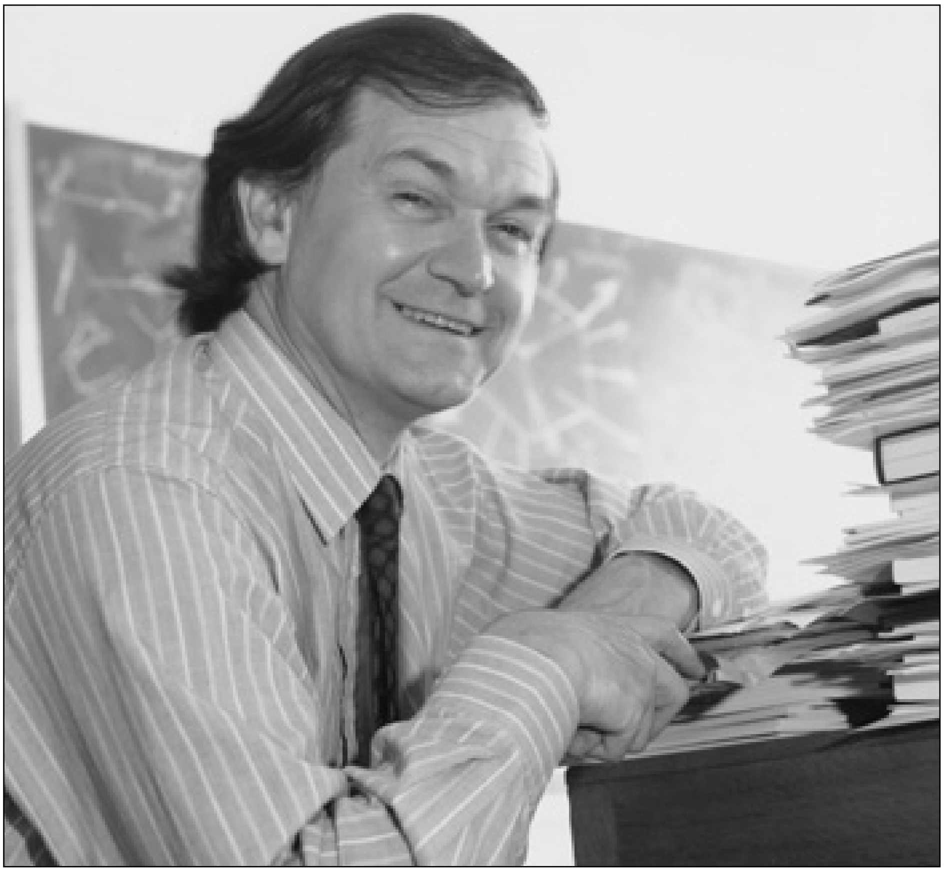
But you were born in England?
Yes. We went over to the US just before the War. My father had a job in London (Ontario) at the Ontario hospital, where he later became the Director of Psychiatric Research. He was interested in mental disease and its inheritance, the sort of thing that he became particularly expert on later. So the question of inheritance versus environmental influence were of great interest to him.

In fact I was born in Colchester in Essex – it's an old Roman town, possibly the oldest town in England. My father took on a project called the Colchester survey, which had to do with trying to decide whether environmental or inherited qualities were more important in mental disease. The conclusion he came to was that the problem was much more complicated than anybody had thought before, which is probably the right answer.

This was before going to Canada?
Yes. Then we went over first to the US when it started to become clear there was going to be a war. He had this opportunity to work overseas and he took it.

And when did you return to England?
Just after the War, in 1945. I went to University College School in London where I became more and more interested in mathematics, but I didn't think of it as a career. I was always the one who was supposed to become a doctor, but I remember an occasion when we had to decide which subjects to do in the two final years. Each of us would go up to see the headmaster, one after the other, and he said 'Well, what subjects do you want to do when you specialise next year'. I said 'I'd like to do biology, chemistry and mathematics' and he said 'No, that's impossible – you can't do biology and mathematics at the same time, we just don't have that option'. Since I had no desire to lose my mathematics, I said 'Mathematics, physics and chemistry'. My parents were rather annoyed when I got home; my medical career had disappeared in one stroke.

Where did you go to university?
I went to University College London for my undergraduate degree. My father was professor there and so I could go there without paying any fees. My older brother had also been there as an undergraduate and he then went to Cambridge to do a Ph.D. in physics. I went to Cambridge afterwards to do my Ph.D. in mathematics.



I was mainly a pure mathematician in those days. I'd specialised in geometry and went to Cambridge to do research in algebraic geometry, where I worked under William Hodge.

A contemporary who was also starting at the same time was Michael Atiyah, who later won the Fields Medal and became President of the Royal Society, Master of Trinity College, Cambridge, and the first director of the Isaac Newton Institute. When you first become a research student you've no idea who the other people are. It took me a while to realise there was something special about him. So it was a bit intimidating, I remember, at the beginning.

I worked with Hodge for only one year, because he decided that the kind of problems I was interested in were not in his line of interest. I then worked under John Todd for two years, but during that period I became more and more interested in physics, largely because of my friendship with Dennis Sciama who rather took me under his wing. He was a good friend of my brother's, and I think I made something of an impression on him when I visited Cambridge and asked him some questions about the steady-state universe which I don't think he'd quite thought about. So he thought it was worth cultivating my interest in physics.

Roger Penrose and Dennis Sciana at the 1962 Relativity Conference in Warsaw

So was he one of the most influential people you came across?

He was very influential on me. He taught me a great deal of physics, and the excitement of doing physics came through; he was that kind of person, who conveyed the excitement of what was currently going on in physics – it was partly Dennis Sciama and partly lectures that I attended 'on the side' when I was in my first year.

I remember going to three courses, none of which had anything to do with the research I was supposed to be doing. One was a course by Hermann Bondi on general relativity which was fascinating; Bondi had a wonderful lecturing style which made the subject come alive. Another was a course by Paul Dirac on quantum mechanics, which was beautiful in a completely different way; it was just such a perfect collection of lectures and I really found them extremely inspiring. And the third course, which later on became very influential although at the time I didn't know it was going to, was a course on mathematical logic given by Steen. I learnt about Turing machines and about Gödel's theorem, and I think I formulated during that time the view I still hold – that there is something in mental phenomena, something in our understanding of mathematics in particular, which you cannot encapsulate by any kind of computation. That view has stuck with me since that period.

You've worked in many areas, but let me start with your 1960s work on cosmology. With Stephen Hawking you discovered the singularity theorems that won you both the prestigious Wolf prize. What are these theorems about, and what do they say about space-time?

Well, singularities are regions of space-time where the laws of physics break down. The main singularity one hears about is the *big bang*, which represents the origin of the universe. Now cosmological models were introduced in accordance with the Einstein equations of general relativity, which describe curvature of space-time in terms of the matter content. The equations determine the time-evolution of the universe. You apply these equations to a very uniform universe, which is what people did originally, assuming that the universe is homogenous and isotropic, in accordance with the standard models that are used to describe cosmology on a large scale. If you extrapolate Einstein's equations backwards you find that at the very beginning was this moment where the density became infinite and all matter was concentrated in a single place. The big bang represents the explosion of matter away from this – in fact, the whole of space-time originated in this single event.

Some people used to worry about this, as I did, because it represents a limit to what we can understand in terms of known physical laws. The same situation arose later when people started to worry about what happens to a star which is too massive to hold itself apart and singularities arise. Back in the 1930s Chandresekar showed that a white dwarf star, which is a really concentrated body, can have the mass of the sun, or a bit more. We know that such objects exist – the companion of Sirius is the most famous one – but if such a body has more than about one-and-a-half times the mass of the sun then, as Chandresekar showed, it cannot hold itself apart as a white dwarf and will continue to collapse; nothing can stop it. A white dwarf is basically held apart by what's called *electron degeneracy pressure* – this means that the electrons satisfy an exclusion principle which tells you that two electrons cannot be in the same state, and this implies that when they get concentrated they hold the star apart. So it's this exclusion principle in effect that stops a white dwarf star from collapsing.

However, what Chandra showed is that gravity will overcome this if the star is too massive, and that its electron degeneracy pressure cannot hold it apart. This problem occurs again in what's called *neutron degeneracy pressure*, which is again the exclusion principle but now applied to neutrons. What happens is that the electrons get pushed into the protons and you have a star made of neutrons. Those neutrons hold themselves apart by not being able to be in the same state. But again the Chandrasekar argument comes to bear on the neutron stars and you find that they also have a maximum mass which isn't believed to be much more than that of a white dwarf. So anything with, say, twice the mass of the sun would seem to have no resting place and would go on collapsing unless it could throw off some of its material. But it seems unlikely that in all circumstances it would throw off enough material, especially if it started with a mass of, say, ten times the mass of the sun.

So what happens to it? Round about 1939, Robert Oppenheimer and various students of his – in particular, Hartland Snyder – produced a model of the collapse of a body. As an idealisation, they considered a body made of pressureless material, which was assumed to be exactly spherically symmetrical – and they showed that it will collapse down to produce what we now call a *black hole*.

A black hole is basically what happens when a body is concentrated to such a small size for such a large mass that the escape velocity is the velocity of light, or exceeds the velocity of light, the escape velocity being that speed at which an object thrown from the surface of the body escapes to infinity and doesn't ever fall back again. It's about 25000 miles an hour for an object on the surface of the earth. But if you concentrate the earth so much, or take a larger body with a mass of, say, twice the mass of the sun and concentrate it down, it reaches the region in which the velocity will reach the speed of light when it's just a few miles across. And then it becomes a black hole once the escape velocity exceeds the velocity of light, so that nothing can escape, not even light.

This is exactly what happened in the model that Oppenheimer and Snyder put forward in 1939. But it didn't catch on. Nobody paid any attention to it, least of all Einstein, as far as one knows. I think the view of many people was that if you remove the assumption of spherical symmetry then the exact model that Oppenheimer and Snyder had suggested would not be appropriate, and who knows what would happen? Maybe it would not concentrate into a tiny thing in the centre, but would just swirl around in some very complicated motion and come spewing out again – I think this was the kind of view some people had. And you wonder about whether assuming that there's no pressure is the fundamental assumption, because matter does have pressure when it gets concentrated.

This was revived in the early 1960s when the first *quasars* were discovered. These extremely bright shining objects seemed to be so tiny, yet so massive that one would have to worry about whether an object had actually reached the kind of limits that I've just been talking about, where you wouldn't see it if it was really inside what's called the *event horizon*, and where the escape velocity exceeds the velocity of light, but if you get close to that then very violent processes could take place which could produce extraordinarily bright objects. When the first quasar was observed, people began to worry again about whether what we now call black holes might not really be there out in the universe.

So I began thinking about this problem and the whole question of whether the assumption of exact spherical symmetry could be circumvented, using techniques of a topological nature which I had started to develop for quite other reasons. What people had normally done would be just to solve complicated equations, but that's not very good if you want to introduce irregularities and so on, because you simply can't solve the equations. So I looked at this from a completely different point of view, which was to look at general topological issues: could you obtain a contradiction from the assumption that the collapse takes place without any singularities? Basically what I proved was a theorem which was published in 1965 in *Physical Review Letters*, where I showed that if a collapse takes place until a certain condition holds (a qualitative condition which I called *the existence of a trapped surface*), then you would expect some type of singularity. What it really showed is that the space-time could not be continued, it must come to an end somewhere – but it doesn't say what the nature of that end is, it just says that the space-time cannot be continued indefinitely.

Can you test this theory in our universe?
Well, the first question is: do black holes exist? They are almost a theoretical consequence of the kind of discussion I've just referred to. Then Stephen Hawking came in as a beginning graduate student working with Dennis Sciama, and he took off from where I'd started, introducing some other results mainly to do with cosmology rather than black holes. Later we put our results together and showed that singularities arise in even more general situations than we had individually been able to handle before.

Now there is a big assumption here to which we still don't know the answer. It's called *cosmic censorship*, a term I introduced to emphasise the nature of this hidden presumption, that is often tacitly made. Cosmic censorship asserts that 'naked singularities' do not occur. We know from the singularity theorems that singularities of some kind occur at least under appropriate initial conditions that are not unreasonable – but we don't know that those singularities are necessarily hidden from external view. Are they clothed by what we call a *horizon*, so you can't actually see them? With a black hole you have this horizon which shields that singularity from view from the outside. Now it's conceivable that you could have these naked singularities, but they're normally considered to be more outrageous than black holes. The general consensus seems to be that they don't happen, and that tends to be my view also. If you assume that they don't occur, then you must get black holes. So it's a theoretical conclusion that if you have a collapse of a body which is beyond a certain size, then you get black holes.

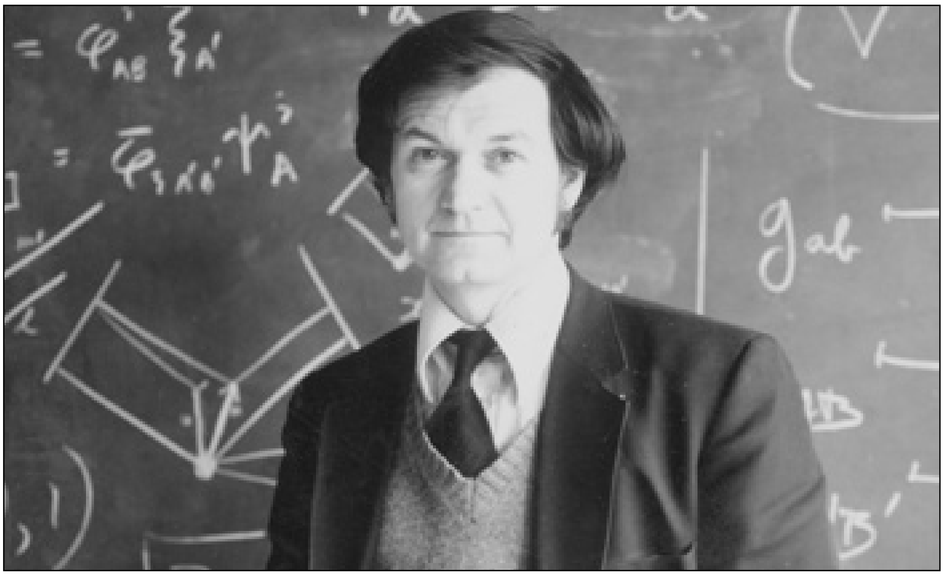
Now one type of system that astronomers have observed is where there is a double star system, only one member of which is visible. The invisible component is taken to be a black hole – *Cygnus X-1* was the first convincing example. It's an X-ray source, and what is seen is a blue supergiant star which is in orbit about something; the 'something' is invisible through a telescope, but seems to be the source of the X-rays. Now the X-rays would come about if material is dragged into a tiny region and gets heated in the process of being dragged in; the material probably forms a disc, which is the normal view people have. The material gets dragged off the companion star, the blue supergiant star, and it spirals into the hole, in the standard picture. It gets hotter and hotter until it reaches X-ray temperature, which is the source of these X-rays, and that's what's seen.

Now it doesn't tell you that this object is actually a black hole, but the dynamics of the system are such that the invisible component has to be much too massive to be either a white dwarf or a neutron star, because of the Chandrasekar argument, and so on. So the evidence is indirect: what one knows is that there is a tiny highly concentrated object which seems to be dragging material into it, and from the neighbourhood of which one sees X-rays. Also gamma ray sources seem to be black hole systems, and there may now be many other examples, other double star systems or black holes in galactic centres. Indeed, there is convincing evidence for a very concentrated dark object at the centre of our own galaxy, of the order of something like a million solar masses.

It seems to be a standard phenomenon that galaxies may have these highly concentrated objects which we believe to be black holes in their centres. Some galaxies may have large ones, and quasars are believed now to be galaxies which have at their centres objects that are much brighter than the entire galaxy, so all you see is this central region which is extraordinarily bright. It's bright because it has dragged material into it, and it gets extraordinarily hot and spews out in certain directions at nearly the speed of light. You see examples of things where jets come out of centres of galaxies and things like this. But all this evidence is indirect. It's not that one knows that black holes are there, it's just that the theory tells us that there ought to be black holes there and the theory fits in very well with the observations. But most observations do not directly say that those are black holes, although there's impressive recent evidence of material being swallowed by one without trace. There's also another potential possibility of the direct observation of a black hole: when I say 'direct', it's more because the theory of black holes is so well developed that one knows very closely what the geometry should be. There's a geometry known as a *Kerr geometry* which seems to be the unique endpoint of a collapsed object to form a black hole, and this geometry has very interesting specific properties. Some of these could be tested to see whether these concentrated objects that we know are there really conform with the Kerr geometry. That would add much more direct evidence for black holes, but it's something for the future.

What would be the most striking physical implications of the singularities here?
What the singularities tell us is that the laws of classical general relativity are limited. I've always regarded this as a strength in general relativity. It tells you where its own limitations are. Some people thought it was a weakness of the theory because it has these blemishes, but the fact that it really tells you where you need to bring in other physics is a powerful ingredient in the theory.

Now what we believe is that singularities are regions where quantum theory and general relativity come together, where



things are both small and massive at the same time. 'Small' is where quantum effects become important, and 'massive' is where general relativity becomes important. So when you get the two things happening together, which is what happens in singularities, then the effects of both general relativity and quantum mechanics must be considered together.

Now this applies in the big bang and in the singularities in black holes, and it would also apply if the whole universe were ever to collapse, although that is just a conglomeration of all the black holes into one big black hole. There's one thing I find particularly interesting, however, which is the stark contrast between the big bang and the singularities in black holes. It's a bit ironic, because in the earlier stages of the black hole singularity discussions, their reasonableness was that we already know there's a singularity in the big bang. It was argued that the singularities in black holes are just the same as the big bang, but time is going the other way – so if you have one you should have the other. This was quite a plausible kind of argument, but when we look at these things in detail we see that the structures are completely different: the structure that the big bang had was very smooth and uniform, whereas the structure we expect to find in singularities is very complicated and chaotic – at a completely different end of the spectrum.

In fact, this is all tied up in a deep way with the *second law of thermodynamics*. This law tells us that there is a time asymmetry in the way things actually behave. This is normally traced far back in time to some very ordered structure in the very early stages of the universe – and the more you trace it back, the more you find that this ordered structure is indeed the big bang.

So what is the nature of that ordered structure in the big bang, and what is its cause? Well, in relation to what I was just saying, it is *quantum gravity*. We believe that this is where quantum theory and gravitational theory come together. And what this tells us – and I've been saying this for quite a few years but few people seem to pick up on this completely obvious point – is that the singularity structure, which is where we see general relativity and quantum mechanics coming together most blatantly, is time-asymmetrical. So it tells me that the laws involved in quantum gravity, combining quantum theory with general relativity, must be time-asymmetrical, whereas the laws we normally see in physics are time-symmetrical.

It also tells us, it seems to me, that the laws of quantum mechanics are not just concerned with applying quantum mechanics to general relativity – when I say 'just', it's a gross understatement because nobody knows how to do that, but I think it must be a union between these two theories, giving a new theory of a different character. It's not just quantum mechanics: quantum mechanics itself will have to change its structure and it will have to involve an asymmetry in time, but I have reason to believe that this is all tied in with the measurement problem – the collapse of the wave function, the curious features that quantum theory has which make it in many respects a totally unsatisfying theory from the point of view of a physical picture or a philosophically satisfying view of the world. Quantum mechanics is very peculiar, because it involves incompatible procedures. My own view is that this is something that we will only understand when we've brought Einstein's general relativity in with quantum mechanics and combined them into a single theory.

So my view on quantum gravity is quite different from that of most people. What most people seem to say is 'Oh, you've got to try and quantise general relativity, and quantise gravitation theory, and quantise space-time': to 'quantise' means to take the rules of quantum mechanics as they are and try to apply them to some classical theory, but I prefer not to use that word. I say that the theory we seek involves also a change in the very structure of quantum mechanics. It's not quantising something; it's bringing in a new theory that has standard quantum theory as a limit. It also has standard general relativity theory as another limit, but it would be a theory that is different in character from both those theories.

Let me come to another aspect of your work. One of your greatest inventions is twistor theory, which you introduced about 30 years ago. What is twistor theory?

Well the main object of twistor theory is to find the appropriate union between general relativity and quantum mechanics. I suppose I had that view over thirty years ago (actually, 1963) before I talked about this singularity issue and the asymmetry, and so on. I'd already felt that one needs a radically different way of looking at things, and twistor theory was originally motivated by such considerations. Since we can't just 'quantise', we need other guiding principles.

Let me mention two of them. One was non-locality, because one knows about phenomena in which what happens at one end of a room seems to depend on what happens at the other end. These experiments were performed about twenty years ago by Alain Aspect in Paris – all right, those experiments hadn't been performed when I introduced twistor theory, but the original ideas were there already – I mean the *Einstein-Podolsky-Rosen phenomena*, which tell you that quantum mechanics says that you have 'entanglements' – things at one end of the world seem to be entangled with things at the other end. Now that's only a vague motivation: it's not really something that twistor theory even now has a great deal to say about, but it does say that somehow non-locality is important in our descriptions, and twistor theory (as it has developed) certainly has features of non-locality, over and above those I was aware of when I started thinking about these ideas.

Originally, rather than having points in space-time as the fundamental objects, I thought more in terms of entire light rays as fundamental. The reason for thinking about light rays actually came from something quite different, which I regard as perhaps the most important motivation underlying twistor theory. In the union between quantum mechanics and general relativity, I feel strongly that complex numbers and complex analytic structures are fundamental for the way that the physical world behaves. I suppose that part of my reason for this goes way back to my mathematical training. When I first learnt about complex analysis at university in London I was totally 'gob-smacked' – it just seemed to me an incredible subject; some of the simplest ideas in complex analysis, such as if a function is smooth then it's analytic, are properties which I always thought were totally amazing.

What are twistors, and how are they more fundamental than a point in space-time?

Well, you see, if I follow the complex analysis I can come back to this. First of all, complex analysis is just mathematics, and it's beautiful mathematics that's tremendously useful in many other areas of mathematics. But in quantum theory you see it at the root of the subject – for the first time one sees that it's really there in nature, and that nature operates (at least in the small scale) according to complex numbers.

Now the thing that struck me from quite early on – it's one of the earliest things I did in relativity – is if you look out at the sky you see a sphere; but if you consider two observers looking out at the same sky, one of whom is moving with a high speed relative to the other, then they see a slightly transformed sky relative to each other, and the transformation of that sky preserves circles and takes angles to equal angles. Now those people who know about complex analysis know that this is the way you look at the complex numbers: you have infinity as well, and they make a sphere – the *Riemann sphere* – and the transformations that send that sphere to itself, the complex analytic transformations, are precisely those that send circles to circles and preserve angles. I was completely struck by this phenomenon, as it seems to me that what you're doing when you look at the sky is you're seeing the Riemann sphere – they are the complex numbers out there in the sky, and it seemed to me that that's the kind of mathematical connection. It seemed to me such a beautiful fact, and in a sense the transformations of relativity are all contained in that fact. Surely that means something. We already know that complex numbers are fundamental to quantum theory, and here we see complex numbers fundamental to relativity when we look at it this way.

My view was to say 'all right, don't think of the points you see when you look at the sky; what you are doing is seeing *light rays*. You and a star in the distance are connected by a light ray, and the family of things that you see as you look at the sky is the family of light rays through your eye at that moment. So the thing with the complex structure is light ray space, telling you that maybe you can see this link between space-time structure and complex numbers if you concentrate not on points but on light rays instead.

So that was really the origin of twistor theory – well, that's cheating slightly, but I suppose one cheats when one gets used to a certain idea, because although these phenomena were known to me and I realised their importance, it was something else that really steered me in the direction of twistor theory. It's a bit technical, but had to do with complex numbers – all right, you see them in the sky, but you also see them in all sorts of other places – in solutions of Einstein's equations, and so on – they started to come up when people looked at specific solutions of Einstein's equations. It turned out very often that you could express things very nicely if you used complex numbers, and it suggested to me that somehow – I had this image like an iceberg, you see – what you see is a little bit at the top and there's the rest of it down underneath which is invisible. It's really a huge area where these complex numbers at the tip poke up through the water, while the rest of it is underneath.

So these solutions, where one sees the complex numbers, seemed just the tip of an iceberg, and they were really underneath governing the way that the first-hand structure works. It was a search to try and find what that complex structure was, and it wasn't until certain things that are not appropriate to describe here, but which relate to solutions of Maxwell's equations and Einstein's equations which show you that the space of light rays, although it's not quite a complex space because it's got the wrong number of dimensions – but if you look at the right structure you see it as part of another structure, a slightly extended one with six dimensions, and it produces complex objective space which is complex projective 3-space.

Now with hindsight I can describe these things more satisfactorily. Let me put it like this. When you think of a light ray, that is an idealised photon idealised in a specific respect, you are just thinking of it as a path through space-time. But you have to bear in mind that massless particles (photons, in particular) also have spin (they spin about their direction of motion), and if you introduce the spin they also have energy. The spin is a discrete parameter. It's either left-handed or right-handed, but when the particle has spin, introducing the energy (a continuous parameter) gives one more degree of freedom. So instead of having just five dimensions of light rays, you find a six-dimensional space that is naturally the complex 3-space. So you've got the whole thing, the right-handed ones, the light rays and the left-handed ones, and they all fit together to form a space that's called *projective twistor space*.

And it seemed to me that once you take this space as being more fundamental than space-time (the main reason being that it's complex), it ties in with other things that I've been interested in for years – the use of spinors and how you treat general relativity, things which I'd learnt in Bondi's and Dirac's lectures. This notion of *spinors*, as a way of treating general relativity, was something I found to be powerful, but it didn't quite do what I wanted, which was to get rid of the points. That was what twistor theory achieved, and it's still going on.

So how do twistors actually relate to these singularity theorems? Do they have anything to say about those theorems?

The short answer to that question is no – or, not yet. The hope is that they will, but the subjects have been going off in two quite different directions. Twistor theory is motivated by trying to bring general relativity and quantum mechanics together. If it's successful in that direction, then it would have something to say about the singularity problem, but at the moment it has very little direct bearing on the singularity problem. I regard it as a very long round-about route, but one needs first to understand how Einstein's general relativity really fits in with twistor theory. Although considerable advances have been made, some dating back to twenty years ago, it's still a question mark. We don't completely know how to represent Einstein's theory in relation to twistors; there are some very strong indications that there's a good connection between the two, but how one does it is still not clear.

So my view is that the major problem in twistor theory is to see how to incorporate Einstein's theory into the twistor framework, and it's still not complete. What we seem to see is that in the process of incorporating Einstein's theory into twistors, we also have to incorporate ideas of quantum mechanics. So my hope is that in bringing classical general relativity into the scope of twistor theory, one will also see how quantum theory must be made to combine with general relativity, and in that combination one will see how to deal with singularities, because that is the place where the combination of the two theories comes in. Also, there must be a time asymmetry in the way it comes together, and that will explain the difference between the past and the future singularities. But all these things are hopes – they're not something I can do now.

Twistor theory has been tremendously successful in applications within mathematics, but has it been helpful in understanding the nature of the physical world?

Not very much, I would say. It's rather curious, but I would say that this is not unique to twistor theory. One sees it in other areas – like string theory, for instance – where people start with great ambitions to solve the problems of physics, and instead come up with ideas that have had implications within mathematics; this is certainly the case with twistor theory, its applications and its interest. If you rounded up all the people who claimed they worked on twistor theory, you'd find, I would think, that a vast majority of them were mathematicians with no particular interest in physics – they might be interested in differential geometry, or integrable systems, or representation theory. Very few of them would have physics as their prime interest, so it's kind of ironic that here's a theory that's supposed to be answering the problems of physics, and yet it's not caught on at all on the physics side.

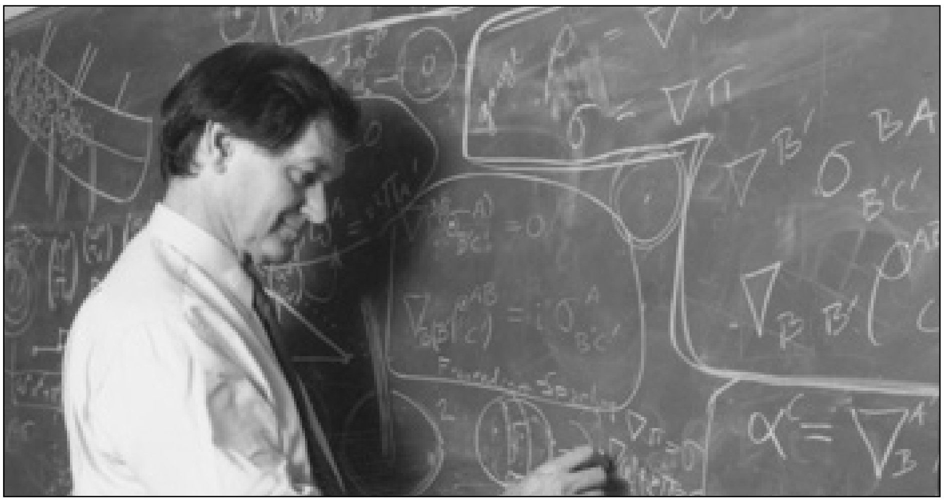
You mentioned string theory. Are there connections between twistor theory and string theory?

I think there probably are. It's not something that has been deeply explored, and the groups of people who work on these subjects are more-or-less disjoint. There have been some attempts to bring the theories together, but I think that the right vehicle for doing so hasn't come about yet. I wouldn't be at all surprised to find that in the future some more significant link between these two areas is found, but I don't see it right now.

These new theories involving p-branes seem to be more suitable, somehow?

Well, there is a connection, but I don't know how significant it is. I was talking to Ed Witten recently and he was telling about the 5-branes they're interested in. But that's curious, because in work that Michael Singer did some years ago with Andrew Hodges and me, the suggestion was made that what one should really be looking at is generalisations of strings. Whenever you see an ordinary string, you should really think of it as a surface, because it's a string in time. It's one-dimensional in time, so that gives you two dimensions. These things are studied very much in connection with complex one-dimensional spaces (Riemann surfaces), so they are in some natural way associated with these Riemann surfaces.

Now what we had in mind, which was much more in line with twistor theory, is to look at a complex three-dimensional version of this, which we called *pretzel twistor spaces*; they're complex three-dimensional spaces, so they are six real-dimensional, and if you can think of them as branes in some sense, then they are 5-branes. Now is there a connection between those 5-branes and the 5-branes of the string theory? I just don't know, and I haven't explored it. I didn't mention it to Witten when I talked to him, but there might be something to explore here. That's just off the top of my head, I don't know, but yes, it might be that there's a connection there.



Interview with Vadim G. Vizing

interviewers: Gregory Gutin and Bjarne Toft

In 1964 the Russian mathematician Vadim G. Vizing published, in a Siberian journal., a paper with the title 'On an estimate of the chromatic class of a p-graph' (in Russian). Its main result is a theorem that today can be found in most textbooks on graph theory. Vizing is now one of the best-known names in modern graph theory. In 1976 he initiated the study of 'list colourings', a topic that has received much attention recently.

***Vizing's Theorem** (1964). The edges of a graph with maximum degree d can be coloured in at most d + 1 colours so that no two edges with a common vertex are coloured the same. Moreover, the edges of a p-graph with maximum degree d (where any two vertices are joined by at most p edges) can be coloured in at most d + p colours so that no two edges with a common vertex are coloured the same.*

In October 2000 Vizing visited the University of Southern Denmark in Odense, where the following interview was conducted by Gregory Gutin (Royal Holloway College, University of London) and Bjarne Toft (University of Southern Denmark).

Where did you grow up, and where did you get your education?

I was born on 25 March 1937, in Kiev in Ukraine. After the war, when I was 10, my family was forced to move to the Novosibirsk region of Siberia because my mother was half-German. I started to study mathematics at the University of Tomsk in 1954 and graduated from there in 1959.

Vadim Vizing in 1965

I was then sent to Moscow to the famous Steklow Institute to study for a Ph.D. The area of my research was function approximation, but I did not like it. I asked my supervisor for permission to do something else, but was not allowed to change. So I did not finish my degree and returned to Novosibirsk in 1962.

From 1962 to 1968 I spent a happy period at the Mathematical Institute of the Academy of Sciences in Academgorodoc, outside Novosibirsk. In 1966 I obtained a Ph.D. I did not have a formal supervisor, but A. A. Zykov helped me.

Because of the very cold climate I wanted to move back to Ukraine, but I could not get permission to live in Kiev. After living in various provincial towns, I finally ended up in Odessa, where I taught mathematics at the Academy for Food Technology from 1974.

How was life in Academgorodoc in the 1960s?

It was nice and quiet, and the atmosphere was good. Zykov let me present my results in his seminar, and he became my friend. And later the place attracted some very good students, like Oleg Borodin, Alexander Kostochka and Leonid S. Melnikov.

What made you choose mathematics in the first place?

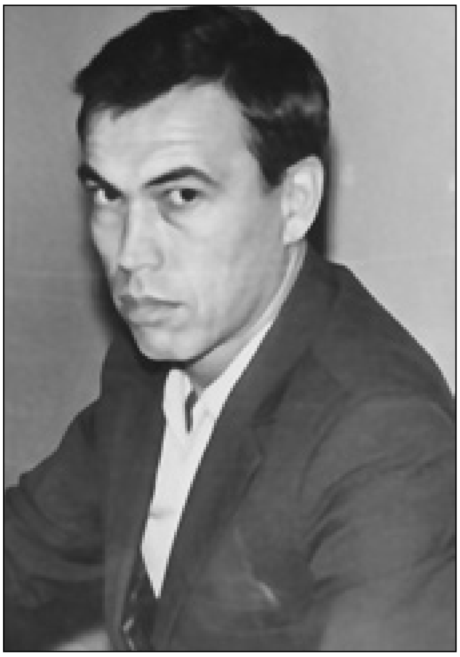
Because I was not happy doing anything else!

How did you conceive the idea of your famous theorem?

In Novosibirsk I started to work on a practical problem that involved colouring the wires of a network. To solve the problem I studied a theorem of Shannon from 1949 (that the edges of any p-graph can be coloured in $3d/2$ colours). Through Shannon's theorem I got interested in more theoretical questions.

Shannon's Theorem is best possible for p-graphs in general, but I asked myself what the situation would be for graphs without multiple edges. I improved Shannon's bound stepwise. At one point I had something like $8d/7$, but eventually I proved the best possible result, $d + 1$. The next step was to consider p-graphs.

I sent the graph result to the prestigious journal *Doklady*, but they rejected it. The referee said that it was just a special case of Shannon and not interesting. They did not understand it. So I published it locally in Novosibirsk in *Metody Diskret. Analiz.* It appeared in 1964 when I had also solved the p-graph case. By this time the result had already been mentioned in the West when Zykov stated it in the proceedings of a meeting in Smolenice that was published jointly by the Czechoslovak Academy of Sciences and Academic Press.



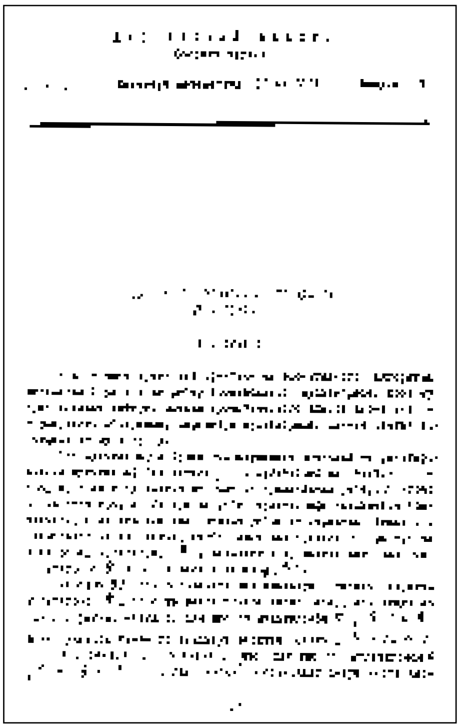
Vadim Vizing in 1975

Did you expect that your result that would eventually find its way into almost all books on graph theory?

No! And I did not consider that the topic had reached its final form by 1964. For example, I looked for algorithms and had many open problems. In 1968 I published a paper on 'Some unsolved problems in graph theory' (English translation in *Russian Math. Surveys*, 1968), summarising these and many other problems. Some are now classical and still unsolved, like the total graph colouring conjecture (posed independently by Behzad).

***The Total Graph Colouring Conjecture** (Vizing 1964, 1968, Behzad 1965). The vertices and edges of a graph with maximum degree d can be coloured in at most d + 2 colours so that no two adjacent or incident elements are coloured the same. Moreover, the vertices and edges of a p-graph with maximum degree d can be coloured in at most d + p + 1 colours so that no two adjacent or incident elements are coloured the same.*

Cover page of Discret Analiz.



First page of Vizing's 1964 paper

What makes a mathematical result outstanding?
A mathematician should do research and find new results, and then time will decide what is important and what is not!

What were the most interesting periods in your scientific life?
Definitely my years in Novosibirsk, when I worked in graph theory. And now, being able to do research again with time to think about unsolved problems. The INTAS grant from the European Union has helped. [The INTAS grant is a 3-year grant initiated by the Technical University of Ilmenau, with participation from Odense, Nottingham, Odessa and Novosibirsk.]

How?
I have retired. My pension is around $70 per month. This corresponds almost to my earlier salary, for which I had to teach up to 20 hours per week. I earned some extra money by writing a mathematics book for those wanting to pass a university entrance exam. The INTAS grant now gives me $45 extra per month, and it makes it possible for me to travel and meet colleagues. Last year in August we had an interesting meeting in Novosibirsk.

Have you carried out research during your years in Odessa?
In 1976 I stopped my graph theory research and moved to scheduling. I was writing a habilitation thesis and finished it in 1985. It did not work out, more for political and economical reasons than for scientific. It was partly my own fault. I could submit it now, but my interests have changed and I would rather use my time on something more useful.

In 1995 I was invited to Odense for the first time. This motivated me to go back to graph theory. During my stay I solved a problem with Melnikov that was later published in the *Journal of Graph Theory.*

What did you like least before Perestroika?
At first we had a police state. Then it became bureaucratic. It ended in economic failure.

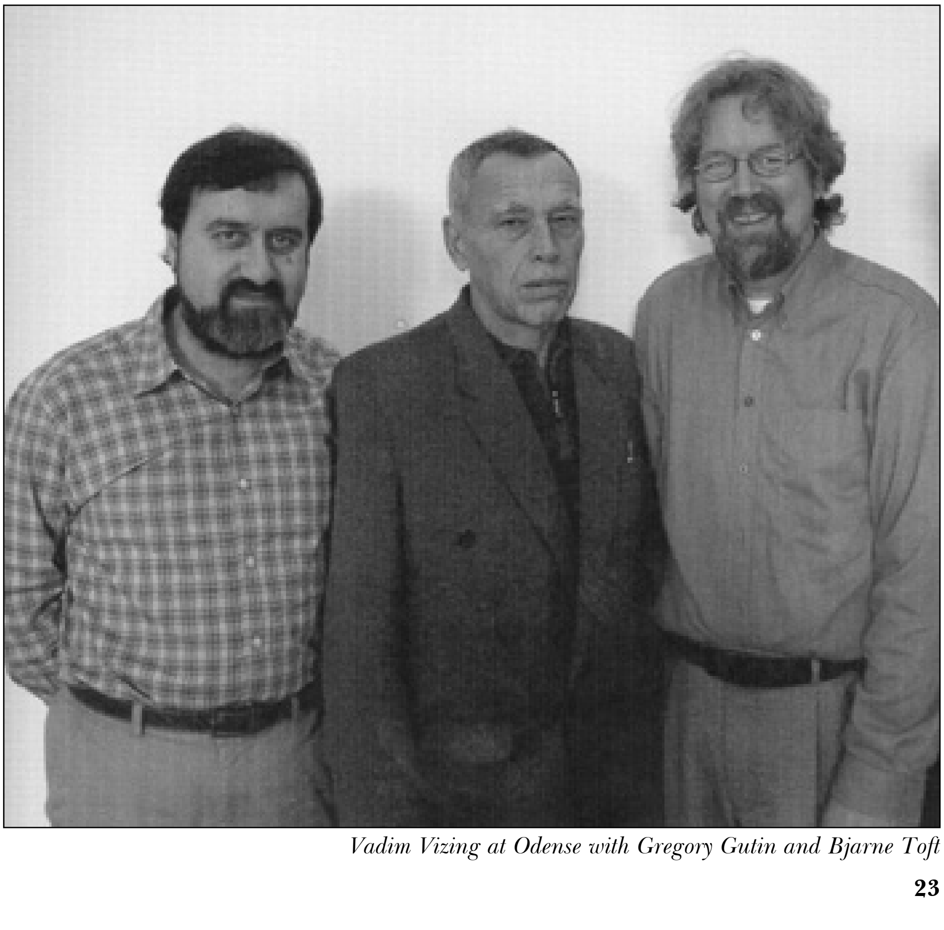
How has life changed in Ukraine after Perestroika?
In general, the direction is positive, but there are many negative aspects also. There is only little social protection. The bureaucratic system has survived, but now without control. This has led to open corruption.

However, the market economy is developing. Consumer goods are easily available if you have money. If you are healthy and energetic you can earn much more and live better than before. I like the general development. Of course there are many mistakes, but the direction is right.

How often have you travelled outside the former Soviet Union?
Three times, all of them to Denmark. Before Perestroika I had many invitations, more than twenty, but I was never allowed to go, not even to other socialist countries. I tried twice, but was stopped. It was hopeless. Very few people from the Ukraine could go. From Novosibirsk it was perhaps easier, but from Ukraine almost impossible, especially if you were not from Kiev. You were looked upon with suspicion if you wanted to travel. When I received foreign letters they were opened by the KGB and afterwards sent to me privately without comment.

What was your relationship to the communist party?
I was asked to join, but I never wanted to do so for political and moral reasons. I did not want to lose the freedom I had. I am glad that I did not join, even though my life in some ways might have been easier as a member.

What are your research plans?
To work on graph-theoretical questions. But great discoveries are not planned. I will work and see where I get!



Vadim Vizing at Odense with Gregory Gutin and Bjarne Toft

2000 Anniversaries

John Napier (1550-1617)

John Fauvel

Scotland has produced many creative and influential mathematicians – one thinks of James Gregorie, James Stirling, Colin Maclaurin and their many successors – but arguably the greatest and most original of all was the first Scottish mathematician of international renown, John Napier, who was born 450 years ago. Napier was indeed the first Scottish mathematician that we know about, and it is extraordinary that he created mathematics of the highest quality from within a country with no other mathematicians, with no mathematical tradition, and plunged into religious, political and social feuding. As his descendant Mark Napier wrote in 1834:

As for Scotland, until Napier arose, it was only famed for mists that science could not penetrate, and for the Douglas wars, whose baronial leaders knew little of the denary system beyond their ten fingers.

Born in 1550, Napier was the eldest son in a wealthy and well-connected family who had been playing an increasingly important part in Scottish court and civic life over the hundred years leading up to his birth. His parents Sir Archibald Napier and his wife Janet Bothwell were both barely 16 when their son was born, and from the start John Napier was living in an atmosphere of political and religious disputation and intrigue: the Scottish Reformation was in full spate and Sir Archibald was strongly on the Protestant side, as his son was to be. This wasn't merely a theological but also a political-cum constitutional position, given the swirl of intrigue surrounding the Catholic Queen Mary, James V's daughter, and her Protestant-inclining son James VI (as he became).

At the age of thirteen, young John was sent to the University of St Andrews, where he lodged with the principal, John Rutherfurd, and where he tells us he developed his theological interests and strongly anti-Papist views. There is no record of Napier graduating from St Andrews, and it is supposed that he probably went to study abroad, as was fashionable among young Scots of his generation and class. He may well have studied in Paris, where he would have had an opportunity to develop his mathematical knowledge, and perhaps in Geneva too, where he could have learned Greek in a fiercely Protestant environment.

His being out of the country during the latter 1560s meant that he missed the excitements at the Scottish court such as the murder of Queen Mary's secretary David Rizzio, the murder of the Queen's husband Lord Darnley, the Queen's marriage to the Earl of Bothwell (the wedding ceremony being performed by Napier's uncle the Bishop of Orkney), the forced abdication of Mary not long afterwards, and the coronation of her son James VI which helped mark the Protestantisation of Scotland. The next we hear of Napier himself is in the early 1570s. His father remarried in 1570 (Napier's own mother had died shortly after he went to St Andrews), and Napier himself married Elizabeth Stirling in 1573, receiving the Merchiston estate from his father as part of the wedding settlement.

There are five books in Napier's textual corpus, which were all first printed in Edinburgh:

– Napier's first and indeed best selling book in its day was *A plaine discovery of the whole Revelation of St John*, published in 1593. This anti-papist tract made his reputation as a leading theologian, and went into numerous editions in many languages.

– His next book, which did not appear for another twenty-one years, was on a quite different subject. *Mirifici logarithmorum canonis descriptio*, of 1614, '*Descriptio*' for short, was the book that introduced logarithms to the world and established his reputation among mathematicians across Europe.

- His next book, in 1617, the year he died, was called *Rabdologiae*. This was not about logarithms but about other devices and means of calculation.
- Two years after Napier's death, in 1619, his son Robert brought out from his manuscripts a companion work, as it were, to the 1614 *Descriptio*, called *Mirifici logarithmorum canonis constructio*, '*Constructio*' for short, which explained how logarithm tables were constructed.
- Finally, 220 years later, another descendant, Mark Napier, edited more of his papers under the name of *De arte logistica* (1839).

[First editions of the *Descriptio*, *Rabdologiae* and *De arte logistica*, as well as early editions of the other two, were in the Turner Collection at Keele University, UK, before that university secretly sold off the collection to a second-hand book dealer for a mess of pottage (see *EMS Newsletter* **31**, pp.10-12, and **32**, pp.14-15.)]

Napier's fame in his own day was as the author of *A plaine discovery of the whole Revelation of St John*. This remarkable best-seller explains such pressing issues as just why the Pope is the Antichrist and how we know that judgement day will fall between 1688 and 1700. It is worth more attention from historians of mathematics than it has received, if less for its conclusions then for the process by which he reaches and explains those conclusions.

Given the assumption that the text of the book of *Revelation* contains predictions about the subsequent course of human history – which is not an unfair inference from the opening words:

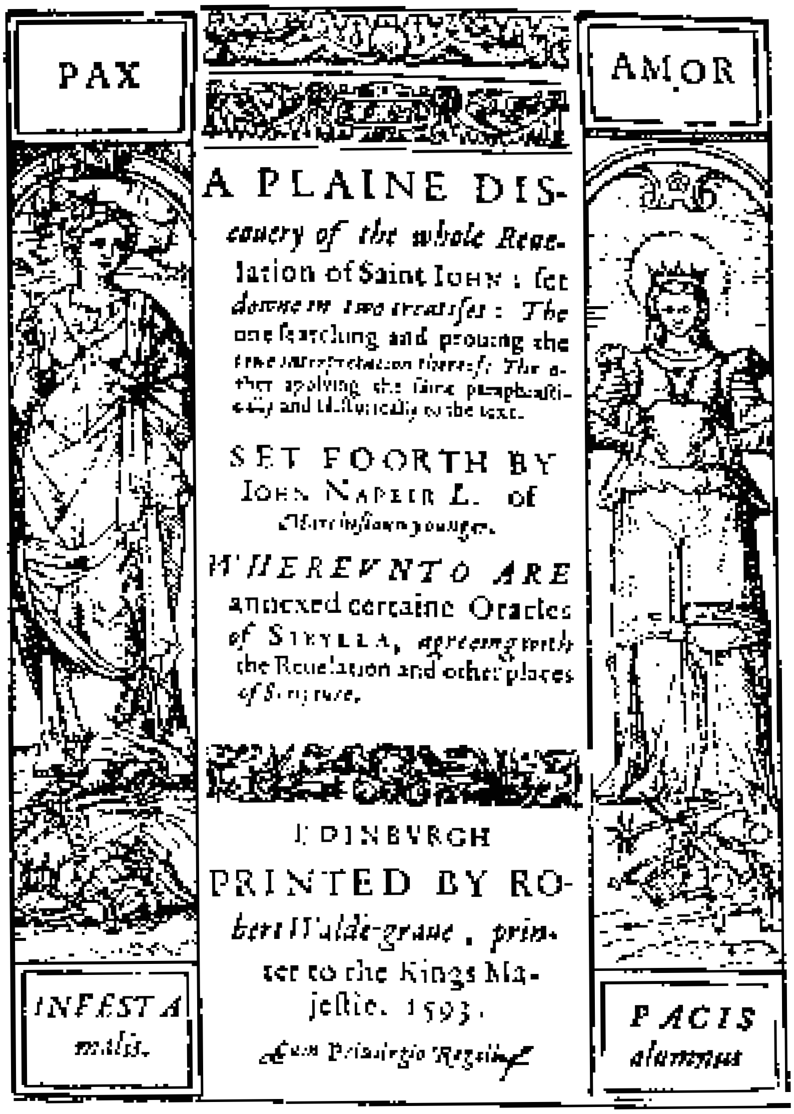
The revelacion of Jesus Christe, which God gave unto him, for to shewe unto his servauntes thynges which must shortly come to passe . . . Happy is he that redith, and they that heare the wordes of the prophesy . . . [*Revelation* Chapter 1, Tyndale translation]

– and given that in the succeeding 1500 or so years some of the predicted events must have happened, then this gives clues about how to match up the language of prediction with the historic record. So what Napier was seeking to establish was a function, if you like, between two continua: the historic time-line from the time of Christ onwards, and the narrative time-line of St John's vision as presented in the Apocalypse which is being mapped onto it. To evaluate the functional correlation, he had to make considered judgements about what trumpets are, what seals are, what candlesticks are, and so on, the conclusions of which he presented in a series of 36 numbered propositions. Once the function is established, from the information about the past which you have, you are then in a position to use the correlation to work out the things you don't know – in particular, the date of the last judgement.

I've described Napier's procedure in his *Plaine discovery* in this functional way in order to point up the similarities with what he was later doing in constructing logarithms. Napier constructed logarithms through considering two moving points, P and L, say, moving along a finite and an infinite line respectively, in such a way that while L is moving at constant speed, in arithmetical progression, P is moving geometrically, it's slowing down, in the original construction, its speed being proportional to the distance it still has to go. Then he defined the logarithm of the distance P had still to go as the distance the other point L has travelled. The idea that multiplication of terms in a geometric progression correspond to addition of terms in an arithmetical progression had long been familiar, from Greek times if not earlier. The fresh insight that Napier brought was to situate this in two continuous movements – he even uses the word 'fluxion' at one point – so that he could make inferences about one from what happened on the other.

So in very broad terms, both the *Plaine discovery* and Napier's construction of logarithms involve functional relationships between two continua, using information from one to make deductions about the other. It might be ill advised to push this parallel too far, but both are examples of Napier's overwhelming characteristic, his lateral thought in the service of making calculations easier. In some ways he was a computationalist, a calculator, even more strongly and more pervasively than he was the inventor of logarithms.

Part of his subsequent success and fame echoing down the ages is due to luck. It was amazing good fortune, which he could not have anticipated, that logarithms turned out in the course of the century after his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death to be not only a calculating device for astronomers and navigators – doubling the life of astronomers, as Laplace remarked – but also central to the development of mathematics itself. Already by the 1650s and 1660s it was becoming clear that logarithms were much deeper mathematical objects than their initial motivation might suggest, relating to the area measure of hyperbolas, and thus a vital tool for the integral calculus, as well as being thought of as an infinite series, which opened up another great swathe of mathematical analysis. The fact that we still teach the logarithm function to young people who wouldn't have a clue how to use logarithm tables or even what they are for, indicates how Napier's invention has transcended its original use and purpose.

Napier's genius was fundamentally that of an amazingly gifted and innovative calculator. His all-pervading interest in calculating showed itself especially strongly in his remarkable little book *Rabdologiae* which appeared in 1617, the year of his death. This described three inventions for aiding calculations, the so-called *Napier's rods*, the *promptuary*, and a *chessboard abacus*.

Napier's rods, or *Napier's bones*, are a physical realisation of an old method of multiplying numbers, known since the middle ages in Europe and maybe in India long before that. Thus the concept was old but its physical realisation was new, demonstrating Napier's lateral technological thinking. *Rabdologiae* explains how to construct the rods as well as how to use them for multiplication and division, taking square roots and cube roots, and doing the rule of three. These became very popular and there are still many sets of rods, generally in wood or ivory, in our museums.

The *promptuary* was a more complicated and more powerful modification of the rods, enabling ready handling of much larger numbers. It uses flat cards rather than rods, but with rather similar markings and factorings. It is sufficiently sophisticated that it has been called 'the first calculating machine', though it's not quite a machine as we usually understand the term, its operation depending on quite a lot of manual manipulation. The only known example of a promptuary from the time of Napier is in the Archeological Museum in Madrid, and was only recognised for what it is in the last twenty years.

The third of Napier's calculational devices, his chessboard abacus, is the most innovative and of greatest conceptual interest, even though he described it as 'more of a lark than a labour'. The fundamental insight is that multiplication of binary numbers is more straightforward than multiplication in base 10, which of course computers got around to realising 350 years later. So in Napier's procedure decimal numbers are converted into binary, the operation is carried out (multiplication, division or whatever) and then the result is converted back into a decimal number. Notice two things. One is that this transformation of base is really quite radical and innovative – no-one else had done this kind of thing before. The other thing you might notice is that the process of converting into different numbers, carrying out your operation and then coming back, is structurally the same as the logarithmic procedure; and indeed, one might argue, of his theological procedures.

Why do we remember John Napier? His deep significance may be that, along with others of his time, Napier was a central figure in the transformation of the mediaeval into the modern world-view, in a very specific way arising from his deep concern for computation and calculating effectiveness. We know the immediate context of logarithms and why they were taken up so widely and so rapidly: the need for ways of doing mathematical calculations was becoming evident to the navigators and others who were beginning to lay the foundations for the British imperial adventure. For some years, a century or more, it was increasingly clear that European expansion, geographically, in military engineering, in terms of trade and business practices, was predicated upon better mathematical skills. Napier happened to be working at a time when the idea of quantification was settling deep into the mindset of the movers and shakers of Renaissance Europe, and supplied a number of justifications for considering that how you handle and compute with numbers is a really important issue. In some ways there was nothing else like this conceptual revolution in the applicability of mathematics to the world until the statisticisation of inquiries in the 19th century.

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John Fauvel is Senior Lecturer in Mathematics at the Open University, UK. This article is based on a lecture to commemorate the 450th anniversary of John Napier's birth, given at Napier University, Edinburgh, on 1 December 2000. The event was organised jointly by Napier University and the International Centre for Mathematical Sciences, Edinburgh.

L'Unione Matematica Italiana

Giuseppe Anichini

The UMI (Italian Mathematical Union) was established in 1922. On 31 March of that year, Salvatore Pincherle, an eminent mathematician from Bologna, circulated a letter to all Italian mathematicians in which a possible national mathematical society was proposed. In July a tentative issue of the future *Bollettino* was published. About 180 mathematicians supported the proposal, and in December the first meeting was held and the first of the Society's by-laws received its approval. The UMI membership swelled to 400 by 1940 and currently stands at over 2700. The registered office remains in Bologna, in the Department of Mathematics.

The goals of the UMI were to communicate the nature of the mathematical sciences and how mathematics contributes to society, and to promote the understanding of mathematics by publishing high-level papers, by encouraging the output of high-quality expositions for members and students at all levels, and by organising meetings in order to stimulate the production and the exchange of ideas.

The formation of the UMI was inspired by the existence and the increasing growth of other mathematical societies, such as the Société Mathématique de France (1872), the Deutsche Mathematik Vereinigung (1891), the American Mathematical Society (1891) and, particularly, the International Mathematical Union (1920).

Before long, distinguished members, among them Luigi Bianchi and Vito Volterra, strongly supported Pincherle's initiative and they were presenting papers in the first issues of the formative journal.

One of the major achievements of the UMI during this period was the organisation of the meeting of the International Mathematical Union (IMU) in Bologna in 1928. Not only was the organisation carried out effectively, but a difficult political question was successfully confronted. Salvatore Pincherle, elected IMU President in 1924, had successfully worked to get together all those with a keen interest in mathematics, despite their nationality, by overcoming a consequence of the First World War. A strong difference of opinion existed between French mathematicians and the mathematicians of other countries, mainly concerning the invitation to the German delegation. In the event, around 840 mathematicians assembled in Bologna, and besides 336 people from Italy there were 76 mathematicians from Germany, 56 from France and 52 from the United States. The opening address was in Latin.

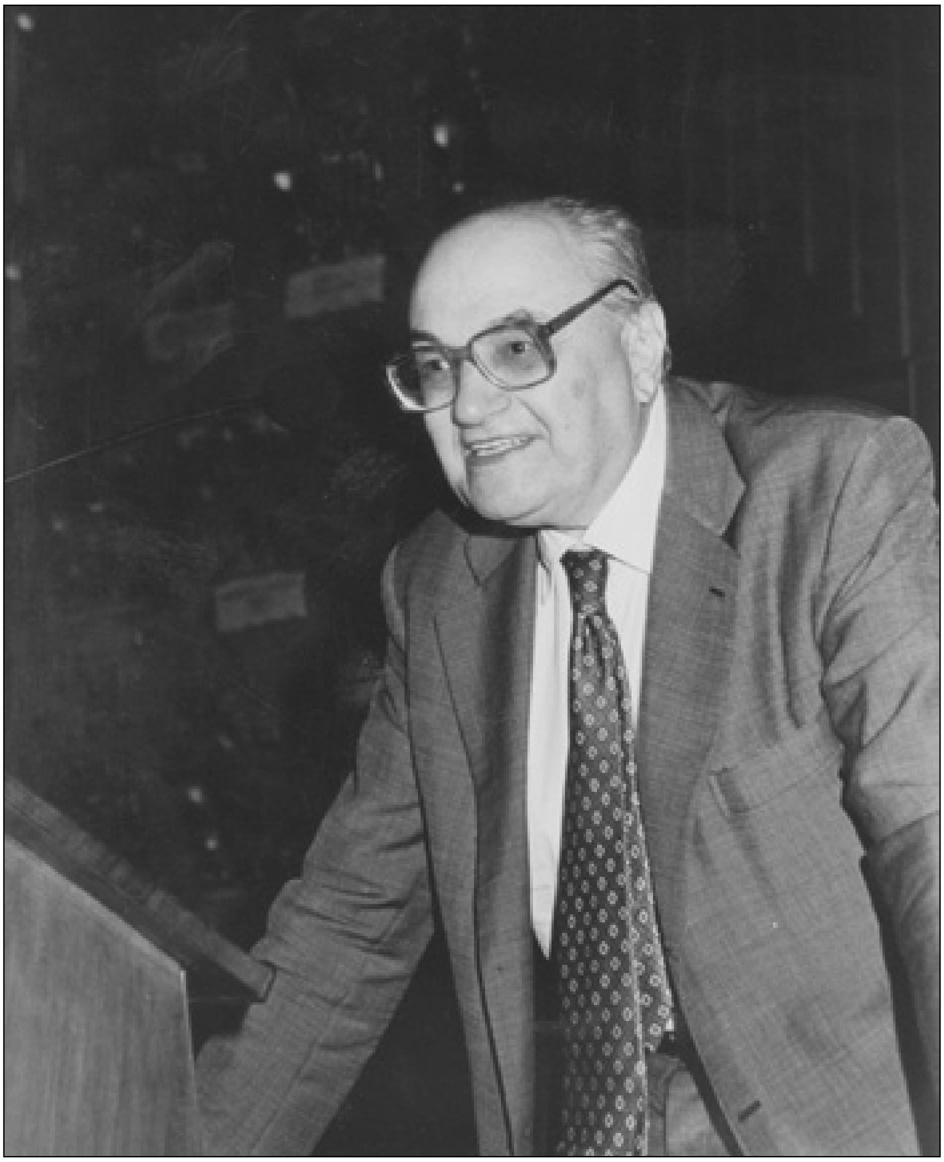
Four presidents: (from left to right) A. Figà-Talamanca, C. Pucci, E. Magenes and C. Sbordone

Currently the UMI organises a general meeting every four years, with a wide turn-out of mathematicians from Italy and overseas, in one of the cities where there is a mathematics department. Under the influence of Pincherle, the *Bollettino dell'Unione Matematica Italiana* was founded: at the beginning there were two sections devoted to 'Short communications' and 'Abstracts of papers published in other journals, Letters to the Society, News from the members, Book reviews, etc.'. In 1939 a special section devoted to the history of mathematics and to mathematical education was introduced.

Since then the *Bollettino* has increased substantially the number of papers of outstanding scientific quality. At present there are two sections of the *Bollettino* (Sections A and B) in which expository papers and high-level scientific papers are published.

Recent years have seen a huge increase in the diversity of activities in which the *Unione* is involved, from education, to popularisation, to institutional policy. The UMI has encouraged, and will continue to do so, the participation of research mathematicians in the reform of mathematics education at university level and at any high-school level. The UMI, in cooperation with the MPI (Italian Department of Education) and the MURST (Italian Department of University and Research), supports efforts to review and reform the undergraduate mathematics curriculum in response to current changes in the world.

Traditionally the UMI supports, as an institutional task, the Committee for



Professor Carlo Pucci, Honorary President

Mathematics Education, the Committee for Research and the Education of Mathematics in Engineering, and the Committee for the Mathematical Olympic games.

Prizes and awards

Since the sixties the *Unione* has sought to promote and reward mathematical achievements, mainly for young people, by means of prizes and awards. Currently four prizes are awarded by the UMI. These prizes are awarded on the recommendation of a Committee especially appointed by the Ufficio di Presidenza (Officers of the Society) of the UMI.

The *Premio Renato Caccioppoli* was established in 1960 with a donation by his family in memory of Renato Caccioppoli, late Professor of Mathematical Analysis at the University of Napoli. This prize is awarded every four years in recognition of an outstanding contribution to mathematical analysis by an Italian mathematician of no more than 38 years old. The prize amounts to ten million Italian lira (approximately 5200 euros).

The *Premio Giuseppe Bartolozzi* was established in 1969 with a donation by Professor Federico Bartolozzi and his family in memory of his son Giuseppe. This prize is awarded every two years in recognition of an outstanding contribution to mathematical research by an Italian mathematician of no more than 33 years old. The prize amounts to three million Italian lira (approximately 1500 euros).

The *Premio Franco Tricerri* was established in 1995, using funds collected by colleagues, friends and students of Franco Tricerri, Professor of Geometry at the University of Firenze, who tragically died in a plane accident in China in 1994. This prize is awarded every two years in recognition of an outstanding contribution to differential geometry by a graduate of not more than 3 years' standing in mathematics or physics. The prize amounts to two million Italian lira (approximately 1000 euros).

The *Premio Calogero Vinti* was established in 1998 with a donation by the family and former students of Calogero Vinti, Professor of Mathematical Analysis at the University of Perugia. This prize is awarded every four years in recognition of an outstanding contribution to mathematical analysis by an Italian mathematician of no more than 40 years old. The prize amounts to eight million Italian lira (approximately 4100 euros).

Publications

Apart from the *Bollettino*, several other publications are produced by the UMI. Since 1974 the *Notiziario dell'UMI* has appeared. This presents news of interest, about meetings, prizes and awards, education, Ph.D. achievements, and so on. There are ten issues each year, with supplements on special occasions.

The *Unione Matematica* also edits a series of *Quaderni*: a series of textbooks for young researchers aimed at arguments outside the usual mathematical path to the Ph.D. degree; a series of monographs covering a wide range of subjects in mathematics; a series of *Opere dei Grandi Matematici* including all (or a selection) of the papers of well-known Italian mathematicians. Among these have been Felice Casorati, Paolo Ruffini, Luigi Bianchi, Leonida Tonelli, Ulisse Dini, Giuseppe Peano, Gregorio Ricci-Curbastro, Vito Volterra, Ernesto Cesaro, Corrado Segre, Guido Fubini, Giuseppe Vitali, Renato Caccioppoli and Salvatore Pincherle.

The structure and the members

The UMI has an Executive Committee of four elected members: the President, the Vice-President, the Treasurer and the Secretary. The Scientific Committee consists of 19 members: those of the Executive Committee and 15 other elected members; elections take place every four years. The Scientific Committee often nominates special committees for specific reasons (mathematics education, Publications, the teaching of non-degree-level mathematics, etc.). Of the 2700 members, many are university researchers, while many others are schoolteachers or belong to industries or to public research centres.

Finally we recall the Presidents of the *Unione*.

After Salvatore Pincherle, the founding President, the Presidents of the UMI have been Luigi Berzolari, Enrico Bompiani, Giovanni Sansone, Alessandro Terracini, Giovanni Ricci, Guido Stampacchia, Enrico Magenes, Carlo Pucci, Vinicio Villani, Alessandro Figà Talamanca and Alberto Conte; the current President is Carlo Sbordone. In addition, Enrico Bompiani (1952-75) and Carlo Pucci (from 1995) were appointed Honorary Presidents by plenary meetings of the members.

The author is very indebted to the following papers for information:

Carlo Pucci, L'Unione Matematica Italiana dal 1922 al 1944: documenti e riflessioni, *Symposia Mathematica* **XXVII**, Istituto Nazionale di Alta Matematica *Francesco Severi*, Roma, 1992, 187 pages.

Giovanni Sansone, Le attivit dell'Unione Matematica Italiana nel primo cinquantennio della sua fondazione, *Bollettino UMI*, suppl. fasc. 2, Bologna, 1974, 8 pages.

Giuseppe Anichini is Professor of Mathematical Analysis in the Engineering Faculty of Firenze, Italy, and has been Secretary of the Unione Matematica Italiana since 1988.

The EULER project: achievements and continuation

Laurent Guillopé (Nantes) and Bernd Wegner (Berlin)

In this article we report on the EULER project, which has developed a web based search engine for distributed mathematical sources. The main features of this EULER prototype are uniform access to different sources, high precision of information, de-duplication facilities, user-friendliness and an open approach enabling participation of additional resources. We describe the functionalities of the EULER engine report on the transition from the prototype developed in the project to a consortium-based service in the internet.

Aims and achievements

The aim of the EULER project was to provide a system for strictly user-oriented, integrated-network-based access to mathematical publications. The period for the project terminated in September 2000. The EULER system has been designed to offer a 'one-stop shopping site' for users interested in Mathematics. An integration of all types of relevant resources has been taken into account: bibliographic databases, library online public access catalogues, electronic journals from academic publishers, online archives of pre-prints and grey literature, and indexes of mathematical Internet resources. They have been made interoperable, using common Dublin Core based metadata descriptions. A common user interface, called the 'EULER engine', assists the user in searching for relevant topics in different sources in a single effort. As a matter of principle, the EULER system has been designed as an open, scaleable and extensible information system. Mathematicians and librarians from mathematics in research, education and industry will be the main users and providers of such an enterprise.

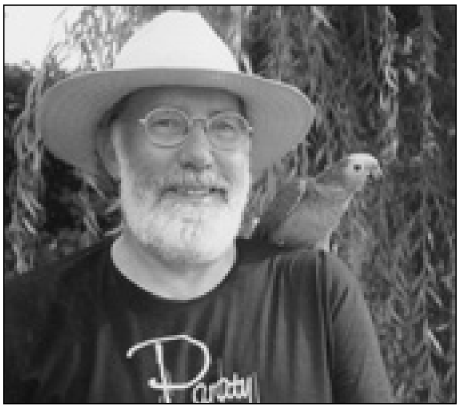
EULER is an EMS initiative and especially focuses on real user needs. The project has been funded by the European Union within the programme 'Telematics for Libraries'. Standard, widely used and non-proprietary technologies such as HTTP, SR/Z39.50 and Dublin Core (DC) are used. Common resource descriptions of document-like objects enable interoperability of heterogeneous resources. One of the main achievements of the project is the development of a DC-based metadata structure that can be used as a common target into which the metadata of the given resources could be converted.

At distributed servers, multi-lingual EULER service interfaces are provided as entry points to the EULER engine, offering browsing, searching, some document delivery and user support (help texts, tutorial, etc.). The interface is based on common user-friendly and widely used web browsers (public domain or commercial), such as Netscape. The multi-lingual user interface has the common features of every good Internet service and a self-explaining structure. Users have one single entry point to start their information search; this entry point contains browsing indices of authors and keywords, form-based searches for authors, titles and other relevant bibliographic information, and a selection of different information sources. Good de-duplication facilities enable to display the availability of the same item at different sites within the same record.

The partners of the EULER project

The currently accessible contents in the EULER prototype are provided by the partners of the project. This group includes libraries from all over Europe, which represent several different types of libraries: the State Library of Lower Saxony and University Library of Göttingen and the J. Hadamard library (University of Orsay) represent libraries with a national responsibility for collecting all publications in pure mathematics; the library of the Centrum voor Wiskunde en Informatica (Amsterdam) represents the typical research library of a national research centre; the University of Florence represents a typical university library with its distributed department libraries; the library of the Institut de Recherche Mathématique Avancée (University of Strasbourg) represents a typical library of an important mathematical institute.

In addition, a partner specialised in digital libraries and net-based information is represented by NetLab, the Research and Development Department at Lund University Library: they give a large set of classified internet resources, complementing a similar collection, the 'Math Guides', organised by the Göttingen Library. MathDoc Cell (Grenoble), as a national centre for coordination and resource-sharing of mathematics research libraries in France, contributes also in giving metadata of its national indexes on preprints and thesis. Via the partner FIZ Karlsruhe, *Zentralblatt MATH* provides a part of its contents as a freely accessible resource in the project. The EMS provides its Electronic Library of Mathematics as a resource, distributed through its EMIS system of Internet servers; scientific co-ordination of this library is currently organised with the Department of Mathematics of the Technical University of Berlin, the final partner of the EULER project.



Bernt Wegner with Einstein

The EULER service

Based on the structure described above, a subgroup of the current EULER partners decided to develop a service from the EULER prototype. It had been guaranteed during the project work that the EULER engine and other tools could be installed at new sites, and thus the group was able to go on with the current offer from EULER. It is expected that all resources made accessible during the project phase will remain open for the service, even if the corresponding partner cannot contribute further work to run the service. The current members of the group care about improvements to the EULER offer and handle software problems potentially coming up with new partners. In particular, the administration of access control (for resources beyond free metadata) is a challenge for the future. This will lead to an essential improvement of the document delivery facilities, and will motivate scientific publishers to support the system and make their contents accessible through EULER.

But also as a free search portal EULER will provide a very useful gateway to mathematics. The present aim is to get more libraries interested in participating in EULER. This means that they should make their catalogues accessible by providing the metadata of their holdings. The EULER engine will include their resource in the searches made by the user, and users will get a bigger choice of providers where they may ask for a copy of the documents they are interested in. The de-duplication check will provide them with comprehensive lists of where to find the documents (a book, journal article or other source), and having a good coverage of the main libraries in Europe, they will probably get a reference for where they will be offered the resource at very low cost.

Several additional libraries are already interested in discussing participation in the EULER service. A definite decision will take some time and the preparation of the metadata possibly even more, but most of these first contacts are very promising. The first bricks of a European catalogue of mathematics resources in the libraries have been installed, while others will be added.

Access to EULER is available through EMIS, the Information Service of the European Mathematical Society on the web (with 39 servers world-wide, see *www.emis.de*).

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The Price Spiral of Mathematics Journals and What to Do About It

Ulf Rehmann (Bielefeld)

The material given here was presented by the author in a talk at the annual assembly of the chairmen of German Math departments (KMathF) in May 2000, and also in a talk at the DMV Jahrestagung in September 2000, both in Dresden; see the website http://www.mathematik.uni-bielefeld.de/\char126rehmann/BIB/

In common with scientists of other disciplines, many of us mathematicians are, concerned about the rapid price increase for scientific journals. Recently a major reduction in the library budget for the Mathematical Library at Bielefeld University forced me, as the person responsible for our departmental library, to take some measures to decide which journals we should cancel. Since many departments are in a similar position, I think it may be useful to publicise the information that I gathered for my department.

As a first step I listed all the mathematical journals at Bielefeld, in a table on the Web, including the publishers, the 1998 price, and also some information from the citation index ISI: http://www.isinet.com/, such as the number of citations of that journal and the average impact of each article, insofar as this information was available to us.

With a little perl script, I made this list more transparent by ordering it with respect to various data: by publisher, by price, or by ISI number, so by a mouse click, I could locate the most expensive journals, those with the strongest impact factor, and so on. I then made this list public, not only to my department, but also to some colleagues and librarians worldwide, on the website *http://www.mathematik.uni bielefeld.de/\char126rehmann/BIB/*, and received a good response. In particular, I learned that at the same time the American Mathematical Society (AMS) had collected data on about 250 journals, including their respective numbers of pages and prices for the years 1994-99: see the website . Since that table was not very transparent at a first glance I decided, with permission from the AMS, to extract the data in a similar way as I did with the Bielefeld list, using some perl script to do computations of derived data, such as the price per page and the price increases over the years, and also to sort the table according to these data.

These tables contained some surprises. I learned that these 250 journals published 323,786 pages of refereed mathematics in 1999. I also learned to my great surprise that many journals had an average *annual* price increase of 15% or more during the last five or six years. *This inflation of 15% or more per year was during a time, when, in the western world, the average price inflation was usually below 2% or so. And this is true both for the price increase per volume and for the price increase per page!*

My conclusion is that mathematicians are funny consumers: they buy the material which they produce themselves from people – the commercial scientific publishers – who do nothing other than distribute that material at prices that increase beyond any reasonable measure. Not only that: mathematicians work hard for the publishers, usually without pay, by acting as their editors, collecting and refereeing the material written by their colleagues, and as authors, by perfectly typesetting their manuscripts, leaving almost nothing to do for the publishers but count their profits.

We have a really strange situation: it seems that serious people are willing to accept such price differences. For example, consider the following information (provided by the publishers themselves): *in 1999 'Inventiones Mathematicae' published 2894 pages for US$2760, a price per page of US$0.95, while 'Annals of Mathematics' published 2294 pages for US$220, a price per page of US$0.10.*

I chose these particular journals, since I think that they have a similar reputation. But when I mention these figures to colleagues, many are surprised by the drastic price difference. This is not an isolated situation: checking the tables will show you several similar cases.

A typical pattern might occur to you when you scan these tables. Journals that are cheap are very often produced by learned societies or by universities, while expensive journals are produced by private publishers. (Using the word "produced" here is often an abuse, since I pointed out above that the production is essentially done by the mathematicians themselves, while the publisher just does the distribution.)

Another fact might strike you. Whatever you might think about citation indices and impact factors, at least they don't seem to provide any arguments for preferring high-priced journals above others. If they suggest anything, it seems to be the opposite: if you click on the list ordered by 'impact' (see the website *http://www.mathematik.uni-bielefeld.de/\char126rehmann/BIB/impact.html*, you will find at the top many journals run by learned societies or universities and offered at moderate prices.

This situation is no longer acceptable. So what is to be done? It is certainly necessary for us all to become better acquainted with the facts concerning scientific publication: every mathematician should know more about journal prices. For that purpose I will, in accordance with the AMS, annually update the price tables as soon as new data is available, and I hope this will help others to make the right decisions concerning their local library budget.

We also should take appropriate decisions ourselves when acting as author, referee or editor, asking ourselves: Why are we submitting to an expensive journal? Why are we refereeing for it? And if you are an editor, why are you not taking any measures to produce the journal by yourself?

Meanwhile, there are successful journals run by mathematicians themselves, such as *Geometry and Topology*, *The Electronic Journal of Combinatorics*, or DOCUMENTA MATHEMATICA, just to mention a few among many. For example, I proved that, using the facilities of DOCUMENTA MATHEMATICA it was possible to produce a serious work such as the *ICM98 Proceedings* in shorter time, with better quality, and for much less money, than most of the earlier productions of ICM proceedings. To do such things is not hard nowadays, since many electronic tools are at our fingertips: I gave a public description of that production process at the Berkeley Workshop on *The Future of Mathematical Communication: 1999*, including financial details and the technical tools used: see the website *http://www.mathematik.uni-bielefeld.de/\char126rehmann/EP/index.html*. And I guess most of our colleagues working actively in the area of publication are willing to share their experiences and knowledge in order to support similar projects by others.

2001 anniversaries

The following mathematicians have anniversaries during 2001.
If you would like to write an anniversary article about any of them, please contact the Editor.

Muhammad al-Tusi (b. 1201)
Girolamo Cardano (b.1501)
Pierre de Fermat (b. 1601)
E. W. Tschirnhaus (b. 1651)
Mikhail Ostrogradsky and Julius Plücker (b. 1801)
Carl Jacobi (d. 1851)
Charles Hermite and Peter Guthrie Tait (d. 1901)
Richard Brauer, P. S. Novikov, I. G. Petrovsky and A. Tarski (b. 1901)

Digital models and computer-assisted proofs

Michael Joswig and Konrad Polthier

The first collection of reviewed electronic geometry models is available online at the new Internet server *http://www.eg-models.de* [1]. This archive is open for any geometer to publish new geometric models, or to browse this site for material to be used in education and research. Access to the server is free of charge.

The geometry models in this archive cover a broad range of mathematical topics from geometry, topology and, to some extent, numerics. Examples are geometric surfaces, algebraic surfaces, topological knots, simplicial complexes, vector fields, curves on surfaces, convex polytopes, and in some cases, experimental data from finite element simulations.

All models in this archive are reviewed by an international team of editors. The criteria for acceptance follow the basic rules of mathematical journals and are based on the formal correctness of the data set, the technical quality, and the mathematical relevance. This strict reviewing process ensures that users of the EG-Models archive obtain reliable and enduring geometry models. For example, the availability of certified geometry models allows for the validation of numerical experiments by third parties. All models are accompanied by a suitable mathematical description. The most important models will be reviewed by the *Zentralblatt für Mathematik*.

We are advocating the construction and submission of digital geometric models from various areas of mathematics. The advantages of these digital models go beyond those of the classical plaster shapes and dynamic steel models of earlier days. At the end of the 19th century several mathematicians felt the need to handle physically the geometric objects they thought about. In particular, Felix Klein and Hermann Amandus Schwarz in Göttingen built many models of curves, surfaces and mechanical devices for teaching and other educational purposes.

What are the main reasons for today's mathematicians to construct digital models of geometric shapes and make them available via the EG-Models server? There are obvious educational aspects, as for the historical models, and the means of interactive visualisation are definitively useful for scientific purposes, too.

But the focus of this article is another, somewhat different, view. Nowadays computer generated or assisted proofs enter virtually all areas of mathematics, and still the majority of the mathematicians are reluctant to accept the validity of such results. On the one hand, it seems somewhat strange to abstain completely from using tools such as the computer for doing mathematics, disregarding, maybe, aesthetic arguments. On the other hand, the inherent property of a proof is its verifiability; that is, verifiable by someone who is sufficiently trained. But this very property of a proof might be challenged in individual cases, where a computer is involved to solve a task too arduous or too tiring for any human. We are not going to raise the general question about the development of the mathematical culture, but we do believe that the installation of a server for mathematical models can help to improve the transparency of computer assisted proofs. For instance, think of a proof that is established by a computer construction of some complicated geometric shape. A standardised description, independently checked by experts and available to everyone, would provide an enormous potential for validation.

Using the digital models, interested mathematicians can verify the claims on their own, using appropriate software of their choice. Moreover, once there is a model available, it is possible to perform one's own computational experiments on this data set. This could be a numerical evaluation as well as a search for another property yet to be analysed for this model.

Each model comes with a detailed description that identifies the author, explains the mathematical purpose, and includes references to other sources of information. Each model has a unique identification number for unambiguous citation. Each model is equipped with qualified metadata information, and therefore, the archive can be searched via specialized search engines such as those from EMIS and MathNet /. Each model itself is represented by a master file from a fixed set of file formats, including XML formats specified by DTDs. By restricting the data formats we want to ensure that the server's information can be kept up to date on a technical level. Additional files in arbitrary formats are welcome for explanatory purposes.

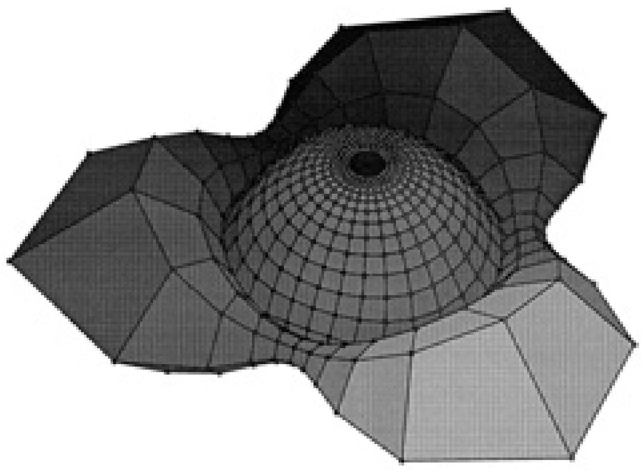
The Electronic Geometry Models Server opened in November 2000.

References

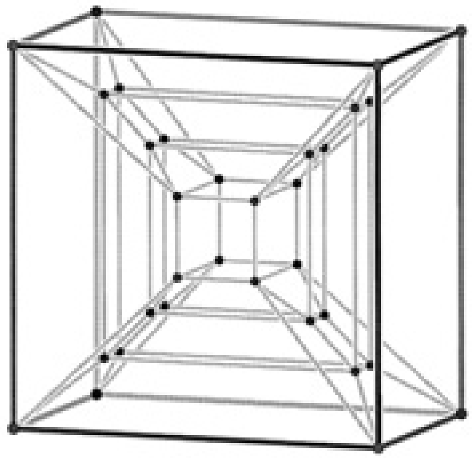
1. *Electronic Geometry Models*, *http://www.eg-models.de*

2. Udo Hertrich-Jeromin, *Isothermic cmc-1 Cylinder*, Electronic Geometry Models, No. 2000.09.038, DarbouxSphere_Master.jvx.

3. Michael Joswig and Günter M. Ziegler, *A neighborly cubical 4-polytope*, Electronic Geometry Models, No. 2000.05.003, C45_Master.poly.



Darboux transform of a spherical discrete isothermic net [2]. Given the data it is easy to verify that this describes an isothermic surface. Additionally, it can be checked that this surface has discrete constant mean curvature.



Schlegel diagram of a cubical 4-polytope whose graph is isomorphic to the graph of the 5-dimensional cube [3].

Forthcoming conferences

Compiled by Kathleen Quinn

Please e-mail announcements of European conferences, workshops and mathematical meetings of interest to EMS members, to k.a.s.quinn@open.ac.uk. 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 2001

8-18: ICMS Instructional Conference on Nonlinear Partial Differential Equations, Edinburgh, UK
Information:
Web site: http://www.ma.hw.ac.uk/icms/currrent

28-3 February: 2001 XXI International Seminar on Stability Problems for Stochastic Models, Eger, Hungary
Information:
e-mail: stabil@math.klte.hu or kolchin@mi.ras.ru
Web site: http://neumann.math.klte.hu/~stabil http://bernoulli.mi.ras.ru
[For details, see EMS Newsletter 36]

February 2001

February – July: Random Walks special semester, Vienna, Austria
Scope: the semester will be dedicated to various problems connected with stochastic processes on geometric and algebraic structures, with an emphasis on their interplay, and also on their interaction with theoretical physics
Topics: some of the focal points are: probability on groups; products of random matrices and simplicity of the Lyapunov spectrum; boundary behaviour, harmonic functions and other potential theoretic aspects; Brownian motion on manifolds; combinatorial and spectral properties of random walks on graphs; random walks and diffusion on fractals
Main speakers: Alano Ancona (Paris), Martine Babillot (Orléans), Martin Barlow (Vancouver), Itai Benjamini (Rehovot), Rob van den Berg (Amsterdam), Donald Cartwright (Sydney), Davide Cassi (Parma), Thierry Coulhon (Cergy), Bernard Derrida (Paris), Persi Diaconis (Stanford), Steven Evans (Berkeley), Alex Furman (Chicago), Hillel Furstenberg (Jerusalem), Rostislav Grigorchuk (Moscow), Geoffrey Grimmett (Cambridge), Yves Guivarch (Rennes), David Handelman (Ottawa), Pierre de la Harpe (Genève), Frank den Hollander (Nijmegen), Barry Hughes (Melbourne), Felix Izrailev (Puebla), Michael Keane (Amsterdam), Yuri Kifer (Jerusalem), Gregory Lawler (Durham), Joel Lebowitz (New Brusnwick), Francois Ledrappier (Paris), Russ Lyons (Bloomington), Gregory Margulis (New Haven), Fabio Martinelli (Rome), Stansilav Molchanov (Charlotte), Sergei Nechaev (Paris), Amos Nevo (Haifa), Yuval Peres (Jerusalem), Ben-Zion Rubshtein (Beer-Sheva), Laurent Saloff-Coste (Ithaca), Oded Schramm (Rehovot), Jeff Steif (Goeteborg), Toshikazu Sunada (Sendai), Domokos Szasz (Budapest), Balint Toth (Budapest), Anatoli Vershik (St. Petersburg), George Willis (Newcastle, NSW)
Programme: there will be two separate main periods of activity in the first (February/March) and in the second (May/June/July) halves of the semester. The first period will start with a two-week workshop with the general theme *Random Walks and Statistical Physics*, 19 February - 2 March 2001. Towards the end of the second period there will be another two-week workshop with the general theme *Random Walks and Geometry*, 25 June - 6 July 2001
Organising committee: Vadim A. Kaimanovich (Rennes, France), Klaus Schmidt (Vienna, Austria), Wolfgang Woess (Graz, Austria)
Site: Erwin Schrödinger Institute
Information:
e-mail: rwalk@esi.ac.at
Web site: http://www.esi.ac.at/Programs/rwalk 2001.html

15-16: Workshop on Fractional Brownian Motion: Stochastic Calculus and Applications, Barcelona
Speakers include: Coutin, Hu, Memin, Mishura, Nualart, Oksendal, Qian, Russo, Valkeila, Zaehle
Site: Facultat de Matemàtiques, Universitat de Barcelona
Information:
Web site: http://orfeu.mat.ub.es/~gaesto/welcome.htm

15-19: Analytic Methods of Analysis and Differential Equations (AMADE-2001), Minsk, Belarus
Topics: integral transforms and special functions; differential equations and applications; integral, difference, functional equations and fractional calculus; real and complex analysis
Main speakers: P. Adler (France), A.B. Antonevich (Belarus), A.E. Barabanov (Russia), H. Begehr (Germany), V.I. Burenkov (UK), L. de Castro (Portugal), I.V. Gaishun (Belarus), Yu.V. Gandel (Ukraine), H.-J. Glaeske (Germany), R. Gorenflo (Germany), V.V. Gorokhovik (Belarus), V.I. Gromak (Belarus), V.A. Il'in (Russia), N.A. Izobov (Belarus), N.K. Karapetyanz (Russia), A. Karlovich (Mexico), A.A. Kilbas (Belarus), V. Kiryakova (Bulgaria), V.I. Korzyuk (Belarus), M. Lanza de Cristoforis (Italy), A. Laurincikas (Lithuania), F. Mainardi (Italy), L.G. Mikhailov (Tadzhikistan), V.V. Mityushev (Poland), E.I. Moiseev (Russia), A.M. Nakhushev (Russia), Yu.V. Obnosov (Russia), Ja.V. Radyno (Belarus), F. Rebbani (Algeria), M. Reissig (Germany), O.A. Repin (Russia), M. Stojanovich (Yugoslavia), J.J. Trujillo (Spain), N.A. Virchenko (Ukraine), Vu Kim Tuan (Kuwait), N.I. Yurchuk (Belarus), L.A. Yanovich (Belarus), P.P. Zabreiko (Belarus), E.I. Zverovich (Belarus)
Languages: Russian, English
Call for papers: the deadline for one-page abstracts is 1 January; see Web site below
Programme committee: V.I. Korzyuk (Belarus), L.A. Aksent'ev (Russia), V.I. Burenkov (UK), P. Butzer (Germany), R. Gorenflo (Germany), V.I. Gromak (Belarus), V.A. Kakichev (Russia), V.S. Kiryakova (Bulgaria), G.S. Litvinchuk (Portugal), O.I. Marichev (USA), S.A. Minyuk (Belarus), Yu.V. Obnosov (Russia), Ya.V. Radyno (Belarus), V.N. Rusak (Belarus), S. Rutkauskas (Lithuania), H.M. Srivastava (Canada), J.J. Trujillo (Spain), M.A. Sheshko (Poland), N.A. Virchenko (Ukraine), L.A. Yanovich (Belarus), P.P. Zabreiko (Belarus), E.I. Zverovich (Belarus). Organizing committee: Academician I.V. Gaishun (Belarus), Academician V.A. Il'in (Russia), A.V. Kozulin (Belarus), A.A. Kilbas (Belarus), M.V. Dubatovskaya (Belarus), S.V. Rogosin (Belarus), H. Begehr (Germany), H.-J. Glaeske (Germany), V.V. Gorokhovik(Belarus), N.A. Izobov (Belarus), N.K. Karapetyants (Russia), A. Kufner (Czech), M. Lanza de Cristoforis (Italy), P.A. Mandrik (Belarus), V.V. Mityushev (Poland), E.I. Moiseev (Russia), M. Saigo (Japan), S.G. Samko (Portugal), A.A. Sen'ko (Belarus), N.I. Yurchuk (Belarus)
Proceedings: to be published in *Integral Transform and Special Functions* and in *Proc. Inst. Math.* (Minsk)
Information:
e-mail: amade99@mmf.bsu.unibel.by
Web site: http://amade.virtualave.net

19-23: New Trends in Potential Theory and Applications, Bielefeld, Germany

25-1 March: NATO Advance Research Workshop: Application of Algebraic Geometry to Coding Theory, Physics, and Computation, Eilat, Israel
Information:
e-mail: NATO@macs.biu.ac.il
Web page: http://www.mat.uniroma2.it/~cilibert/workshop.html
[For details, see EMS Newsletter 37]

March 2001

18-24 Geometric Analysis and Index Theory Conference, Trieste, Italy
Information:
Web site:
http://www.sissa.it/~bruzzo/ncg2001/ncg2001.html

26-29: Numerical Methods for Fluid Dynamics, Oxford, UK
Aim: to bring together mathematicians, engineers and other scientists in the field of computational fluid dynamics, to review recent advances in mathematical and computational

techniques for modelling fluid flows
Topics: all areas of CFD but with particular emphasis given to adaptivity, biomedical modelling and innovative methods in CFD
Invited speakers: include: M.J. Baines (Reading), T.J. Barth (NASA Ames), J.-D. Benamou (INRIA-Rocquencourt), F. Brezzi (Pavia), S.M. Deshpande (IISC-Bangalore), C. Farmer (Geoquest), D. Kr"ner (Freiburg), R. LeVeque (Washington), D. Noble (Oxford), R. Rannacher (Heidelberg), P.L. Roe (Michigan), S.J. Sherwin (Imperial-London), E. Süli (Oxford), N.P. Weatherill (Swansea)
Programme: invited lectures, 20-minute contributed talks and poster sessions. These will be selected mainly, but not exclusively, on the basis of their likely contribution to the above themes
Organiser: this is the seventh international conference on CFD organised by the ICFD (Institute for Computational Fluid Dynamics), a joint research organisation at the Universities of Oxford and Reading
Organising committee: M.J. Baines (Reading), M.B. Giles (Oxford), M.T. Arthur (DERA, Farnborough), M.J.P. Cullen (ECMWF), M. Rabbitt (British Energy)
Prize: a feature of the meeting will be the third award of 'The Bill Morton Prize' for a paper on CFD by a young research worker. The Prize papers will be presented by the authors at a special session of the Conference and the prize will be presented at the Conference dinner
Information: contact Mrs B. Byrne, Oxford University Computing Laboratory, Wolfson Building, Parks Road, Oxford OX1 3QD, UK, *tel*: +44-1865-273883, *fax*: +44-1865-273839
e-mail: bette@comlab.ox.ac.uk
Web site: http://web.comlab.ox.ac.uk/ oucl/people/bette.byrne.html

26-29: Quantum Field Theory, Noncommutative Geometry and Quantum Probability Workshop, Trieste, Italy
Web site: http://www.sissa.it/~bruzzo/ncg2001/ncg2001.html

April 2001

2-6: Lévy Processes and Stable Laws, Coventry, UK
Information:
*Web sit*e: http://science.ntu.ac.uk/msor/conf/Levy/

7-9: 16th British Topology Meeting, Edinburgh, UK
Information:
*Web sit*e:

9-12: 53rd British Mathematical Colloquium, Glasgow, Scotland
Sponsors: The Edinburgh Mathematical Society, the Glasgow Mathematical Journal Trust and the London Mathematical Society
Special sessions: partial differential equations (Jean-Yves Chemin, Pierre Collet, Emmanuel Grenier, John Toland) and modular forms (Kevin Buzzard, Ernst-Ulrich Gekeler, Jacques Tilouine)
Plenary speakers: Henri Berestycki (Paris), Michel Broué (Paris), Henri Darmon (Montreal), Clifford Taubes (Harvard)
Other speakers: Nikolaos Bournaveas, Rob de Jeu, Kenneth Falconer, Cameron Gordon, Alexander Ivanov, Mark Jerrum, Paul Martin, Steffen König, Oleg Kozlovski, Ian Leary, Ran Levi, James McKee, Viacheslav Nikulin, Robin Wilson
Registration: £30 before 26 February, £40 afterwards
Information: Department of Mathematics, University of Glasgow, Glasgow G12 8QW
e-mail:
Web site: http://www.maths.gla.ac.uk/bmc2001

15-21 : Spring School in Analysis, Paseky nad Jizerou, Czech Republic
Theme: Banach spaces
Main speakers: Joram Lindenstrauss (The Hebrew University of Jerusalem), Israel Gideon Schechtman (The Weizmann Institute of Science, Rehovot, Israel), Yoav Benyamini (The Technion, Haifa, Israel), Gilles Lancien (Université de Franche-Comte, Besancon Cedex France), W. B. Johnson (not yet confirmed, Texas A&M University, United States)
Language: English
Organising committee: Jaroslav Lukes, Jan Rychtar (Czech Republic)
Grants: probably support for a limited number of students
Deadlines: for reduced fee, 15 January; for support, 15 January
Information:
e-mail: paseky@karlin.mff.cuni.cz
Web site: http://www.karlin.mff.cuni.cz/katedry/kma/ss/apr01/ss.htm

May 2001

27-2 June: Spring School in Analysis: Function Spaces and Interpolation, Paseky nad Jizerou, Czech Republic
Theme: function spaces and interpolation
Topics: function spaces, interpolation, rearrangement estimates, Sobolev inequalities, *K*-divisibility, Calderon couples, extrapolation
Main speakers: A. Cianchi (University of Florence, Italy), M. Cwikel (Technion, Haifa, Israel), M. Milman (Florida Atlantic University, USA)
Language: English
Organizing committee: Jaroslav Lukes, Lubos Pick (Czech Republic)
Lecture notes: notes containing main talks to be published
Grants: probably support for a limited number of students
Deadlines: for reduced fee, 15 February; for support, 15 February
Information:
e-mail: pasejune@karlin.mff.cuni.cz
Web site: http://www.karlin.mff.cuni.cz/katedry/kma/ss/jun01/ss.htm

28-1 June: Harmonic morphisms and harmonic maps, Marseille, France
Aim: to gather specialists four years after the first international conference on harmonic maps and harmonic morphisms, brest97
Main speakers: (to be confirmed) P. Baird (France), R. Bryant (USA), F.E. Burstall (UK), J. Eells (UK), B. Fuglede (Danemark), S. Gudmundsson (Sweden), F. Helein (France), S. Ianus (Romania), D. Kotschick (Germany), L. Lemaire (Belgium), P. Li (USA), M. Micallef (UK), C. Negreiros (Brazil), Y. Ohnita (Japan), Y.L. Ou (China), F. Pedit (USA), Z. Tang (China), B. Watson (Jamaica), J.C. Wood (UK)
Programme: one-hour lectures and thirty-minute talks
Call for papers: prospective speakers should contact M. Ville (e-mail below)
Programme committee: J. Eells (Cambridge); L. Lemaire (Brussels); J.C. Wood (Leeds)
Organising committee: M. Ville (Ecole Polytechnique), E. Loubeau (Brest), S. Montaldo (Cagliari).
Sponsors: CIRM, Ministries
Proceedings: will be submitted to a publisher
Site: Centre International de Rencontres Mathématiques, Luminy
Grants: for information on financial support, contact M. Ville (e-mail below)
Deadlines: no deadline but limited number of seats
Information:
e-mail: ville@math.polytechnique.fr
Web-site: http://beltrami.sc.unica.it/harmor/

June 2001

4-9: Fractals in Graz 2001, Analysis-Dynamics-Geometry-Stochastics, Graz, Austria
[Loosely linked to a special semester on random walks at the Erwin Schrödinger Institute in Vienna. For further information see http://www.esi.ac.at/Programs/rwalk2001.html]
Theme: fractals
Scope: analysis on fractals, fractals in dynamics, geometry of fractals, stochastic processes on fractals
Aim: to bring together researchers from various mathematical areas who share a common interest in fractal structures, with open-mindedness to interaction between different fields inside and outside the fractal world. The subtitle of the conference gives the range of topics
Main speakers: Martin Barlow (Canada), Thierry Coulhon (France), Kenneth Falconer (UK), Hillel Furstenberg (Israel), Ben Hambly (UK), Jun Kigami (Japan), Takashi Kumagai (Japan), Michel Lapidus (USA), Andrzej Lasota (Poland), Michel Mendès-France (France), Robert Strichartz (USA), Alexander Teplyaev (Canada)
Language: English
Organising committee: Martin Barlow (Vancouver), Robert Strichartz (Ithaca), Peter Grabner (Graz), Wolfgang Woess (Graz)
Site: Technical University of Graz
Information:
e-mail: fractal@weyl.math.tu-graz.ac.at
Web site: http://finanz.math.tu-graz.ac.at/~fractal/

18-22: Fourth European Conference on Elliptic and Parabolic Problems: Theory, Rolduc, Netherlands
[The former Pont-à-Mousson meeting is now split into two conferences. This one is devoted to more theoretical aspects; the other, with more emphasis on applications, takes place in Gaeta, Italy, 24-28 September 2001]
Topics: besides elliptic and parabolic issues, topics include geometry, free boundary problems, fluid mechanics, evolution problems in general, calculus of variations, homogenization, control, modelling and numerical analysis

Invited speakers: include C. Bandle (Basel), H. Beirão da Veiga (Pisa), X. Cabré (Barcelona), P. G. Ciarlet (Paris), M. Escobedo (Bilbao), H. Farwig* (Darmstadt), M. Fila (Bratislava), D. Hilhorst* (Orsay), D. Kinderlehrer (CMU), Yan-Yan Li (Rutgers), F.H. Lin (New York), S. Luckhaus (Leipzig), H. Matano (Tokyo), U. Mosco (Rome), J.C.C. Nitsche (Minneapolis), F. Otto (Bonn), M. Padula (Ferrara), P. Pedregal* (Ciudad Real), L.A. Peletier (Leiden), J.F. Rodrigues* (Lisbon), C.J. van Duijn (Amsterdam);
* organisers of thematic sessions
Organising committee: J. Bemelmans (Aachen), B. Brighi, A. Brillard (Mulhouse), M. Chipot (Zurich), F. Conrad (Nancy), I. Shafrir (Haifa) V. Valente (IAC, Rome), G. Vergara-Caffarelli (Rome)
Programme: in addition to the main lectures parallel sessions of short communications will be organized.
Deadline: for submission of abstracts, 1 April
Note: The division between theory and applications will not be enforced, but a theoretical subject will certainly have a greater audience in Rolduc, and an applied one a greater audience in Gaeta
Information:
e-mail: rolduc@amath.unizh.ch, gaeta@amath.unizh.ch
Web site: http://www.math.unizh.ch/rolducgaeta

19-22: Computational Intelligence, Methods and Applications (CIMA 2001), Bangor, UK
Information:
e-mail: planning@icsc.ab.ca; operating@icsc.ab.ca; l.i.kuncheva@bangor.ac.uk
Web site: http://www.icsc.ab.ca/cima2001.htm
[For details, see EMS Newsletter 37]

25-29: Cmft2001, Computational Methods and Function Theory, Aveiro, Portugal
Theme: the various aspects of interaction of function theory and scientific computation; other areas from complex variables (including generalisations such as quaternions, etc.), approximation theory and numerical analysis are also covered.
Aim: to assist in the creation and maintenance of contact between scientists from diverse cultures; there is a strong effort to encourage the participation of highly qualified scientists who normally have only limited opportunity to attend international conferences
Organisers: H. Malonek (Aveiro, Portugal), N. Papamichael (Nicosia, Cyprus), St Ruscheweyh (Würzburg, Germany), E. B. Saff (Tampa, USA)
Note: anyone interested in being invited should send the following details by ordinary mail or e-mail: name, affiliation, address, phone/fax/e-mail, please send me the Second Announcement, I intend to submit a communication (yes or no)
Information: contact: H. R. Malonek, Departamento de Matematica Universidade de Aveiro, Portugal
tel./fax: +351-234-370359 /+351-234-382014
e-mail: cmft2001@mail.ua.pt
Web site: http://event.ua.pt/cmft2001/

July 2001

1-6: Eighteenth British Combinatorial Conference, Brighton, United Kingdom
Information:
e-mail: bcc2001@susx.ac.uk
Web sites: http://www.maths.susx.ac.uk/Staff/JWPH/
http://hnadel.maps.susx.ac.uk/TAGG/Confs/BCC/index.html
[For details, see EMS Newsletter 36]

4-6: MathFIT workshop: The Representation and Management of Uncertainty in Geometric Computations, Sheffield, UK
Information:
Web site: http://www.shef.ac.uk/~geom2001/

5-7: British Congress of Mathematics Education, Keele, UK
Information:
Web site: http://www.bcme.org.uk
8-13: Second Workshop on Algebraic Graph Theory, Edinburgh, Scotland
Main topics: the new fullerenes, eigenspace techniques, generalisations from distance-regular graphs, topological considerations
Key speakers: N.L. Biggs (London School of Economics), P.J. Cameron (Queen Mary & Westfield College), D. Cvetkovic (Belgrade), P.W. Fowler (Exeter), M.A. Fiol (Barcelona), W. Haemers (Tilburg), P. Hansen (Directeur du GERAD, Montreal), B. Mohar (Ljubljana), B. Shader (Wyoming)
Information:
e-mail: p.rowlinson@maths.stir.ac.uk
Web site: http://www.ma.hw.ac.uk/icms/current/graph/index.html

9-22: European summer school: Asymptotic combinatorics with application to mathematical physics, St Petersburg, Russia
Aim: to observe the recent progress in the asymptotic theory of Young tableaux and random matrices from the point of view of combinatorics, representation theory and theory of integrable systems. Systematic courses on the subjects and current investigations will be presented
Scientific committee: E. Brezin (ENS, France), O. Bohigos (Orsay, France), P. Deift (U.Penn, USA), L. Faddeev (POMI, Russia), V. Malyshev (INRIA, France), A. Vershik (POMI, Russia, Chair)
Main speakers: P. Biane (Paris), E. Brezin (Paris), P. Deift (USA), K. Johansson (Stockholm), V. Kazakov (Paris), R. Kenyon (Orsay), M. Kontsevich (France), A. Lascoux (France), A. Okoun'kov (USA), G. Ol'shansky (Moscow), L. Pastur (Paris), R. Speicher (Heidelberg), R. Stanley (MIT), C. Tracy (USA), H. Widom (USA)
Topics: asymptotic combinatorics and its applications in the theory of integrable systems, random matrices, free probability, quantum field theory, etc. Also those topics concerned with low-dimensional topology, QFT, new approach in Riemann-Hilbert problem, asymptotics of the orthogonal polynomials, symmetric functions, representation theory and random Young diagrams
Local organising cmmittee: A. Vershik, Ju. Neretin., K. Kokhas., E. Novikova
Site: International Euler Institute
Language: English
Sponsors: RFBR, EMS, NATO, local funds
Information:
e-mail: emschool@pdmi.ras.ru
Web site: .pdmi.ras.ru/EIMI/2001/emschool/index.html

15-20: Algorithms for Approximation IV International Symposium, Huddersfield, UK
[in celebration of the 60th Birthdays of Claude Brezinski, Maurice Cox and John Mason]
Theme: approximation theory
Aim: to provide an opportunity for exchange of ideas about current theoretical and practical research on approximation
Topics: radial basis functions, splines, rational approximation, computer-aided geometric design, shape preserving methods, wavelets, support vector machines and neural networks, non-linear approximation, spectral methods, orthogonal polynomials, approximation on a sphere, special functions, applications
Main speakers: M. Buhmann (Germany), M.G. Cox (UK), K. Driver (South Africa), M. Floater (Norway), T. Goodman (UK), W. Light (UK), C.A. Micchelli (USA), L. Nielsen (Denmark), G. Plonka (Germany), T. Poggio (USA), L.L. Schumaker (USA), G.A. Watson (UK)
Special sessions: splines, wavelets, orthogonal polynomials and pade approximation, integrals and integral equations, the mathematics and statistics of metrology, mathematical modelling methods in medicine
Proceedings: to be published as a special issue of *The Journal of Numerical Algorithms* by Kluwer Academic/Plenum Publishers
Programme committee: C. Brezinski (France), M. Buhmann (Germany), T. Goodman (UK), T. Lyche (Norway), L.L. Schumaker (USA), G.A. Watson (UK).
Organising committee: I.J. Anderson (UK), J.C. Mason (UK), D.A. Turner (UK), M.G. Cox (UK), A.B. Forbes (UK), J. Levesley (UK), W. Light (UK)
Sponsors: European Office Of Aerospace Research And Development, London Mathematical Society, Software Support For Metrology (National Physical Laboratory, Department Of Trade And Industry)
Site: School of Computing and Mathematics, University of Huddersfield, Queensgate, Huddersfield, HD1 3DH, UK
Grants: a limited amount of money will be available as grants for *bona fide* research students and people from less advantaged countries
Deadlines: for abstracts, 31 December 2000 (please e-mail the symposium committee at the address below if you require an extended deadline); for registration, 15 June (late registration will be allowed, but will incur a ten percent surcharge)
Note: registration forms are available at the Web site below
Information:
e-mail: A4a4@Hud.Ac.Uk
Web-site: Http://Helios.Hud.Ac.Uk/A4a4/

23-27: 20th IFIP TC 7 Conference on System Modelling and Optimization, Trier, Germany
Scope: IFIP TC7 promotes applications, the development of new techniques and theoreti-

cal research in all areas of system modelling and optimisation. Each biennial conference brings together TC7 working groups and a wide scientific and technical community, who share information through lectures and discussions
Main speakers: A. Ben-Tal (Haifa), O.L. Mangasarian (Madison), K.-H. Hoffmann (Bonn), J.-S. Pang (Baltimore), F. Jarre (Düsseldorf), R. Rackwitz (München), C.T. Kelley (Raleigh), R. Schultz (Duisburg), K. Kunisch (Graz), P.L. Toint (Namur)
Language: English
Deadlines: for submission of extended abstracts, 31 December 2000
Organising committee: E. Sachs (Chair), Universitaet Trier FB IV - Mathematik
Information:
e-mail: ifip2001@uni-trier.de
Web site: http://ifip2001.uni-trier.de

August 2001

5-18 2001 BALTICON 2001, BALTICON 2001, Banach algebra theory in context, Krogerup Hojskole, Humlebaek, Denmark
[15th in a series of conferences and workshops]
Topics: the emphasis will be on the connections between Banach algebra theory and other areas of mathematics; for instance (listed alphabetically), automatic continuity theory, Banach spaces, homological algebra theory, locally compact groups and harmonic analysis, operator theory, spectral theory, topology
Invited speakers include: G. Dales, J. Esterle, A.Ya. Helemskii, B.E. Johnson, C. Read and G. Willis
Local organising committee: Niels Grønbæk and Kjeld Bagger Laursen, both University of Copenhagen
Sponsors: include the Mathematics Department of the University of Copenhagen, the Danish Science Research Council, Pomona College
Call for papers: all interested are urged to sign up and to submit papers
Site: Krogerup Hojskole, approx. 25 miles north of Copenhagen
Deadlines: for abstracts, 15 February
Note: around 60 speakers and contributors are expected
Information:
e-mail: balticon2001@math.ku.dk
Web site: http://www.math.ku.dk/conf/balticon 2001/

5-18: Groups St Andrews 2001, Oxford, England
Information: Groups St Andrews 2001, Mathematical Institute, North Haugh, St Andrews, Fife KY16 9SS, Scotland
e-mail: gps2001@mcs.st-and.ac.uk
Web site: http://www.bath.ac.uk/~masgcs/gps01/
[For details, see EMS Newsletter 36]

12-19: Summer School 2001: Homological conjectures for finite dimensional algebras, Nordfjordeid, Norway
Topics include: origin of conjectures, resolutions and syzygies, homologically finite subcategories, some geometrical aspects, infinitely generated modules, derived categories, connections to the commutative setting
Programme: the meeting is in two parts: in the first part the participants lecture on introductory topics; the second part is a workshop where specialists in the area lecture on recent results
Workshop specialists: Luchezar L. Avramov (USA), Edward L. Green (USA), Dieter Happel (Germany), Birge Huisgen-Zimmermann (USA), Bernard Keller (France), Claus M. Ringel (Germany)
Organisers: Peter Dräxler (draexler@mathematik.uni-bielefeld.de, Universität Bielefeld), Henning Krause (henning@mathematik.uni-bielefeld.de, Universität Bielefeld), Øyvind Solberg (oyvinso@math.ntnu.no, NTNU, Trondheim)
Sponsors: support is provided by the TMR scheme of the EC; further support applied for
Information: contact Øyvind Solberg, (oyvinso@math.ntnu.no, NTNU, Trondheim)
Web sites: http://www.mathematik.uni-bielefeld.de/~sek/summerseries.html
http://www.math.ntnu.no/~oyvinso/Nordfjordeid/

24-30: 10th International Meeting of European Women in Mathematics, Malta
Programme: pure session on *Cohomology theories*, applied session on *Mathematics applied to finance*, interdisciplinary session on *The uses of geometry*, social session on *Mathematics outside the classroom: cultural differences*
Information: contact Dr Tsou Sheung Tsun (EWM01), Mathematical Institute, 24-29 St Giles, Oxford OX1 3LB, United Kingdom, *fax:* +44-01865-273583
Web site: http://www.maths.ox.ac.uk/~ewm01/

27-31: Equadiff 10, Czechoslovak International Conference on Differential Equations and their Applications, Prague, Czech Republic
Honorary presidents: Ivo Babuska, Jaroslav Kurzweil
Topics: ordinary differential equations, partial differential equations, numerical methods and application
Language: English
Organising committee: Jiri Jarnik (Chair), Bohdan Maslowski (Secretary), Jan Chleboun, Vladimir Dolezal, Eduard Feireisl, Miroslav Krbec, Alexander Lomtatidze, Josef Malek, Pavol Quittner, Milan Tvrdy, Jaromir Vosmansky
Advisory board: H. Amann (Switzerland), D. Arnold (USA), F. Brezzi (Italy), P. Brunovsky (Slovakia), F. Clarke (France), G. Da Prato (Italy), N. Everitt (UK), B. Fiedler (Germany), J. Hale (USA), W. Jaeger (Germany), I. Kiguradze (Georgia), P.L. Lions (France), J. Mawhin (Belgium), P. Raviart (France), K. Schneider (Germany), N. Trudinger (Australia), A. Valli (Italy), W. Wendland (Germany)
Site: Charles University of Prague, Faculty of Law
Notes: 2nd announcement including all forms is available at the Web site
Deadlines: for registration, 31 May; for abstracts, 31 March
Information:
e-mail: equadiff@math.cas.cz
Web site: www.math.cas.cz/~equadiff/

September 2001

24-28: Fourth European Conference on Elliptic and Parabolic Problems: Applications, Gaeta, Italy
[The former Pont-à-Mousson meeting is now split into two conferences. This one is devoted to applications; the other, with more emphasis on theory, takes place in Rolduc, Netherlands, 18-22 June 2001]
Topics: besides elliptic and parabolic issues, topics include geometry, free boundary problems, fluid mechanics, evolution problems in general, calculus of variations, homogenisation, control, modelling and numerical analysis
Invited speakers include: H. Amann (Zurich), C. Baiocchi (Rome), J. Ball (Oxford), A. Bermúdez (Santiago), M. Bertsch (Rome), C.M. Brauner* (Bordeaux), A. Capuzzo-Dolcetta* (Rome), J. Escher (Hannover), E. Fereisl (Prague), A. Friedman (Minneapolis), G. Geymonat (Montpellier), W. Hackbusch (MIP), A. Henrot* (Nancy), M. Iannelli* (Trento), M. Mimura (Hiroshima), P. Podio-Guidugli (Rome), J. Rubinstein (Haifa), E. Sanchez-Palencia (Paris), S. Sauter* (Zurich), A. Sequeira (Lisbon)
* organisers of thematic sessions
Organising committee: J. Bemelmans (Aachen), B. Brighi, A. Brillard (Mulhouse), M. Chipot (Zurich), F. Conrad (Nancy), I. Shafrir (Haifa) V. Valente (IAC, Rome), G. Vergara-Caffarelli (Rome)
Programme: in addition to the main lectures parallel sessions of short communications will be organised.
Deadline: for submission of abstracts, 1 April
Note: The division between theory and applications will not be enforced, but a theoretical subject will certainly have a greater audience in Rolduc, and an applied one a greater audience in Gaeta
Information:
e-mail: rolduc@amath.unizh.ch, gaeta@amath.unizh.ch
Web site: http://www.math.unizh.ch/rolducgaeta

October 2001

16-22: Conference of the Austrian Mathematical Society and the Deutsche Mathematiker Vereinigung, Vienna, Austria
Plenary speakers: V. Capasso (Milano), M.H.A. Davis (London), I. Ekeland (Paris), W.T. Gowers (Cambridge), M. Kreck (Heidelberg), N.J. Mauser (Vienna), V.L. Popov (Moskau), T. Ratiu (California), D. Salamon (Zürich), G. Teschl (Vienna), J.-C. Yoccoz (Paris), D. Zagier (Bonn), G.M. Ziegler (Berlin)
Local organiser: Karl Sigmund (University of Vienna)
Site: Technical University
Information: Karl Sigmund, University of Vienna, Institute of Mathematics, Strudlhofgasse 4, 1090 Vienna,
tel: +43 1 4277 506 02 or 506 12; *fax:* +43 1 4277 9506
e-mail oemg@mat.univie.ac.at
Web site: http://www.mat.unive.ac.at/~oemg/Tagungen/2001/

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.

A. S. Asratian, T. M. J. Denley and R. Häggkvist, *Bipartite Graphs and their Applications*, *Cambridge Tracts in Mathematics **131**, Cambridge University Press, Cambridge, 1998, 259 pp., £40, ISBN 0-521-59345-X*
This book is devoted to the study of a particular class of graphs. Yet the book demonstrates that this is a rich class that captures many important properties of graphs in general.

The book is divided into twelve chapters which include metric properties (with an appendix: addressing schemes for computer networks), connectivity (with an appendix on the construction of linear superconcentrators), and expanding properties (with an appendix on expanders and sorters). Curiously, algorithms for the minimum spanning tree problem are included in an appendix devoted also to the travelling salesman problem. Graph theory is maturing: one day every class of graphs will have a book. (jnes)

M. Atkinson, N. Gilbert, J. Howie, S. Linton and E. Robertson (eds.), *Computational and Geometric Aspects of Modern Algebra*, *London Mathematical Society Lecture Note Series **275**, Cambridge University Press, Cambridge, 2000, 279 pp., £27.95, ISBN 0-521-78889-7*
This volume of proceedings contains 18 papers, for which it is hard to find any unifying description other than the title of the conference. There are papers on group presentations, term rewriting, string rewriting, cancellation diagrams with non-positive curvature, a new proof of the cut-point conjecture for negatively curved groups, papers on discontinously cocompact actions by isometries, with computations in word-hyperbolic groups and in groups with exponent 6, and several further topics.

I will explicitly mention the papers that exceed 20 pages. Bartholdi and Grigorchuk present a paper whose expository part associates a graded Lie algebra to a group G with a given N-series, discusses the questions of growth; the authors then construct two examples of groups of intermediate growth that can be used as counter-examples to a conjecture on the structure of just-infinite groups of finite width. A paper by Huch and Rosebrock is concerned with two mutually dual small cancellation conditions that generalise (C6), (C4) (T4), (C3) and (T6); they solve the conjugacy problem for the groups with a respective presentation. A paper by Madlener and Otto surveys the application of prefix rewriting to the subgroup problem in combinatorial group theory, and a paper of Mislin and Tolleli is concerned with periodic Farrell and Tate cohomologies for hierarchically decomposable groups. Finally, a paper of Nekrashevych and Sushchansky studies automorphism groups of spherically homogeneous rooted trees. (ad)

H. Bercovici and C. Foias (eds.), *Operator Theory and Interpolation*, *International Workshop on Operator Theory and Applications, IWOTA 96, Operator Theory, Advances and Applications **115**, Birkhäuser, 2000, 309 pp., ISBN 3-7643-6229-4*
The papers in this volume were presented at the International Workshop on Operator Theory and Applications (IWOTA), held at Indiana University, Bloomington, in June 1996. They represent most of the areas that were discussed at the workshop, with some emphasis on modern interpolation theory, a topic that has seen much progress in recent years. Much of the work in this volume is related to Béla Sz.-Nagy's results on interpolation and dilation theory.

The book may serve as an inspiration for further research, and can be recommended to researchers and postgraduate students involved in these fields. (knaj)

F. Bergeron, G. Labelle and P. Leroux, *Combinatorial Species and Tree-like Structures*, *Encyclopedia of Mathematics and its Applications **67**, Cambridge University Press, Cambridge, 1998, 457 pp., £55, ISBN 0-521-57323-8*
This book gives, in English for the first time, a thorough presentation of the combinatorial theory of species (which originated in the work of A. Joyal in 1980). The introductory Chapter 1 explains associated power series and the operations of addition, multiplication, substitution and differentiation of species. Chapter 2 introduces further operations, weighted species, virtual species (enabling species subtraction), and molecular and atomic species. Chapter 3 is devoted to combinatorial functional equations; among other things, Lagrange inversion, iterative methods, and a useful overview of asymptotic analysis are presented. Chapter 4 deals with unlabelled enumeration and asymmetric structures and gives proofs for substitution formulas for weighted species. Chapter 5 presents species on totally ordered sets and combinatorial theory of differential equations.

The book contains more than 350 exercises and an extensive bibliography. The exposition is illuminated by many diagrams. In the appendix, numerous tables are given. The book is essential for anybody who wants to learn more about this part of combinatorics with quite a strong algebro-categorical aesthetic appeal. As a bonus, it has one of the never boring forewords by G.-C. Rota. (mkl)

P. Berthelot, *D-modules arithmétiques II. Descente par Frobenius*, *Mémoires de la SMF, **81**, Société Mathématique de France, Paris, 2000, 136 pp., FRF 150, ISBN 2-85629-086-8*
This is a continuation of the author's project of developing foundations of crystalline/rigid cohomology with coefficients in terms of 'arithmetic D-modules'. The basic objects of interest are schemes (resp. formal schemes) smooth over a given base $\mathbf{Z}/p^n\mathbf{Z}$-scheme (resp. a p-adic formal scheme).

The volume is devoted to various functionality properties of arithmetic D-modules with respect to (a lift of) the Frobenius morphism F. The main result ('Frobenius descent') is a far-reaching generalisation of the classical Cartier isomorphism. This is used by the author to establish, among other things, compatibility of F^* with various cohomological operators. (jnek)

A. Böttcher and S. M. Grudsky, *Toeplitz Matrices, Asymptotic Linear Algebra, and Functional Analysis*, *Birkhäuser, Basel, 2000, 116 pp., DM58, ISBN 3-7643-6290-1*
This text is a self-contained introduction to some problems for Toeplitz matrices on the border between linear algebra and functional analysis. The text looks at Toeplitz matrices with rational symbols, and focuses attention on the asymptotic behaviour of the singular values; this includes the behaviour of the norms, the norms of the inverses, and the condition numbers as special cases. The text illustrates that the asymptotics of several linear algebra characteristics depend in a fascinating way on functional analytic properties of infinite matrices. Many convergence results can be comfortably obtained by working with appropriate C^*-algebras, while refinements of these results (for example, estimates of the convergence speed) nevertheless require hard analysis.

This book is warmly recommended to beginners specialising in functional analysis and algebra. (knaj)

A. Candel and L. Conlon, *Foliations I*, *Graduate Studies in Mathematics **23**, American Mathematical Society, Providence, 2000, 402 pp., US$54, ISBN 0-8218-0809-5*
This is the first volume of a two-volume monograph on the qualitative theory of foliations. It consists of three parts. The first part *The Foundations* is designed as an introduction to the theory of foliated manifolds for postgraduate students. The authors state that the readers of this part are assumed to have a fairly good background in manifold theory, but I think that the authors do not require any extraordinary knowledge. This first part can also be considered as a necessary prerequisite for the next two parts. The second and third parts have the titles *Codimension*

One and *Arbitrary Codimension*. These are devoted to the study of the foliations of codimension 1 and to the foliations of higher codimension, and this division is quite understandable, because the methods used in these two cases are quite different. They can be compared with the theory of flows on surfaces, and the theory of flows on manifolds of dimension >2. Already this first volume covers a lot of material on foliated manifolds, and a great part deals with more general foliated spaces.

In a way, the book is built on examples. This means that the authors first demonstrate various phenomena on examples, and only when the reader understands them do they present any systematic theory. The authors pay great attention to examples, and you can find a large number of them in the book. We also find many exercises. This is very important, especially in the book of this extent. They are well chosen, and will keep the interest of a reader on a high level. The biography has 149 items, and goes up to 1999. The book is surely not a short introduction into foliations or a concise survey of foliation theory, but is a fundamental source for everybody with a serious interest in foliations. (jiva)

R. Cerf, *Large Deviations for Three Dimensional Supercritical Percolation*, *Astérisque 267, Société Mathématique de France, Paris, 2000, 177 pp., FRF 250, ISBN 2-85629-091-4*

The aim of the work is to propose a method for analysing phase separation and coexistence for the three-dimensional Bernoulli percolation model. The main results concern the large deviation principles and their application to the Wulff crystal. The case of a single cluster, as well as the whole configuration, are considered.

The book is divided into twelve chapters with the headings: Introduction, The large deviation principles (LDP), Sketch of the proofs, The model, Surface tension, The surface tension, Coarse graining, The central lemma, Proof of the LDP for a single cluster, Collections of sets, The surface energy of a Caccioppoli partion, Proof of the LDP for the whole configuration.

The large deviation principles are stated in Chapter 2, together with their application to the Wulff crystal. Chapter 3 is an informal sketch of the proofs for the single cluster case. The notation and the model are introduced in Chapter 4. Important facts on the theory of Caccioppoli sets and the Wulff Isoperimetric Theorem are summed up in Chapter 6. (mhusk)

S. D. Chatterji and H. Wefelscheid (eds.), *Selected Papers. G. C. Young, W. H. Young*, *Presses Polytechniques et Universitaires Romandes, Lausanne, 2000, 484 pp., CHF149, ISBN 2-88074-445-8*

In this volume the authors present a selection of 52 of the 215 published articles of Grace Chisholm Young (1868-1944) and William Henry Young (1863-1941), a complete list of which appears next to a brief chronology of their lives. The mathematical work of the Youngs can be conveniently divided into three broad categories: the theory of real functions, Fourier analysis, and miscellaneous. The bibliography is based entirely on that of I. Grattan-Guinness in *Historia Mathematica* **2** (1975), 43-58. The authors have grouped the articles according to the year of their publication. The three books of the Youngs follow the list of the articles. The two obituaries, by G. H. Hardy (1877-1947) and M. L. Cartwright (1900-1998) respectively, give a balanced account of the mathematical work of the Youngs, as viewed by their almost-contemporaries. A brief overview of the totality of their mathematical work from a modern viewpoint is given in the essay by Chatterji.

This book should form an ideal resource for mathematicians and specialists in the history of mathematics. (knaj)

B. Cipra, *What's Happening in the Mathematical Sciences: 1998-1999*, *American Mathematical Society, Providence, 1999, 126 pp., ISBN 0-8218-0766-8*

The contents of the fourth volume in this series is well expressed by the titles given below. This lively presentation of an amazingly wide spectrum of happenings in mathematics is impressive. I believe that this should be presented to a wide audience even outside mathematics, which could be fascinated by the ideas, concepts, and beauty of the mathematical topics.

The contents: *A blue-letter day for computer chess* (the end of the long way to beat Kasparov does not mean solving the combinatorial games problem); *A prime of chaos* (on quantum chaology and algebraic number theory); *Proof by example: a mathematician's mathematician* (on the impact of Paul Erdős); *Computers take algebraic geometry back to its roots* (algorithmic questions in algebraic geometry); *As easy as EQP* (on automatic theorem proving); *Beetlemania: chaos in ecology* (on experimental evidence for chaotic dynamics); From *wired to weird* (on revolutionary quantum computing); *Tales from the cryptosystem* (computational complexity and cryptographic systems); *But is it math?* (mathematics and art: Escher, etc.); *Mathematical discovery by Henri Poincaré* (Henri Poincaré's thoughts). (jslo)

C. Corduneanu and I. W. Sandberg (eds.), *Volterra Equations and Applications*, *Stability and Control: Theory, Methods and Applications* ***10***, *Gordon and Breach, Amsterdam, 2000, 496 pp., £ 75, ISBN 90-5699-171-X*

This volume contains 52 papers out of more than 60 presentations of the symposium held at University of Texas at Arlington in 1996 to celebrate the 100th anniversary of Vito Volterra's (1860-1940) publications on integral equations.

It begins with nine invited papers addressing both history (M. Schetzen, Retrospective of Vito Volterra and his influence on nonlinear system theory, and R. K. Miller, Volterra integral equations at Wisconsin) and recent developments (N. Azbelev, Stability and asymptotic behavior of solutions of equations with aftereffect, C. T. H. Baker and A. Tang, Generalized Halanay inequalities for Volterra functional differential equations and discretized versions, P. Clément and G. da Prato, Stochastic convolutions with kernels arising in some Volterra equations, H. Engler, An example of *Lp*-regularity for hyperbolic integro-differential equations, V. Lakshmikantham and A. S. Vatsala, The present status of UAS for Volterra and delay equations, I. W. Sandberg, Myopic maps and Volterra series approximation, and O. J. Staffans, State space theory for abstract Volterra operators).

This is followed by 43 contributed papers addressing a great variety of problems. In particular, they deal with stability theory, stochastic processes, classical Volterra equations (also in connection with dynamical systems and blow-up type problems), numerical problems (with attention to finite-element method and generalisations of known discretisation methods for ordinary differential equations), periodic solutions, control theory (especially optimal control), infinite-dimensional systems, integro-differential equations, approximation methods, abstract Volterra operators and equations, applied problems in physics and engineering, and other topics.

This volume will be of interest for both pure and applied mathematicians, as well as theoretically oriented engineers and graduate students seeking a broad state-of-the-art insight into Volterra equations and their applications. (trou)

W. A. de Graf, *Lie Algebras: Theory and Algorithms*, *North-Holland Mathematical Library* ***56***, *North-Holland, Amsterdam, 2000, 393 pp., US$118, ISBN 0-444-50116-9*

The theory of Lie algebras has many explicit constructions and concrete algorithms (Levi decomposition, branching rules, Hall-Shirshov and Grbner bases, etc.). This book contains a standard course in Lie algebras and includes practically all existing algorithms in this theory. The approach simplifies proofs of some important theorems and makes them more transparent and clear. Moreover, since current research on Lie algebras requires the use of computers, such an exposition facilitates understanding and practical use of computational methods for solving concrete problems. The author is also the author of a sub-package *Lie algebras* in the programme package GAP. This has enabled him to create a book that will be useful for experts, as well as for interested researchers from other fields of mathematics and mathematical physics. (ae)

J. J. Duistermaat and J. A. C. Kolk, *Lie Groups*, *Universitext, Springer, Berlin, 2000, 344 pp., DM79, ISBN 3-540-15293-8*

This book is devoted to the theory of finite-dimensional Lie groups and their representations, mainly from the differential geometry point of view. Lie algebras are studied in the first chapter, together with their relations to Lie groups. The proof of Lie's third fundamental theorem on the existence of a simply connected Lie group with a given Lie algebra is included. Proper actions of groups on manifolds, the corresponding stratification of manifold into orbit types and the related blowing-up process are the main topics of the second chapter. In the third chapter, the authors study compact Lie groups and algebras, their fundamental group, the corresponding Weyl group and Stiefel diagrams.

Invariant densities and problems of invariant integration are discussed, together with the classical Weyl integration formula. The last chapter presents a good overview of the representation theory of compact Lie groups, including the Peter-Weyl theorem, induced representations, character formulas and real forms of complex representations. There is also a nice description of the right regular representation of Lie groups, the Borel-Weil theorem and its applications. The book can be recommended as a higher level introduction to theory of (compact) Lie groups and their representations. (jbu)

Y. Eliashberg and L. Traynor (eds.), ***Sympletic Geometry and Topology***, *IAS/Park City Mathematics Series* ***7***, *American Mathematical Society, Providence, 1999, 430 pp., US$69, ISBN 0-8218-0838-9*
The seventh volume in this series is devoted to various aspects of symplectic topology and related topics. The individual parts present the contents of the following lectures: *Introduction to symplectic topology* by Dusa McDuff, *Holomorphic curves and dynamics in dimension three* by Helmut Hofer, *An introduction to the Seiberg-Witten equations on symplectic manifolds* by Clifford Taubes, *Lectures on Floer homology* by Dietmar Salamon, *A tutorial on quantum cohomology* by Alexander Giventál, *Euler characteristics and Lagrangian intersections* by Robert MacPherson, *Hamiltonian group actions and symplectic reduction* by Lisa Jeffrey, and *Mechanics, dynamics, and symmetry* by Jerrold Marsden.
The result is a lively exposition of recent developments in this exciting branch of mathematics, often starting with quite elementary and introductory facts and reaching far beyond standard textbooks, up to sketches of proofs of most recent deep results. In particular, this volume will be useful reading for graduate students and experts. (jslo)

W. Ewald, ***From Kant to Hilbert. A Source Book in the Foundations of Mathematics, I, II,*** *Clarendon Press, Oxford, 2000, 648 and 690 pp., £50, ISBN 0-19-850537-X, 0-19-850535-3 and 0-19-850536-1*
This is an excellent collection of carefully selected and edited classical texts on the foundations of mathematics. Each text is preceded by an introduction and notes and a comprehensive bibliography is included at the end of each volume. Many texts appear in a reliable English translation for the first time.

The selection starts with the texts of Berkeley, MacLaurin and d'Alembert, continues with a selection from Kant and Lambert and valuable translations of the texts of Bernard Bolzano. It then continues with excerpts or complete texts of Gauss, Gregory, De Morgan, Hamilton, Boole, Sylvester, Cayley, Peirce, Baire, Hilbert, Brouwer, Zermelo and Hardy. The book is in some sense complementary to van Heijenoort's source book in mathematical logic 'From Frege to Gdel' (for example, it contains no texts by Frege, Peano, Russell, or Weyl), and represents a traditional and widely accepted view on the foundations of mathematics. This point of view is expressed by the very last text of this collection, 'The architecture of mathematics' (Bourbaki, 1948). (jmlc)

J. Faraut, S. Kaneyuki, A. Korányi, Qi-keng Lu and G. Roos, ***Analysis and Geometry on Complex Homogeneous Domains***, *Progress in Mathematics* ***185***, *Birkhäuser, Boston, 2000, 540 pp., DM138, ISBN 0-8176-4138-6 and 3-7643-4138-6*
The book is an introduction to several basic topics in complex analysis and geometry at an advanced graduate level; a certain amount of preliminary knowledge is required. It is based on lectures delivered at the CIAMPA Autumn School in Beijing in 1997, and extended in several interesting directions. It consists of five parts written by different authors. The parts are more or less independent.

The first part (by J. Faraut) deals with the theory of function spaces on complex semi-groups, and gives an overview of the theory of Hilbert spaces of holomorphic functions on complex manifolds endowed with the action of a (real) Lie group. The main problems discussed are the decomposition of the Hilbert space into irreducible invariant subspaces and a description of the reproducing kernel on it. The second part (by S. Kaneyuki) on graded Lie algebras and related geometric structures gives a nice survey of recent results on semi-simple pseudo-Hermitian symmetric spaces and Siegel domains. The third part (by A. Korányi) presents an introduction to the theory of holomorphic functions on Cartan domains. It is based on the Harish-Chandra approach arising from the theory of semi-simple groups. The fourth part (by Q. Lu) is devoted to the study of properties of Laplace-Beltrami operator and various integral transforms. The last part (by G. Ross) on Jordan triple systems contains another approach to study of geometry and analysis of Hermitian bounded symmetric domains.

All contributions are written carefully and systematically. Let me mention especially Parts 2 and 3 which bear a strong relation to the geometry and analysis of invariant operators for special geometric structures. (jbu)

J. Francheteau and G. Métivier, ***Existence de chocs faibles pour des systèmes quasi-linéaires hyperboliques multidimensionnels***, *Astérisque* ***268***, *Société Mathématique de France, Paris, 2000, 198 pp., FRF250, ISBN 2-85629-092-2*
In this work the authors consider weak shocks for systems of conservation laws in any space dimension. The main result is a construction on a space-time domain, independent of the parameter ε, of families of weak solutions u^ε, discontinuous along a smooth hypersurface Σ^ε, with jumps of order ε. For a fixed ε, the problem can be recast as a non-linear mixed hyperbolic problem with a free non-characteristic boundary, which has been solved by A. Majda. When ε tends to 0, the front tends to be characteristic; this induces a loss of stability and regularity. As a consequence, the classical non-linear methods based on Picard's iterations and differentiations do not apply. To prove suitable *a priori* estimates and construct the solutions the authors use more sophisticated methods, such as the para-differential calculus and Nash-Moser's type iteration schemes. These results have important applications to Euler's equations of gas dynamics, both to the full system and the isotropic system. Weak solutions of both two systems are constructed and compared.

The authors start the book with a nice introduction, giving a summary of existing literature, pointing out the general scheme of proofs, indicating crucial points and difficulties that must be overcome and briefly describing how this can be done. (jkop)

H. Gordon, ***Discrete Probability***, *Undergraduate Texts in Mathematics, Springer, New York, 1998, 266 pp., DM68, ISBN 0-387-98227-2*
This is an undergraduate text designed for an introductory course in probability theory. With a few exceptions, only elementary mathematics is used throughout. The book starts with the definition of probability on discrete sample spaces. It proceeds to discuss combinatorial probability (sampling with and without replacement), independence of events and conditional probability, and random variables and their mean and variance. Independence of random variables is treated only briefly. One section is devoted to the weak law of large numbers. The Poisson distribution as a limit of a sum of independent Bernoulli variables, the Stirling formula, and the De Moivre-Laplace theorem (without proof) are all treated in one chapter. The rest of the book is devoted to moment generating functions, random walks and discrete Markov chains.

The strengths of the book are undoubtedly its exercises (over 400 of them), all with numerical solutions, and the many interesting remarks on the history of probability theory and biographies of important personalities that are scattered throughout the book. On the other hand, important definitions and facts are sometimes hidden in the text. (mkul)

T. V. Gramchev and P. R. Popivanov, ***Partial Differential Equations. Approximate Solutions in Scales of Functional Spaces***, *Mathematical Research* ***108***, *Wiley-VCH, Berlin, 2000, 155 pp.,*

DM148, ISBN 3-527-40138-5
In this book the authors present in a unified form the results of their research over the last two decades in micro-local analysis of pseudo-differential operators. The reader is supposed to be familiar with basic facts from the theory of Gevrey classes, pseudo-differential operators, micro-local analysis, Fourier integral operators and differential geometry. The authors study micro-local properties (solvability, hypo-ellipticity) of pseudo-differential operators in Sobolev spaces and Gevrey classes; construct approximate solutions with non-classical phase functions and amplitudes; investigate linear differential operators with multiple characteristics and quasi-homogeneous operators; and present applications of Airy operators to oblique derivative problems for hyperbolic equations and applications of Gevrey classes to dynamical systems (approximate normal forms for pairs of glancing hypersurfaces). The language of the book is very general and abstract. Unfortunately, the misprints make the technically demanding notions even more difficult to read. The book is suitable for experts in the field. (efa)

A. Guichardet, *Groupes quantiques*, *Mathématiques, EDP Sciences, Les Ulis, 1995, 149 pp., FRF 160, ISBN 2-7296-0564-9 and 2-271-05272-6*
This book gives an excellent introduction into the field of quantum groups. It is a relatively subtle volume, but nevertheless contains a lot of interesting material. The text is written with the necessary mathematical rigour, which ensures that the book will be well received by mathematicians. On the other hand, its reading requires no extraordinary mathematical preparation, and will be understandable to physicists.

The book starts with a chapter presenting some prerequisites from algebra. It then continues with a chapter introducing the main concepts concentrated around the notion of a Hopf algebra. We find here also the notion of compact quantum group, in the sense of Woronowicz, and relations to the Poisson structures. The third chapter deals with formal deformations of the objects introduced in the previous chapter. From the fourth chapter the author passes to very concrete considerations: namely, a chapter about the quantum group U_h sl(2,k), a chapter about the quantum group U_h sl(n+1,k), and a very interesting chapter about deformations of homogeneous spaces.

The book reads very well. One reason for this is that it contains many interesting examples, and hints for further studies are given. It can be strongly recommended. (jiva)

L. C. Kannenberg, *Geometric Calculus. Giuseppe Peano,* *Birkhuser, Boston, 2000, 150 pp., DM138, ISBN 0-8176-4126-2 and 3-7643-4126-2*
The first edition of Peano's important work on geometrical calculus, 'preceded by the first operations of deductive logic', was published with a small print run in 1888, and has never been reissued in its entirety (only an extract was printed in Peano's *Opera Scelte* and Hubert Kennedy included an English translation of the Introduction and Chapter 1 in his *Selected Works of Giuseppe Peano*). Now a complete and reliable translation is available to a wider audience.

The preliminary chapter of the book is Peano's first publication in mathematical logic: he first develops a calculus of classes and then a calculus of propositions, introducing for the first time modern notation (such as the symbols ∪ and ∩). Of particular interest is his treatment of Grassmann's regressive product. Chapter IX represents one of the first attempts to axiomatise the idea of a linear vector space. Comments on two errors, discovered and corrected by Honbo Li, are included in a short Editorial Note. The book (unfortunately) contains no other comments on this classical text. (jmlc)

A. Khrennikov, *Interpretations of Probability*, *VSP BV, Utrecht, 1999, 228 pp., ISBN 90-6764-310-6*
The book presents an interesting discussion on quantum mechanics from a probability point of view. It is well known that the theory of quantum mechanics gives strange results in some specific situations: the Einstein-Podolsky-Rosen paradox and Bell's inequalities seem to be the most popular of these. The author points out that such difficulties could be caused by an inconvenient measurement of randomness, and instead of values in the ordinary interval [0,1], he proposes the space of p-adic numbers as the most convenient range for probability employed in quantum mechanics.

The book begins with a survey on the notion of probability. Kolmogorov's measure-theoretical approach and von Mises' idea on collectives giving frequency probability theory and proportional approach to randomness are introduced and compared. After that, the author proceeds to random principles in quantum mechanics. The Einstein-Podolsky-Rosen paradox is formulated and compared with Bell's inequality for probabilities as well as for covariances and with the idea on hidden variables. The next two sections are devoted to the necessary theory of p-adic numbers and their calculus. The book concludes with a discussion on tests for randomness for p-adic-valued probability.

The book is intended as a deep presentation of the author's idea that p-adic-valued probability is able to remove, and even to explain, such difficulties as the Einstein-Podolsky-Rosen Paradox and to validate places where the theory produces 'negative' probabilities. It will be valuable for theoretical physicists, especially those working in quantum mechanics and related fields. On the other hand, it has value for mathematicians dealing with probability theory, since the book is an interesting attempt to use special Banach space-valued probability for description of observed phenomena. (pl)

H. Koch, Number Theory. *Algebraic Numbers and Functions*, *Graduate Studies in Mathematics* ***24****, American Mathematical Society, Providence, 2000, 368 pp., US$59, ISBN 0-8218-2054-0*
According to the preface, it is the author's conviction 'that an area of mathematics such as number theory that has developed over a long period of time can be properly studied and understood if one proceeds through this entire development in abbreviated form, much as an organism recapitulates its evolutionary path in abbreviated form during its embryonic development. From this I derived the concept of allowing the reader to take part from chapter to chapter in the historical development of number theory'.

Leaving aside the allusion to a by-now-discredited biological principle, let us examine the contents of the book in the light of the author's intentions. Chapter 1 consists of several topics in elementary number theory, such as Pythagorean triples, the (incomplete) history of Zell's equation and Fermat's last theorem, congruences, quadratic reciprocity law and the distribution of primes. Chapter 2 is devoted to elementary theory of orders in number fields, including Dirichlet's theorem on units, finiteness of class number and Minkowski's theorem in the geometry of numbers. Chapters 3 and 4 develop the theory of Dedekind rings and valuations. These are used in Chapter 5, which treats function fields in one variable over perfect constant fields, up to the Riemann-Roch theorem. Chapter 6 is on higher ramification groups (including Herbrand's theorem) and their applications, such as the decomposition of prime ideals in cyclotomic and Kummer extensions. Chapter 7 begins with an introduction of adèles and idèles and reproduces Tate's approach to the functional equation of Hecke L-series, as well as F. K. Schmidt's proof of the functional equation of the zeta-function of a function field. Analytic properties of Hecke L-functions are used in Chapter 8 to prove various distribution results for prime ideals that generalise Dirichlet's theorem on primes in arithmetic progressions. Chapter 9 is devoted to the arithmetic of quadratic fields, and treats the correspondence between classes of binary quadratic forms and ideal classes in quadratic fields, units and class number formulas. Finally, Chapter 10 gives a brief survey of class field theory. There are three appendices, on elements of divisibility (including the structure theory of finitely generated modules over PID's and Euclidean domains), on traces, norms and discriminants, and on Fourier analysis on locally compact abelian groups.

The book requires as a prerequisite a good knowledge of basic algebra and Galois theory and is meant to be an introductory text aimed at Ph.D. students in number theory and related areas.

The brief description of its contents shows that the book is concerned mainly with the general theory of number fields and function fields. In fact, a significant part of the material goes beyond what one would expect from an introductory text. A disadvantage of this approach, however, is the absence of the full-flavoured 'concrete arithmetic', regardless of its place in the historical development of algebraic number theory. The most significant omissions include cubic and biquadratic reciprocity laws, genus theory of quadratic forms, Hilbert symbols, a more detailed analysis of the class number formula and examples of zeta-functions of function fields. For these reasons this book can be recommended to students of number theory for its rigour and emphasis on theory, but its study should be complemented by reading other, more 'concrete' texts, such as Borevich and Shafarevich or Ireland-Rosen. (jnek)

I. Lasiecka and R. Triggiani, ***Control Theory for Partial Differential Equations: Continuous and Approximation Theories, 1: Abstract Parabolic Systems***, *Encyclopedia of Mathematics and its Applications* ***74***, *Cambridge University Press, Cambridge, 2000, 644 pp., £75, ISBN 0-521-43408-4*
This volume represents a comprehensive and up-to-date treatment of quadratic optimal control theory for linear parabolic-like partial differential equations (PDEs) over a finite or infinite time horizon and related differential (integral) and algebraic Riccati equations. A semigroup approach is systematically used. Besides continuous problems, numerical approximation theory is pursued. On an abstract level, the controlled system is assumed to have the form $dy/dt = Ay + Bu$, with A and B linear possibly unbounded operators, the former generating a C^0- (and even analytic) semigroup on a Hilbert space, and with the control u being an L^2-function in time. The quadratic cost functional to be minimised then involves still an observation operator $\mathbf{R}$.

The abstract theory for such problems applicable to a broad class of PDEs is presented in Chapters 1 and 2 for the finite and infinite horizon cases. Chapter 3 presents many PDE illustrations with Dirichlet or Neumann boundary control or point control. This includes the heat equation, the Kelvin-Voight, Kirchhoff, and Euler-Bernoulli equations, and thermo-elastic plates. Chapter 4 provides a detailed numerical approximation, including optimal rates of convergence, detailed illustration being then given in Chapter 5. Finally, Chapter 6 returns to an abstract level, dealing with a min-max game theory over an infinite time interval.

This thorough very detailed exposition largely expands the lecture notes of these experienced authors, published in 1991 by Springer-Verlag, and is primarily addressed to applied mathematicians and theoretical engineers interested in optimal control, in particular, of linear distributed-parameter systems, as well as to graduate students in this area. This volume will be followed by optimal control theory for hyperbolic or Petrowski-type PDEs (Volume II) and for hyperbolic-like dynamics and coupled PDE systems (Volume III). (trou)

K. B. Laursen and M. M. Neumann, ***An Introduction to Local Spectral Theory***, *London Mathematical Society Monographs New Series* ***20***, *Clarendon Press, Oxford, 2000, 591 pp., £75, ISBN 0-19-852381-5*
This monograph develops the local spectral theory for bounded linear operators on Banach spaces. Chapter 1 is devoted to decomposable operators. The authors derive several basic characterisations of decomposability, explore the role of the local spectrum, and establish the important connection with the theory of spectral capacities. Chapter 2 centres around certain characterisations and applications of Bishop's property β and the decomposition property δ for bounded linear operators on an arbitrary complex Banach space; the main goal of this chapter is to show that property β describes precisely the restrictions of decomposable operators to closed invariant subspaces, that property δ characterises the quotients of decomposable operators by closed invariant subspaces, and that there is a complete duality between the two properties. In Chapter 3, distinguished parts of the spectrum and their relationships to local spectra are studied, and several important classes of spectral subspaces are considered; particular emphasis is placed on the relations between the spectra and essential spectra of two operators that are connected with each other through some intertwining condition. Chapter 4 collects essentially everything that is known about the spectral theory of multipliers, and particularly about convolution operators on group and measure algebras. Chapter 5 illustrates the usefulness of local spectral theory in automatic continuity. Finally, Chapter 6 contains a list of open problems. The modest prerequisites from functional analysis and operator theory that the authors require are collected in the Appendix. (dmed)

J. M. Lee, ***Introduction to Topological Manifolds***, *Graduate Texts in Mathematics* ***202***, *Springer, New York, 2000, 385 pp., 138 fig., DM69, ISBN 0-387-95026-5 and 0-387-98759-2*
This is a first course on topology for postgraduate students, written by an author who has evidently great experience in teaching this subject. In order to reduce the prerequisites to the minimum, the author has included an appendix in which he reviews the necessary notions from set theory, the theory of metric spaces, and group theory. Later, we find a special chapter 'Some group theory', whose aim is to have the necessary algebraic techniques available when studying the fundamental group. Moreover, he assumes no knowledge even of general topology, and develops the relevant part of this theory in full detail.

The main part of the book is concentrated around the topology of 2-manifolds. The author has devoted the whole introductory chapter to motivating the notion of a manifold (of arbitrary dimension), showing the role played by manifolds in topology, geometry, complex analysis, algebra, algebraic geometry, classical mechanics, general relativity and quantum field theory. He then introduces an important tool, simplicial complexes, and presents triangulation theorems for manifolds of dimensions 1, 2 and 3. Using simplicial complexes, he describes 1-manifolds and gives a complete classification of compact 2-manifolds. He introduces the fundamental group, paying much attention to this notion. We find here various methods enabling us to compute the fundamental group, the Seifert-Van Kampen theorem, and covering spaces. Of course, the central objects of interest are the fundamental groups of compact 2-manifolds. To make the theory of 2-manifolds relatively complete, the author introduces the notions of homology and cohomology.

The book is very carefully written. In the text we find many exercises, classified as simpler problems, which should not be omitted because some are used later in the main text. At the end of each chapter are problems that are classified as more difficult. The author has written this course as a first course in topology, and as a preparation for more advanced courses on topology and differential geometry. This is the reason why he did not touch PL-structures or differential structures on manifolds. It can be used to in full or partially for various basic courses on topology. It is especially good that the course is written in a very clear and attractive way, and we can expect that it will attract the attention of students. (jiva)

M. Liebeck, ***A Concise Introduction to Pure Mathematics***, *Chapman & Hall/CRC, Boca Raton, 2000, 162 pp., £17.95, ISBN 1-584888-193*
This well-written book is based on the author's lectures 'Foundations of Analysis' at Imperial College for students in the first term of their degree. It contains sections on number systems, combinatorics, geometry, and a basic introduction to analysis and set theory.

The aim of this book is to fill the gap between high-school mathematics and mathematics taught at university. In particular, the reader is shown what it means to prove something rigorously. The book begins with topics often taught at high school, and goes further; for example, it starts with a naive understanding of real numbers and ends with least upper bounds and a proof of the existence of the nth root. The author illustrates the theory with number of exercises.

In order to keep the book easily readable, a few mathematical proofs are inaccurate; however, these omissions are not explicitly mentioned, which might confuse a thorough reader. This book is easy to read for anyone with a high-school mathematics background. (sh)

V. G. Maz'ya and S. B. Poborchi, ***Differentiable Functions on Bad Domains***, *World Scientific, Singapore, 1997, 481 pp., £56, ISBN 981-02-2767-1*

Sobolev spaces of functions whose partial derivatives belong to L^p hold an exceptional position among spaces of differentiable functions. These spaces are well adapted for solving boundary value problems in the theory of partial differential equations. For these applications, it is important to know under what circumstances the inequalities and theorems on embedding, extension and traces hold. The validity depends on the quality of domain. If the boundary is locally represented as an isometric image of a graph of a Lipschitz function, then the domain is still relatively good, although it can have 'corners'. Most of the material of the book is devoted to domains with non-Lipschitz singularities or even to general domains.

The introductory chapter contains a self-contained exposition to the general theory of Sobolev spaces. Next, many examples of wild domains are shown to demonstrate the failure of basic statements of the theory when the assumptions on domain are violated. The second part deals with parameter-dependent domains. Typically, a family of domains depending on a small positive parameter ε is considered. The family exhibits a certain degeneracy as ε tends to 0. The asymptotic behaviour of norms of extension operators and trace operators is then investigated. In the third part, a domain with an inner or outer cusp (peak) is mostly considered. Here, the results that depend on the domain shape include Friedrichs' inequality, Hardy's inequality, estimates of the extension operator (also the weighted case), trace theorems and embedding theorems (the Sobolev inequality). Another type of domains considered are domains between two graphs, of type $\{[x, y] | \phi(x) < y < \psi(x)\}$, which even for smooth graphs may have singularities at boundary points belonging to the contact set $\{[x, y] | \phi(x) = y = \psi(x)\}$. Some results on traces are considered on arbitrary domains.

Specialists in function spaces will already have this book, as well as others in the excellent series of books by V. G. Maz'ya. For the same reason, the book is widely known among experts in boundary value problems for elliptic partial differential equations. Although such equations are not explicitly studied in the book (with one exception), the theory developed there is needed for an analysis of such problems. However, the book may be useful and interesting for mathematicians working in other related areas, such as the rest of PDE theory, the calculus of variations, numerical analysis and the theory of functions of several real variables. The 'bad domains' are not artificial products invented only for counter-examples, and the emphasis is put on simple shapes with cusps that occur in real life. The book is strongly recommended to researchers and advanced students. (jama)

R. J. Y. McLeod and M. L. Baart, *Geometry and Interpolation of Curves and Surfaces*, *Cambridge University Press, Cambridge, 1998, 414 pp., £50, ISBN 0-521-32153-0*

This textbook provides an elegant and serious introduction to the basic concepts and results of (elementary) algebraic geometry. The computational and algorithmic aspects provide the guidelines of the exposition, but the synthetic approach is also presented. The result is a pleasant combination of intuitive and technical exposition of the material.

The main topics include: simple interpolation and spline theory, conic sections, an introduction to algebraic projective geometry, the theory of algebraic curves (including resultants), the Maclaurin-Bézout theorem, resolutions of singularities and the genus of curves, and the theory of algebraic surfaces. Much space is devoted to applications and examples.

The book is designed as a text for a genuine course on algebraic geometry and its applications, and selections for shorter courses are also possible. I believe that professionals seeking applied mathematics, as well as students and researchers, will make good use of this text. (jslo)

Y. Meyer and R. Coifman, Wavelets. *Calderón-Zygmund and Multilinear Operators*, *Cambridge Studies in Advanced Mathematics **48**, Cambridge University Press, Cambridge, 2000, 314 pp., £42,50, ISBN 0-521-42001-6*

This book is a translation of *Ondelettes et opérateuers, Opérateuers de Calderón-Zygmund*, by Yves Meyer, and the volume *Opérateuers multilinéaires*, by R. R. Coifman and Yves Meyer. The original numbering of the chapters and of the theorems has been retained.

In this volume the theory of paradifferential operators and the Cauchy kernel on Lipschitz curves are discussed, with the emphasis firmly on their connection with wavelet bases. Calderón-Zygmund operators have a special relationship with wavelets and with classical pseudo-differential operators, of which they are a remarkable generalisation. They form the subject of an independent theory which the authors expand completely and autonomously in Chapters 7-11. Multilinear analysis is one of the routes into the non-linear problems studied in Chapters 12-16.

This route is possible only for those non-linear problems with a holomorphic structure, enabling them to be decomposed into a series of multilinear terms of increasing complexity. The multilinear operators turn out to be the Calderón-Zygmund operators, whose continuity is established using the earlier chapters. Wavelets make a final appearance, as eigenfunctions of certain realisations of paraproducts, in the final chapter, which is devoted to J. M. Bony's theory of paradifferential operators. The bibliography lists 239 items. This book can be strongly recommended to those wishing to learn about the mathematical foundations of operator theory and wavelets. (knaj)

L. A. Moyé and A. S. Kapadia, *Difference Equations with Public Health Applications*, *Biostatistics: A Series of References and Textbooks **6**, Marcel Dekker, New York, 2000, 392 pp., US$165, ISBN 0-8247-0447-9*

Difference equations are a powerful tool for solving many problems arising in applications involving health-related research. The authors start with a general introduction to difference equations and develop the iterative solution for first-order equations. The main method used for solving difference equations is the method of generating functions. General properties of generating functions are described (scaling, the convolution principle, the use of partial fractions, coefficient collection) and the role of probability generating functions is emphasised. Among the applications of difference equations we find a model of unusual heart rhythm, the random walk problem, a model of clinic visits, run theory, drought prediction and follow-up losses in clinical trials. The end of the book is devoted to applications of difference-differential equations in epidemiology that are derived from the Chapman-Kolmogorov forward equations.

The book is written in an understandable style for students in biostatistics and for researchers in this field. It is surprising that such a fundamental concept as the characteristic equation is not introduced, specialised to difference equations. Mathematically, the book should be read with some care; for example, the interchange of derivative and infinite summation is frequently used, but not discussed. Nevertheless, the book describes some useful methods for solving difference equations and can be recommended as a source of interesting examples of applications. (ja)

P. J. Nahin, *Duelling Idiots and Other Probability Puzzlers*, *Princeton University Press, Princeton, 2000, 232 pp., £15.95, ISBN 0-691-00979-1*

There are many textbooks on probability theory, but unfortunately, books with interesting problems and examples from probability theory are extremely rare. This is such an exception. The author is an experienced teacher. His collection of twenty-one puzzles (with solutions) is designed for students who are eager to try their skills on challenging problems.

The first problem, whose name forms the title of the book, can be formulated as follows. Two idiots A and B decide to duel, but they have only one six-shot revolver and only one bullet in it. First A spins the cylinder and shoots at B. If the gun does not fire, then B spins the cylinder and shoots at A. The process continues until one fool shoots the other. What is the probability that A will win? How many trigger pulls will occur (on average) before somebody wins? Most of the problems are formulated in this style: for example, find the distribution function and density of the length of a walk through a square garden if one enters it at a randomly chosen point on the border and continues in a random direction. A few problems are formulated mathematically: for example, find the density of the random variable Z

$= X^Y$ when X and Y are independent variables with rectangular distribution on (0, 1). The author proposes simulating the problems on a computer to check the theoretical results. The last part of the book contains MATLAB programs that serve this purpose. To help understanding of the principles of simulation, a short chapter on random numbers generators is included. This book can be recommended as inspiration for teachers of introductory courses on probability theory. (ja)

D. Perrin, *Géometrie algébrique*, *Mathématiques, EDP Sciences, Les Ulis, 1995, 301 pp., FRF 240, ISBN 2-7296-0563-0 and 2-271-05271-8*
This is a well-composed first course on algebraic geometry, based on the author's courses from 1991-94 at the Université Paris Sud (Orsay). Covering the material should take approximately 50 hours, and a quarter of this time should be devoted to exercises. The methods are entirely algebraic, but the author requires from a reader only a fairly standard knowledge of algebra. He very skilfully introduces the really necessary ideas from commutative algebra, and has included an appendix *Mémento d'algébre*, where one can find a compact summary of the necessary definitions and results with references.

The text in fact represents an introduction into contemporary algebraic geometry. The principal notion is an algebraic variety, always endowed with the corresponding sheaf. The author's explicitly stated idea behind the exposition is to start with problems that can be simply formulated, but whose solution is non-trivial. Concerning the important notion of a scheme, in the text we meet only schemes of dimension 0, but, being aware of the importance of this notion, the author includes an appendix Les schémas. In the text are many exercises and problems, including those used at the examinations organised by the author. In summary, the main feature of this book is a good choice of topics and a very nice presentation of them. (jiva)

A. Pietsch and J. Wenzel, *Orthonormal Systems and Banach Space Geometry*, *Encyclopedia of Mathematics and its Applications* ***170****, Cambridge University Press, Cambridge, 1998, 553 pp., £55, ISBN 0-521-62462-2*
This voluminous monograph is devoted to the interplay between orthonormal expansions and Banach space geometry. A theory of orthonormal expansions with vector-valued coefficients is presented. Besides the classical trigonometric system, other orthonormal systems are considered (Haar and Walsh functions, Rademacher functions and Gaussian random variables). Harmonic analysis is a starting point and classical inequalities and special functions lead to the study of orthonormal systems of characters on compact Abelian groups. The authors investigate numerical parameters that can be used to quantify certain properties of Banach spaces (such as a measure of non-Hilbertness of the space). The text yields a detailed insight into concepts involving type and co-type of Banach spaces, B-convexity, super-reflexivity, the vector-valued Fourier and Hilbert transforms, and the unconditionality property for martingale differences. The list of sections includes ideal norms, operator ideals, Khintchine constants, Sidon constants, Riemann, Dirichlet and Parseval ideal norms, Gauss versus Rademacher, the Maurey-Pisier theorem, J-convexity, unconditional norms, super weakly compact operators, and uniform convexity and uniform smoothness. The text also includes challenging unsolved problems.

The book is accessible to graduate students and researchers interested in functional analysis and is understandable with a basic knowledge of Banach space theory together with a background from real analysis, probability and algebra. (jl)

B. P. Rynne and M. A. Youngson, *Linear Functional Analysis*, *Springer Undergraduate Mathematics Series, Springer, London, 2000, 273 pp., DM59, ISBN 1-85233-257-3*
This book provides an introduction to the ideas and methods of linear functional analysis and is addressed mainly at undergraduate students. The opening chapter outlines the basic ideas from linear algebra, metric spaces and Lebesgue measure and integration that are required throughout the book. Further chapters are devoted to the fundamental properties of normed linear and Hilbert spaces and to linear transformations between these spaces (also the open mapping theorem and its equivalent forms). Elementary properties of linear operators on Hilbert spaces and of compact operators are included in the next chapters. The last chapter is concerned with applications of previous results to integral and differential equations. More sophisticated theorems, such as the Hahn-Banach theorem, the principle of uniform boundedness and the notions as reflexivity, are not included.

The text includes many exercises with complete solutions. The book is understandable with only standard undergraduate linear algebra and real analysis. (jl)

Séminaire Bourbaki 1998/99, exposés 850-864, *Astérisque* ***266****, Société Mathématique de France, Paris, 2000, 483 pp., FRF 450, ISBN 2-85629-090-6*
This volume comprises written versions of fifteen lectures at the Bourbaki Seminar during 1998-99. The topics covered are the following: recent proofs of the local Langlands Conjecture for $GL(n)$ and of Kepler's Conjecture on the densest sphere packing in $\mathbf{R}^3$; quantum computing; the classification of simple Lie algebras in characteristic $p > 7$; chaotic behaviour of the motion of inner planets in the solar system; spin glasses; p-adic L-functions and p-adic integration; Brownian motion with obstacles; finite subgroups of Lie groups; Thurston's uniformisation theorem; singularities of solutions of non-linear wave equations; holonomy groups; L^2-methods in algebraic geometry; resonances and quasi-modes. (jnek)

M. Serfati (ed.), *La recherche de la vérité*, *L'écriture des mathématiques, ACL, Les éditions du Kangourou, Paris, 1999, 335 pp., ISBN 2-87694-057-4*
This book presents 10 articles based on the history of mathematics seminar at the Université Paris VII. The texts are written with a view to the historical analysis of ideas and to epistemology and present actual researches into the history of mathematics.

The first contribution by the editor is devoted to the birth of the procedure for solving cubic (algebraic) equations in 16th-century Italy. The second article, written by M. Waldschmidt, is a historical survey of the theory of transcendental numbers up to 1900 (when Hilbert posed his 7th problem, whose solution was the source of a new era for this theory); in particular, it presents works of Liouville, Cantor, Hermite, Lindemann and Weierstrass on this topic. In the third article, M. Barbut describes an approach for teaching probability to beginners which is based on intuition of the economical value: the expected value of a (discrete) random variable is axiomatically introduced and then the Kolmogorov's 'axioms' for probability measures are derived. R. Langevin surveys the history of integral geometry and its interactions with probability theory, measure theory, Riemannian geometry and topology, starting from 1777.

A philosophical article of M. Serfati, *La dialectique de l'indétermité, de Viète à Frege et Russell*, is devoted to the representation of 'datum' in symbolic mathematical writing. In P. Cegielski's contribution, the history of presentation, formalisation and axiomatisation of mathematics from ancient times is described, leading to the Zermelo-Fraenkel set theory as a base of mathematics. O. Hudry's article deals with the four-colour problem, methods and results of its study in historical order, and meditates over the 'correctness' of computer-aided proofs. The eighth article is a philosophical survey on the conception of scientific discovery, due to the scientist-philosophers Poincaré and Einstein: the creative process is based on 'free constructions of thought'; the author, M. Paty, compares it with other concepts and tries to connect them with the scientists' inventions. The ninth article presents the history of the negative answer to Hilbert's tenth problem on the solvability of diophantine equations, to which the author, Y. Matiasevitch, contributed. In the final article, J. Bénabou studies the analogy between the categories of 'observable sets' (introduced in the text) and 'ordinary sets'.

The book has appeared in the collection *L'écriture des mathématiques*, directed by M. Serfati. It is aimed at a wide readership: mathematicians, philosophers, historians, teachers, and others interested in science and its development. (efa)

P. Taylor, *Practical Foundations of Mathematics*, *Cambridge Studies in Advanced*

*Mathematics **59**, Cambridge University Press, Cambridge, 199, 572 pp., £50, ISBN 0-521-63107-6*
'Our system conforms very closely to the way mathematical constructions have actually been formulated in the twentieth century. The claim that set theory provides the foundations of mathematics is only justified via an encoding of this system, and not directly', says the author in paragraph 2.2 after Chapter I on First order reasoning' and after the first paragraph of Chapter II on 'Constructing the number system'. He does not use 'the encoding' and he works with sets quite freely using the *axiom of comprehension*: if X is a set and $\varphi[x]$ is a predicate on X, then $\{x: X \ \varphi[x]\}$ is also a set. Beginning with Chapter IV, his basic mathematical tool is category theory. The use of categories as a basis for mathematics and the application of categorical notions and methods in logic and in computer science (more precisely, the developing of logic and of computer science on the basis of categorical notions and categorical methods) has been widely and intensively examined during the last period. The book presents a systematic exposition of this topic, explaining its ideas and summarising the corresponding results. The author also aims to show how these modern ideas develop the classical ones and he presents many interesting historical facts. The book is intended for programmers and computer scientists, rather than for mathematicians and logicians, but it can be useful for both groups. (vt)

A. Terras, Fourier Analysis on Finite Groups and Applications, London Mathematical Society Student Texts **43**, Cambridge University Press, Cambridge, 1999, 442 pp., £18.95, ISBN 0-521-45108-6 and 0-521-45718-1
The main goal of this book is to consider finite analogues of symmetric spaces, such as $\mathbf{R}^n$ and the Poincar upper half plane. The author describes finite analogues of all the basic theorems in Fourier analysis, both commutative and non-commutative, including the Poisson summation formula and the Selberg trace formula. One motivation for this study is to prepare the ground for understanding the continuous theory by developing its finite model. The book is written in such a way that it can be enjoyed by non-experts, such as advanced undergraduates, beginning graduate students, and scientists from outside mathematics. Several applications are included: the construction of graphs that are good expanders, reciprocity laws in number theory, the Ehrenfest model of diffusion random walks on graphs, and vibrating systems and chemistry of molecules. (ae)

A. Tuganbaev, *Distributive Modules and Related Topics*, *Algebra, Logic and Applications Series **12**, Gordon and Breach, Amsterdam, 1999, 258 pp., US$95, ISBN 90-5699-192-2*
This book is not based on a few main theorems, but is rather a collection of miscellaneous results bearing on the central notion of a distributive module. Distributive modules are characterised in several different ways, and are studied simultaneously with uniserial and Bezout modules (each finitely generated submodule is cyclic). In some cases the notions coincide (for example, over local rings) or are closely related (over semi-perfect rings). Right distributive rings are described when they are semi-perfect right Goldie rings, right perfect or semi-perfect right noetherian. It is proved that the Krull dimension of left or right regular modules over noetherian right distributive rings is at most 1. Then semi-distributive modules are defined as direct sums of distributive ones. Rings over which all right modules are semi-distributive, serial rings, and rings such that each (finitely generated) right module is serial, are characterised. The author continues with the study of tensor product and flat modules; the relation of this part to the topic is quite vague. Some strong results are obtained for modules over right invariant rings (rings whose right ideals coincide with two-sided ones). After that, the question of the left-right symmetry of distributivity is treated and distributive modules over commutative rings are studied. Among other things it is shown that an endomorphism ring of a distributive module over a commutative ring is commutative. Finally, the question of preserving distributivity when passing from a ring to another using certain classical ring constructions is touched on. A remarkable fact is that a module M is distributive if and only if its character module Hom (M,E), where E is an injective cogenerator, is End (E) distributive.

The author does not separate lemmas, propositions and theorems, and the text gives the impression of a homogeneous mass of claims; orientation is very difficult. Even though it is impossible to avoid all formal mistakes in such a large text, the number of inaccuracies in the book is greater than one would expect. However, despite a few drawbacks, the book provides ample material for anyone interested in the topic. (pruz)

J. S. Wilson, *Profinite Groups*, *London Mathematical Society Monographs New Series **19**, Clarendon Press, Oxford, 1998, 284 pp., ISBN 0-19-850082-3*
This book presents the study of a nice class of infinite groups that are built up from their finite homomorphic images and, indeed, appear in the classical literature as Galois groups of algebraic field extensions. Although profinite groups attract the attention of abstract group theorists we also meet them as topological quotients of compact groups.

The book starts with topological preliminaries and introductory chapters giving the basics of completions, Sylow theory and Galois theory. These chapters are followed by the study of modules over group algebras for a profinite group, with coefficients in a profinite commutative ring. The advanced part of the book explains the cohomology theory of profinite groups. Among the main results is Lazard's description of cohomology algebras of uniform pro-p groups. The final chapter is on finitely presented pro-p groups.

The treatment is accessible to graduate students and includes exercises and historical and bibliographical notes. The clear topological character of the subject is explored in the development of the theory but is also well explained at elementary level. (rb)

M. C. K. Yang, *Introduction to Statistical Methods in Modern Genetics*, *Asian Mathematics Series **3**, Gordon and Breach, Singapore, 2000, 247 pp., US$75, ISBN 90-5699-134-5*
The importance of genetics can be felt almost daily. The topics the author chooses are undoubtedly biased; as he explains: 'these are the topics I wanted to know more about when I got into this field, and I hope that many beginners will share the same interest in them'. The topics include questions as how a gene is found, how scientists have separated the genetic and environmental aspects of a person's intelligence, how genetics has been used in agriculture so that domestic animals and crops are constantly improved, what a DNA fingerprint is and why there are controversies about it, and how genes were used to rebuild evolutionary history?

The author believes he understands these questions and hopes that his readers will not find gaps in how they are answered. The book is written mainly for statistics students and therefore some statistical background beyond elementary statistics is assumed. The author hopes that a year of graduate study in most statistical departments is sufficient background. (jant)

List of reviewers for 2000
The Editor would like to thank the following for their reviews this year: **J. Anděl, J. Antoch, R. Bashir, J. Bečvář, M. Němcová-Bečvářová, V. Beneš, L. Beran, J. Bureš, E. Calda, K. Čuda, A. Drápal, V. Dupač, J. Dupačová, J. Eisner, A. Elashvilli, M. Engliš, E. Fašangová, M. Feistauer, E. Fuchs, S. Hencl, J. Hurt, M. Hušek, M. Hušková, T. Kepka, M. Klazar, J. Kopáček, O. Kowalski, J. Kratochvíl, M. Kružík, M. Krížek, M. Kulich, P. Lachout, M. Loebl, J. Lukeš, J. Málek, J. Malý, P. Mandl, M. Markl, J. Matoušek, D. Medková, J. Milota, J. Mlček, K. Najzar, J. Nekovár, J. Nešetril, I. Netuka, Z.Pluhar, P. Pyrih, Š. Porubský, J. Rohn, T. Roubíček, P. Ružička, P. Simon, J. Slovák, V. Souček, J. Trlifaj, V. Trnková, J. Tuma, J. Vanžura, J. Veselý, L. Zajíček.**
All of these are on the staff of the Charles University, Faculty of Mathematics and Physics, Prague, except: **J. Eisner, M. Engliš, M. Kružík, M. Krížek, M. Markl, D. Medková** and **J. Vanžura** *(Mathematical Institute, Czech Academy of Sciences),* **M. Němcová-Bečvárová** and **Š. Porubský** *(Technical University, Prague),* **J. Nekovár** *(Cambridge University, UK),* **E. Fuchs** and **J. Slovák** *(Masaryk University, Faculty of Natural Sciences, Brno).*

EMS Newsletter Index for 2000

The numbers 35–38 refer to the issue numbers, in March, June, September and December, respectively; the second number is the page number.

Personal Column

We list below information about some appointments, awards and deaths that have occurred in the past few months. Since this list is inevitably incomplete we invite you to send appropriate information to the Editor [r.j.wilson@open.ac.uk] or to your Country representative (see Issue 34) for inclusion in the next issue. Please also send any items you feel should be included in future Personal Columns.

Awards

Semyon Alesker (Israel), **Raphael Cerf**, **Emmanuel Grenier**, **Vincent Lafforgue**, **Paul Seidel** and **Wendelin Werner** (France), **Dominic Joyce** and **Michael McQuillen** (UK) and **Stefan Nemirovski** (Russia) were awarded EMS prizes at the Third European Congress in Barcelona; details of their work can be found in *EMS Newsletter* **37**.

Pierre Auger (Lyon), **Gérard Bricogne** (Orsay) and **Thibauld D'Amour** (IHES) have been elected to membership of the Académie des Sciences (Paris).

John Ball (Oxford) has been elected as a foreign member of the Académie des Sciences de Paris.

Grigory Barenblatt (Russia) has been awarded the Maxwell Prize by ICIAM (The International Council for Industrial and Applied Mathematics).

Richard Borcherds (Cambridge) has been awarded an Honorary Doctorate by the University of Birmingham.

Elisabeth Busser and **Gilles Cohen** have been jointly awarded the d'Alembert Prize for 2000 by the Société Mathématique de France.

Mark Chaplain (Dundee), **Gwyneth Stallard** (Milton Keynes), **Andrew Stuart** (Warwick) and **Burt Totaro** (Cambridge) have been awarded Whitehead Prizes for 2000 by the London Mathematical Society.

Michele Conforti (Padua) has shared the 2000 Delbert Ray Fulkerson Prize for a paper on the decomposition of balanced matrices.

Alain Connes (Paris) has been awarded a Clay Research Award by the Clay Mathematics Institute for revolutionising the field of operator algebras and inventing modern non-commutative geometry.

Simon Donaldson (London) has been elected as a foreign associate of the US National Academy of Sciences.

Ludwig Elsner (Bielefeld) has been awarded the Hans Schneider Prize in Linear Algebra by the International Linear Algebra Society (ILAS).

Athanassios Fokas (London) has been awarded the Naylor Prize for 2000 by the London Mathematical Society for substantial contributions to the theory of integrable systems.

Nigel Hitchin (Oxford) has been awarded the Sylvester Medal of the Royal Society of London for contributions to geometry.

Sir Tony Hoare (Cambridge) has been awarded an Honorary Doctorate by Oxford Brookes University.

John Howie (St Andrews) has been awarded an Honorary Doctorate by the Open University, UK.

Laurent Lafforgue (Paris) has been awarded a Clay Research Award by the Clay Mathematics Institute for work on the Langlands programme

Jacques-Louis Lions (Paris) has been awarded the Lagrange Prize by ICIAM.

Terry Lyons (Oxford) has been awarded the Pólya Prize for 2000 by the London Mathematical Society for fundamental contributions to analysis and probability.

Robert MacKay (Warwick) and **Paul Townsend** (Cambridge) have been elected Fellows of the Royal Society of London.

Stefan Müller (Leipzig) has been awarded the Collatz Prize by ICIAM.

Helmut Neunzert (Kaiserslautern) has been awarded a SIAM Pioneer Prize by ICIAM.

Hilary Ockendon (Oxford) has been awarded an Honorary Doctorate by the University of Southampton.

Sir Roger Penrose (Oxford) has been awarded the Order of Merit. Membership of this order is limited to 24 people; another current holder is Sir Michael Atiyah.

Sergei Pereversev (Ukraine) has been awarded the 2000 Prize for Achievement in Information-based Complexity for many outstanding contributions to the area.

Istvan Reiman and **János Suranyi** (Hungary) and **Francisco Bellot Rosado** (Valladolid) have been awarded Paul Erdos National Awards of the World Federation of National Mathematics Competitions (WFNMC).

Jean-Pierre Serre (Paris) has been awarded an Honorary Doctorate by the University of Durham.

Ian Stewart (Warwick) has been awarded the Institute of Mathematics and its Applications Gold Medal for 2000 for exceptional service to mathematics and research

Vera Sós (Budapest) has been elected as an Honorary Fellow of the Institute of Combinatorics and its Applications.

John Toland (Bath) has been awarded the Senior Berwick Prize for 2000 by the London Mathematical Society for an outstanding piece of research.

Hendrik Van Maldeghem (Ghent) has been awarded a Hall Medal by the Institute of Combinatorics and its Applications.

Benjamin Weiss (Jerusalem) has been elected as a foreign honorary member of the American Academy of Arts and Sciences.

Deaths

We regret to announce the deaths of:

Slawomir Biel (1 September 2000)

Florent J. Bureau (28 June 1999)

V. N. Fomin (23 February 2000)

Rainer Hettich (23 July 2000)

Aubrey Ingleton (28 June 2000)

Frank Leslie (15 June 2000)

Thomas Lippold (10 June 2000)

Cyril Offord (4 June 2000)

Jean-Marie Painvin (July 2000)

Ian Sneddon (4 November 2000)

Terence Stanley (15 October 2000)

Dirk Struik (21 October 2000)

Ion Suliciu (24 November 1999)

Andreas Tamanas (15 August 2000)

Lyndon Woodward (12 June 2000)