EUROPEAN MATHEMATICAL SOCIETY

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NOTICE FOR MATHEMATICAL SOCIETIES

Labels for the next issue will be prepared during the second half of May 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

4-6 May
EMS Workshop on *Applied mathematics in Europe*, Berlingen (Switzerland)
Contact: Rolf 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: Luxembourg
Contact: V. Villani, A. Bodin or Jean-Paul Pier
e-mail: *villani@gauss.dm.unipi.it, bodin@math.univ-fcomte.fr or jppier@pt.lu*

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*

19-21 June
EMS lectures at the University of Heraklion, Crete (Greece)
Lecturer: Prof. George Papanicolaou (Stanford, USA)
Title: *Time Reversed Acoustics*
Contact: George N. Makrakis, *e-mail*: *makrakg@jacm.forth.gr*

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

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

Deadline for submission of material for the August issue of the *EMS Newsletter*
Contact: Robin Wilson, *e-mail*: *r.j.wilson@open.ac.uk*

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

24-30 August
EMS lectures in Malta, as part of 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*

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*

19-21 November
EMS lectures at Università degli Studi, *Tor Vergata*, Rome (Italy), jointly arranged by *Tor Vergata* and *Roma Tre*
Lecturer: Michèle Vergne (Ecole Polytechnique, Palaiseau, France)
Title: *Convex polytopes*
Contact: Prof. Maria Welleda Baldoni, *e-mail:baldoni@mat.uniroma2.it*

22-23 November
Diderot Mathematical Forum 5
Title: *Mathematics and telecommunications*
Venues: Eindhoven (Netherlands), Helsinki (Finland) and Lausanne (Switzerland)
Contact: Jean-Pierre Bourgignon, *e-mail*: *jpb@ihes.fr*

2002

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

Editorial

Bodil Branner (Lyngby, Denmark)

EMS Vice-President (2001–2004)
President of the Danish Mathematical Society (1998–2002)

Better interaction
During the EMS Council meeting in Barcelona last July, some of the corporate member societies called for better interaction between the EMS and its member societies. There is indeed a need for more direct interaction in between the biannual Council meetings – the question is how this can be set up most effectively.

The best way to be informed about EMS activities is through the *EMS Newsletter*, which is mailed to all member societies and all individual members. In addition, since taking office the EMS president Rolf Jeltsch has started a tradition of sending out – by the end of each calendar year – a letter to each individual member and another letter to all corporate member societies, describing the highlights of the previous year and the most important future undertakings. Also, more e-mails than ever before have been sent to member societies to inform, to ask for opinions on certain questions, and to ask for help in spreading information of general interest received by the EMS. I think we should develop such activities even more in the future.

For the EMS to be successful, it is highly dependent on collaborations with member societies and work done by individuals. Mathematicians working for the EMS are however all appointed as individuals, not representing any society in particular. This gives a freedom which is of great value, and I have no doubt that this is the way it should be. Only for Council meetings do all member societies directly appoint their delegates. Together with the elected delegates of individual members, they elect the president, vice-presidents and other members of the executive committee, and can express their opinions and have influence on the broader aspects of the work and the initiatives taken by the various committees of the EMS.

The best idea would be to interact more with the delegates between Council meetings, or with other appointed representatives of the member societies. In the past, the role of a society's delegate has been more-or-less restricted to participation in Council meetings. Indeed, some delegates were mainly chosen because they were also speakers at the conference associated with the Council meeting. To make a more lively and valuable exchange of ideas between and during Council meetings, it could be important for the EMS and its member societies to rethink the role of the delegates and increase their responsibilities. The *EMS Newsletter* too wishes to have a person appointed by each society, responsible for transferring local news to the *Newsletter*. Some societies have appointed such a person, others not yet.

What can member societies do to make the EMS more visible?
Many societies publish a newsletter and have a homepage. We wish to encourage all societies to publicise its EMS membership, both in its newsletter and on the front homepage of the society, and to advocate individual membership.

Individual membership of the EMS is usually obtained and paid through member societies, but this may not be obvious to the society's members, and neither may it be obvious how to distinguish between the society being a member and a person being a member. We encourage societies to make it easy for their members to join the EMS. However, the way in which each society collects its EMS fees should be as easy as possible for that society, and may differ from one society to another.

The most visible sign of EMS membership is the receipt of the *EMS Newsletter*. Societies can add new EMS members four times per year, in mid-February, May, August and November, by mailing the additional list to Tuulikki Mäkeläinen. The individual benefits, besides the *Newsletter*, include reduced conference fees for EMS conferences and reduced prices of certain books and journals (see the list at EMIS under 'How to join the EMS').

Societies should also encourage mathematical departments to subscribe to the *EMS Newsletter*: it is very cheap (60 euros annually). As explained above, it is mainly through the *Newsletter* that the mathematical community can be informed about the work of the EMS. Many mathematical departments subscribe to the AMS Newsletter, the *Notices*, and it should be just as natural to subscribe to the *EMS Newsletter*. Individual members of the EMS can of course also encourage their department to subscribe.

I believe that all the above can be handled by the individual societies without too much difficulty.

What does the EMS offer?
The purpose of the EMS is to 'promote the development of all aspects of mathematics in the countries of Europe, with particular emphasis on those which are best handled on the international level'.

Some of the society's activities are of a purely mathematical nature – for instance, summer schools, conferences, and lectures are organised under the EMS umbrella, mainly by different volunteers. The weakness is that the EMS, besides moral support, can offer at most symbolic economic support, and so the work involved is not very different from organising any other such international mathematical activity; still, we hope that many will find it worth doing so under the name of the EMS. The *Diderot Mathematical Forums* are of a different nature. These are workshops that take place in three different cities simultaneously, featuring a special topic – the last one was *Mathematics and Music* and the next is *Mathematics and Telecommunications* – with three different themes, and with a round-table discussion in which the three cities are linked (when possible) by electronic means.

Other activities need local support to be of a truly European dimension. One example is the announcement of vacant jobs in mathematics in Europe. Some of these are collected by a number of member societies and can be found under Euro-Math-Job at EMIS; however, to be really useful, the list should be not only more complete, but also searchable. The EMS is also a partner of *Zentralblatt MATH*. Through the *LIMES* (Large Infrastructures in Mathematics – Enhanced Services) project, funded by the EU, the database is being improved in many ways.

One of the goals of the several distributed editorial units is to ensure a better coverage of the European mathematical literature. One example where member societies can be helpful is to ensure that all PhD theses are recorded in the database – this is done systematically in Germany, and ought to be followed up throughout the rest of Europe. Another activity is *EULER* (EUropean Libraries and Electronic Resources in mathematical sciences), a former EU project that will be continued in some way. Institutions other than the core participants can join by making their library resources available (for more details see *EMS Newsletter* **38**, December 2000). The newest added activity is the EMF (the European Mathematical Foundation), founded in March 2001. Its main purpose is to run the EMS publishing house, which will start to function this year. Again, interaction with member societies is highly needed.

In order to expand such activities as the above, the EMS will have to describe more precisely how member societies or other partners may contribute. The list of activities is by no means exhaustive.

Asymptotic combinatorics with application to mathematical physics.

European Mathematical Society SUMMER SCHOOL
Euler International Mathematical Institute, St. Petersburg, Russia.
9th July – 25th July 2001

The SUMMER SCHOOL aims to discuss recent progress in the asymptotic theory of Young tableaux and random matrices from the point of view of combinatorics, representation theory and the theory of integrable systems. This subject belongs both to mathematics and theoretical physics. Systematic courses on the subjects and current investigations will be presented. The SUMMER SCHOOL is aimed at physicists as well as mathematicians. Graduate students are encouraged to apply.

Main Speakers

P. Biane	ENS, Paris, France	E. Brezin	ENS, Paris, France	P. Deift	UPenn, USA
K. Johansson	KTH, Stockholm, Sweden	V. Kazakov	ENS, Paris, France	R. Kenyon	University Paris-Sud, Orsay, France
M. Kontsevich	IHES, France	A. Lascouix	University Marne-la-Valiee, France	A. Okoun'kov	UCB, USA
G. Ol'shansky	IPPI, Moscow, Russia	L. Pastur	University Paris-7, France	R. Speicher	University of Heidelberg, Germany
R. Stanley	MIT, USA	C. Tracy	UCD, USA	H. Widom	UCS Cruse, USA

The lectures will be devoted to asymptotic combinatorics and applications to the theory of integrable systems, random matrices, free probability, quantum field theory etc. They will also cover topics in low-dimensional topology, QFT, a new approach to the Riemann-Hilbert problem, asymptotics of orthogonal polynomials, symmetric functions, representation theory, and random Young diagrams. Lately there has been great progress; new links and problems have appeared.

The following long-standing problems have recently been solved: fluctuation of random Young diagrams and of the maximal eigenvalues of the random Hermitian matrix. A new approach to the Riemann-Hilbert problem and integrable systems has been developed by Deift-Baik-Johansson (based on the Korepin-Izergin-Its approach, papers by Tracy-Widom and others). Alternative methods come from the asymptotic theory of representations and in particular from studying the Plancherel measure. These ideas let us calculate the correlation functions of the corresponding point processes (Ol'shansky-Borodin and previous results by Kerov-Vershik) and also to apply the boson-fermion correspondence (Okoun'kov). The explicit distribution of the fluctuations of the characteristics of Young diagrams is one of the main results as is the precise distribution of the fluctuations of the eigenvalues of the random matrix.

Such progress has initiated great activity in many related topics, namely – the growth of polymers, ASEP, random walks on groups and semigroups. Prospective problems and applications of the results will be discussed during the SUMMER SCHOOL in seminars and round-table discussions.

Scientific Committee
E. Brezin, O. Bohigos, P. Deift, L. Faddeev, V. Malyshev, A. Vershik (chair).

Local Organizing Committee
A.Vershik, Ju. Neretin, K. Kokhas, E. Novikova

Organization
The SUMMER SCHOOL will take place 9th –25th July, 2001, at the International Euler Institute, St.Petersburg, Russia.
The Summer school has financial support from the EMS and the RFBR. Additional information about the SUMMER SCHOOL can be found at http://www.pdmi.ras.ru/EIMI/2001/emschool/index.html E-mail: emschool@pdmi.ras.ru.

EMS Summer School in Probability Theory

Saint-Flour, Cantal, France

17 August – 2 September 2000

Pierre Bernard ***(Blaise Pascal University, Clermont-Ferrand, France)***

Around one hundred mathematicians from twenty countries, mainly young researchers, took part in the Year 2000 *Summer School in Probability Theory* at Saint-Flour. This was the thirtieth such summer school; the series was founded in 1971 by Paul Louis Hennequin, and is well known by the international community in probability theory, statistics, and their applications.

The three series of lectures were chosen to have applications in different fields, and provided advanced training in these areas. Each series consisted of ten 90-minute lectures.

The lectures by **Sergio Albeverio**, University of Bochum, were on *Dirichlet forms and infinite-dimensional processes, their theory and applications*. These covered basic theory: analytic and probabilistic tools; diffusion processes; jump processes; connections with systmes of stochastic ordinary differential equations and stochastic partial differential equations; applications to stochastic dynamics (statistical mechanics, quantum field theory and polymer physics); and analysis and geometry on configuration spaces and applications.

Walter Schachmayer, University of Vienna, gave an updated overview of *The mathematical probabilistic tools of finance and the mathematics of arbitrage*; the applications here concern banks and finance and insurance companies. This subject has been greatly developed in the past ten years, and this summer school provided the opportunity for a state-of-the-art review by one of the main specialists in Europe.

The course dealt with the applications of stochastic analysis to mathematical finance. The basic economic concept underlying the modern approach to mathematical finance is the 'principle of arbitrage'. The theory was developed by systematically elaborating this concept and its applications. The mathematical model of a financial market is a stochastic process S modelling the discounted price of a financial asset (a 'stock'); the time index can be either discrete or continuous. Trading on the stock S is modelled by predictable processes H, describing the amount of stock held by an investor at a given time. The basic object of study is the process of gains and losses given by the stochastic integral $H.S$.

The course was in two parts. In the first, the underlying probability space was assumed to be finite. In this elementary setting all the measure-theoretic difficulties disappear, and the basic themes and ideas of mathematical finance can then be presented without unnecessary technicalities: the basic relation between arbitrage and equivalent martingale measures (the 'fundamental theorem of asset pricing'), pricing and hedging of derivative securities in complete and incomplete markets, optimal investment and consumption problems, etc. In the second part, the same programme was carried out in proper generality to develop the natural framework in continuous time. The tools used are general semi-martingale theory and functional analysis.

Michael Talagrand, research director at the CNRS (National centre of Scientific Research) in France, taught us about *Spin glasses*. Under this name one denotes a number of stochastic models introduced by physicists. These models are purely mathematical objects of a remarkably simple and canonical character. They have been studied by physicists using non-rigorous methods, and predict a number of extremely interesting behaviours that potentially open new areas of probability theory. The challenge is to say something rigorous about this topic, and the purpose of the course was to introduce the basic ideas and tools that have been developed in this direction.

The young participants were all invited to present their research work in 40-minute presentations, and forty of them did so. The environment of the summer school was very favourable for exchanges between young researchers and more experienced participants.

The help of the EMS was much appreciated, and I wish to thank all the sponsors of the Summer School: the European Commission XII, Région Auvergne, Départment du Cantal, City of Saint-Flour, UNESCO, the Blaise Pascal University, and CNRS.

The next Saint-Flour Summer School will be held from 8-25 July 2001, and the three lecturers will be Olivier Catoni (CNRS, Paris VI University): *Statistical learning theory and stochastic optimization*; Simon Tavaré (University of Southern California): *Ancestral inference from molecular data*; Ofer Zeitouni (Technion–Israel Institute of Technology): *Random walk in random environments: asymptotic results*.

STATUTES

of the European Mathematical Foundation

At the London meeting of the EMS Executive Committee in November 2000 it was decided that an EMS publishing house should be created and that a foundation, the European Mathematical Foundation, should be the legal owner of such a publishing house. The statutes of this foundation appear below.

Article 1: Name, seat and duration
The European Mathematical Foundation is a Foundation in the sense of Article 80 of the Swiss Civil Code. It has its seat in Zurich. The duration of the Foundation is not limited.

Article 2: Purpose of the Foundation
The Foundation has the purpose of furthering Mathematics in all its aspects in Europe (including scientific, educational and public awareness).

To this purpose the foundation can undertake the following activities:

a) the establishment and supervision of a publishing house, whose mode of operation will be regulated by by-laws determined by the Board of Trustees of the Foundation;

b) furtherance of the activities of the European Mathematical Society ["EMS"]; in particular, the furtherance, dissemination and popularization of mathematical knowledge, furtherance of exchange of ideas between mathematicians in Europe and between mathematicians in Europe and other mathematicians;

c) collaboration with the administration of the EMS;

d) support of activities of corporate member societies of the EMS.

The Foundation may, on the basis of decisions made by its Board of Trustees, extend all its activities towards further tasks with similar objectives.

Article 3: Foundation capital
The foundation capital is Euro 10000. The foundation capital may be increased anytime by additions from the founder or third parties.

Article 4: Bodies of the Foundation
The operating bodies of the Foundation will be:

a) its Board of Trustees;

b) the Executive Committee of the Board of Trustees;

c) the managing director of the publishing house;

d) the Auditors of the Foundation.

Article 5: Board of Trustees
The Board of Trustees will consist of at least 4 members but not more than 12 members.

Members of the Board of Trustees will include:

* the current President of EMS;
* the previous President of EMS, unless he/she renounces this office;
* the current Secretary of EMS;
* the current Treasurer of EMS;
* a representative of the Swiss Federal Institute of Technology in Zürich ["ETHZ"].

The Board of Trustees may appoint further members at its discretion, as specified in the by-laws of the Foundation.

The President of EMS will chair the Board of Trustees.

The Board of Trustees will appoint a Secretary.

The Board of Trustees will supervise the management of the funds of the Foundation, and will ensure that the funds are used according to the aims of the Foundation. The Board of Trustees will meet at appropriate intervals, and at least once a year for an Annual Meeting. In that Annual Meeting the financial statements and budget of the Foundation will be approved. The Executive Committee of the Board may call a meeting of the Board of Trustees at any time.

The board of trustees will establish by-laws on the details of the organization and the management. These by-laws can be changed by the board of trustees within the purpose of the foundation any time and have to be approved by the supervising authorities.

A member of the board of trustees will in principle receive no payment from the Foundation. Expenses will be covered upon presentation of receipts. If some tasks are extraordinarily work intensive these can be paid for in an isolated case.

Article 6: Agency for Auditing
The Board of Trustees elects an independent external Agency for Auditing which audits the books of the foundation on an annual basis and submits its result to the Board of Trustees in a detailed report with the motion for approval. In addition it has to ensure that the Statutes and the purpose of the foundation are adhered to.

The Agency for Auditing has to inform the Board of Trustees on shortcomings observed during their investigation. If these are not corrected in a reasonable time period, the agency has to inform the supervising body.

Article 7: Executive Committee
The Executive Committee of the Board shall comprise the following:

* the Chairman of the Board of Trustees (or a nominee from amongst the Board members);
* two nominees of the Board of Trustees, at least one of whom is also a member of the Board of Trustees.

The Executive Committee is responsible for the day-to-day running of the Foundation, the Annual Report of the Board, the audited Annual Financial Report of the Board, and a budget. The Board of Trustees will specify who is authorized to sign for the Foundation. The Executive Committee will supervise the investment of the funds of the Foundation.

Article 8: Changes to the Statutes of the Foundation
The Board of Trustees may, within the limitations of Article 85 and 86 of the Swiss Civil Code, with a two-thirds majority of the present or represented members of the Board of Trustees, decide on a total revision or a partial revision of the Foundation's Statutes.

The Board must submit its decision to the supervising body, the Swiss Ministry of the Interior, with a request for an appropriate changement decree.

Article 9: Termination of the Foundation
Should the objectives of the Foundation no longer be achievable for any reason, then the Board of Trustees may at its discretion decide to dissolve the Foundation, subject to the approval of the supervising body (the Swiss Ministry of the Interior). In the event of a dissolution of the Foundation, its remaining funds, after payment of all debts, may be given to organizations, foundations and institutions with the same or similar objectives to the present Foundation.

In the name of the European
Mathematical Society
President
Rolf Jeltsch

EURESCO Conferences in Mathematics in 2001

18-23 August: Algebra and Discrete Mathematics, Hattingen, Germany
EuroConference on *Classification, Non-Classification and Independence Results for Modules, Groups and Model Theory*
Chairs: Rüdiger Göbel, Essen, and Manfred Droste, Dresden

1-6 September: Number Theory and Arithmetical Geometry, Acquafredda di Maratea (near Naples), Italy
EuroConference on *Arithmetic Aspects of Fundamental Groups*
Chair: Anthony J. Scholl, Durham, UK

Raising Public Awareness of Mathematics

An ARTICLE COMPETITION

Vagn Lundsgaard Hansen

Articles in many ways,
math displays,
says,
the EMS committee of RPA:
A competition surely may,
inspire the way,
in which to pay,
as we say,
attention to public awareness!

During World Mathematical Year 2000, several articles on mathematics addressing a general audience were published throughout the world, and many valuable ideas for articles popularising mathematics have been generated. The newly appointed committee for *Raising Public Awareness of Mathematics* of the European Mathematical Society (acronym RPA) believes that it is vital that such articles be written. In order to inspire future articles with a mathematical theme and to collect valuable contributions, which deserve translation into many languages, the EMS wishes to encourage the submissions of articles on mathematics for a general audience, in a competition. The EMS is convinced that such articles will contribute to raising public awareness of mathematics. The RPA-committee of the EMS invites mathematicians, or others, to submit manuscripts for suitable articles on mathematics.

To be considered, an article must be published, or about to be published, in a daily newspaper, or some other general magazine, in the country of the author, thereby providing some evidence that the article does catch the interest of a general audience. Articles for the competition shall be submitted both in the original language (the published version) and in an English translation. The English version shall be submitted both in paper and electronically.

There will be prizes for the three best articles of 200, 150 and 100 Euros, and the winning articles will be published in the *EMS Newsletter*. Other articles from the competition may also be published if space permits. Furthermore, it is planned to establish a web-site containing English versions of all articles from the competition approved by the RPA-committee.

By submitting an article for the competition, it is assumed that the author gives permission to translation of the article into other languages, and for possible inclusion into a web-site. Translations into other languages will be checked by persons appointed by relevant local mathematical societies and will be included on the web-site.

Articles should be sent before 31 December 2001, to the chairman of the RPA-committee of the EMS:
Professor Vagn Lundsgaard Hansen,
Department of Mathematics,
Technical University of Denmark,
Building 303,
DK-2800 Kongens Lyngby, Denmark.
e-mail: V.L.Hansen@mat.dtu.dk

JEMS

The *Journal of the European Mathematical Society* (*JEMS*) is a joint publication of the European Mathematical Society and Springer-Verlag. There is one volume per year, consisting of four quarterly issues; Volume 1 was published in 1999. *JEMS* includes research papers in all areas of pure and applied mathematics. The Editor-in-Chief is Dr. Jürgen Jost.

JEMS is one component of the continuing effort of the European Mathematical Society to promote joint scientific activities among the many diverse structures that characterise European mathematics.

To look at the journal, use the website:
http://link.springer.de/link/service/journals/10097/index.htm
To see the contents of the first two volumes, use the website:
http://link.springer.de/link/service/journals/10097/tocs.htm
Individual members of the EMS can purchase *JEMS* at a special price of DM 52 in Central and Eastern European, and DM 80 outside Central and Eastern European (plus carriage charges). The corresponding rates for institutional subscribers are DM 180 and DM 396. These subscription rates include both the printed and electronic forms of the journal. To subscribe, please contact Springer-Verlag on the website:
http://link.springer.de/link/service/journals/10097/subs.htm
The contents of the most recent issue (Volume 3, No. 1) are as follows:
D. Mucci, *A characterization of graphs which can be approximated in area by smooth graphs*
M. Harris, *A note on trilinear forms for reducible representations and Beilinson's conjectures*
L. Ambrosio, V. Caselles and J.-M. Morel, *Connected components of sets of finite perimeter and applications to image*

Maths Quiz 2000

The international competition *Maths Quiz 2000* took place on 4-5 December. There were 378 teams from around the world registered to play, including 108 from the USA, 27 from Russia, and teams from Mongolia, Azerbaijan, the Philipines and Thailand, to name a few. As the competitors and organisers can testify, it was an emotional experience and an excellent way to celebrate World Mathematical Year 2000.

It is now time to announce the winners and explain the background to this unique event. The competition was conceived and designed at the Centre de Recerca Màtematica in Barcelona by Manuel Castellet, Rafel Serra and Jaume Aguadé. Designed as a real-time question-and-answer competition to be played over the internet, with successive levels of scoring following the Fibonacci sequence, it was played in one continuous 24-hour session to guarantee fairness to players from all time zones. In this way it was also a test of endurance!

When Sun Microsystems offered to sponsor the game with five magnificent prizes, as well as donating the server needed to host it, *Maths Quiz 2000* was born. Now that the game is over, the server will be presented to a mathematics department in a less-favoured region. Birkhäuser publishers and Wolfram Research also showed interest, offering prizes of book vouchers and Mathematica licences. The Centre de Recerca Matemàtica offered a special prize to the team from the Catalan countries which achieved the best result in the competition.

To make the game fun to play it was necessary to think carefully about the design (and the prizes!) and to have good questions. A committee of five mathematicians (Jaume Aguadé, Joan J. Carmona, Enric Nart, Pere Puig and Jaume Soler) worked for months on the task of producing a large database of questions that were simultaneously hard, enjoyable and correct. At the technical end, the game was programmed by Rafel Serra and Waldo Mateo, with a group from Universitat Oberta de Catalunya, implementing the hardware and providing and configuring the internet connection for the server.

The competition started at noon, Greenwich Mean Time, on Monday 4 December and ended exactly 24 hours later. The organisers, following its progress from the UOC, were consistently surprised by the high level of play sustained by the competitors during this period and their extraordinary skill on really hard questions!

The leading team was a group of young researchers from the Universitat Autònoma de Barcelona, led by Raul Fernandez, who achieved a final score of 925 points. In second place came an Italian team led by Andrea Rizzi from Pisa. Third was a Brazilian team from IMPA in Rio de Janeiro, lead by Krerley Oliveira, while the fourth position went to Martin Kollar and his collaborators from the Comenius University in Slovakia. Positions 5, 6, 7 and 8 were taken by Andrei Moroianu (currently in USA), Juan Pablo Rossetti (Dartmouth College, USA), Greg Martin (University of Toronto, Canada) and Ricardo Perez-Marco (UCLA, USA).

The CRM is now considering ways to make the game MQ2000 available to the public.

Simulation of Fluid and Structure Interaction

European Mathematical Society SUMMER SCHOOL
Campus of the Faculty of Mathematics and Physics, Charles University, Prague
19th-31st August 2001

The SUMMER SCHOOL will be concerned with mathematical and numerical methods in fluid dynamics, structural mechanics and, particularly, the interaction of fluids and structures. This last is a relatively new, but extensively developing, area having great importance from the standpoint of applications in science and technology. There will be a comprehensive series of lectures on the above subjects.

The level will be appropriate for graduate students and young researchers. Limited financial support will also be available for graduate students.

Speakers
J. Ballmann, TH Aachen, Germany
D. Causon, University of Manchester, UK
M. Feistauer, Charles University, Prague, Czech Republic
J. Felcman, Charles University, Prague, Czech Republic
P. Hemon, Institut Aerotechnique, France
P.Leyland, EPFL, Switzerland
A. Quarteroni, EPFL, Switzerland
M. Schäfer, TH Darmstadt, Germany
L. Tobiska, University of Magdeburg, Germany
J.Vierendeels, University of Gent, Belgium

Organizers
P. Wesseling, Delft University of Technology, Netherlands
L. Tobiska, Otto-von-Guericke-University, Magdeburg, Germany
M. Feistauer, J. Felcman, Charles University, Prague, Czech Republic

Co-Organisers
P. Chocholatý, Commenius University, Bratislava, Slovakia
G. Stoyan, ELTE University, Budapest, Hungary
J. Rokicki, Warsaw University of Technology, Poland

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European
Mathematical Society

Interview with Bernhard Neumann

interviewer: John Fauvel, Open University, UK

Bernhard Neumann was born in Berlin in 1909, and took his Dr. phil from the University of Berlin in 1932. He moved to England in 1933, taking a PhD at the University of Cambridge, and taught at the Universities of Wales, Hull and Manchester before moving to Australia in 1962, to create the mathematics department within the Institute for Advanced Studies of the Australian National University. This interview focuses on his life, work and experiences in Europe up to 1962.

Professor Neumann, I wanted to ask you first about the influence of your family on your mathematical interests and development.

My home environment was a very strong influence. My father, Richard Neumann, was an engineer who worked for the electricity company AEG (Allgemeine Elektrizitäts Gesellschaft) in Berlin, and we lived in a prosperous Berlin suburb where I went to school. It was one of his student textbooks that first introduced me to the fascination of mathematics, at the age of eleven or twelve: it was Stegemann and Kiepert's textbook on differential and integral calculus. Studying differential and integral calculus was in those days not generally done until university—it had not migrated down to high school yet. My father showed this textbook to me, to show me the shape of some curve, I think, and it fired my imagination. I worked through the differential calculus from cover to cover, did all the exercises, and enjoyed it immensely. The second volume, on integral calculus, I think I got stuck on after a while. I must have been eleven, but that certainly was a great influence.

At school I was thoroughly lazy, but very good at mathematics, and that saved me, except on one occasion when my form master sent for my mother and told her I was very close to not being moved up at the end of the year. That would have been a terrible thing, for me and for the family, and my sister, who was four years older than I, was delegated to see to it that I worked. I worked really hard under her guidance for something like six weeks, and by then I had got into the habit of doing enough work to get by.

And how did you enjoy your school days?

I spent three years in primary school and nine years in high school. All in all I took nine years of French, eight years of Latin, and three years of English. The French was uninspiring. The Latin I didn't like—I didn't like the teacher because he insisted on our working—until one day, I was in the fifth form by then, when he said we have covered what we have to do, let us read an author who is not on the syllabus. He chose a minor writer from the second century AD, Minucius Felix, an early Christian apologetic, and suddenly this was interesting. Caesar was somewhat spoiled for us by having to translate word for word, but here was something that was alive, and suddenly I got interested in Latin. My Latin improved tremendously and I did rather well at the examination.

It was when I went to university that I began to read more books in Latin, reading the authors we hadn't got to in eight years' study of Latin at school. I would read them on the train journey, using a tiny little dictionary in which I looked up the words I didn't know. After a while I could read Latin with reasonable fluency. Among other things, I read engineering texts of Frontinus, from the end of the first century, about the Roman water supply. It sounds a very dry subject but I was fascinated by the author's tables of pipes, their diameter, circumference & carrying capacity, which he calculated by a simple formula. I taught myself calculating with Roman fractions and checked all the tables, which had been rather badly transmitted.

Where did you go to university?

I spent my first two semesters (1928-29) at the University of Freiburg, in the Black Forest, but returned to the Friedrich-Wilhelms University in Berlin for the rest of my studies (1929-32). There were four professors in Berlin: Issai Schur, Richard von Mises, Ludwig Bieberbach and Erhard Schmidt. They made an excellent team, each completely different in style, in lecturing style. Issai Schur was my Doktorvater, a distant but kindly and supportive man.

Were you always primarily interested in algebra?

I had really intended to become a topologist, influenced by Heinz Hopf, and my conversion to algebra was rather by chance. In my sixth semester, towards the end of my third year, there was a student seminar and I was the understudy to the person reporting on a paper about automorphism groups by the Danish mathematician Jacob Nielsen. I realised that I could reduce the number of generators he used from four to two, in general; so I wrote it up and showed it to Heinz Hopf. He immediately suggested I might like to take my doctorate with this work, to which I replied that the paper was too slight and I was too young. Nonetheless, Hopf showed the work to Issai Schur, who sent his assistant Alfred Brauer with the same suggestion, to which I gave the same response. In the next semester Schur sent Brauer again to say "But Professor Schur *wants* you to take your doctorate with this work." So I agreed. A little later Schur himself spoke to me and said that perhaps I was right and it was rather thin, so would I like to use the same methods to explore an additional topic in which he had become interested, that is now called the wreath product of groups. My suspicion is that Schur was thinking in that direction because of a recent paper by Loewy in which the idea had been adumbrated. I did the work in a fortnight, which doubled the length of my thesis, and submitted it secretly, as a surprise for my parents.

I took my oral examination for the doctorate in November 1931—my examiners were Issai Schur and Erhard Schmidt in mathematics, and for my subsidiary subjects Peter Pringsheim in physics, and Wolfgang Köhler in psychology. My examination with Schmidt was intended to take forty minutes but we found the conversation so interesting that it took twice as long. I received the degree some months later in July 1932, since I had to get copies of my dissertation. I expected Issai Schur to publish my dissertation in *Mathematische Zeitschrift*, of which he was founding editor, but he didn't, and instead Otto Blumenthal published it in *Mathematische Annalen*. Then Jacob Nielsen, on whose work it was based, reviewed it in *Zentralblatt*. I was then 23, which was a very young age to take a doctorate in mathematics in Berlin.

Of the four full professors at Berlin, Ludwig Bieberbach became notorious later for his Nazi sympathies. Were there signs of this when you knew him?

One always had the feeling that this was a defensive move, because Bieberbach had been too friendly before with wives of Jewish colleagues—not in Berlin, but elsewhere—at least, that was the rumour. Perhaps he was concerned for his own future, and that is why he became not just Nazi but ultra-Nazi. He was in fact quite an inspirational teacher, whose effect was rather great in a number of ways on Hanna, my first wife.

What happened after you took your doctorate?

I continued to go to lectures and seminars, and also worked as an unpaid assistant in experimental physics. Some time, it must have been in January 1933, a friend introduced me to a young student, Hanna von Caemmerer. I thought her name sounded rather right-wing (and indeed her ancestors were Prussian officers), so thought little more about it.

But then I met her again at *Mapha*, the Mathematisch-Physikalische Arbeitsgemeinschaft, which was a wonderful institution within the university, set up by Alfred Brauer, one of Professor Schur's assistants, and Hans Rohrbach. It had, uniquely, its own rooms and its own library, and there we would play chess, play go, and discuss mathematics and other things. Hanna was in her second semester then, and when we talked more I discovered that she too was anti-Nazi—Hitler had come to power at the end of January, and it was now the end of February. So we became friendlier and at Easter I invited her to come for a walk with me in one of the forests on the outskirts of Berlin. After the walk we came back and played table tennis. Suddenly she called me, by mistake—by deliberate mistake, perhaps—it was certainly a highly significant slip in terms of German etiquette—the familiar *Du* instead of the impersonal *Sie*. That led to my really falling in love with her.

A little later I took her home to meet my family. My mother immediately took to her, and that became very important for us.

1933 was an eventful year in Germany.

Yes, in August of that year I moved to Cambridge, in England. I knew I had no chance in Nazi Germany, but my arrival in Cambridge was quite coincidental. A school friend of mine knew I wanted to emigrate somewhere, I didn't mind particularly where, and rang up one day to say "Meet me in Amsterdam tomorrow." I phoned home and my father, who was at work, immediately arranged for me to get a passport, which took a day to obtain. I took a train to Amsterdam, met my school friend there, who said Cambridge was the best place for a mathematician, and saw me on my way. So I arrived in Cambridge. Like so many of the emigrés at that time I had a doctorate already, but unlike some I immediately registered to do a second doctorate in Cambridge. This was against the advice of G. H. Hardy, who said that a doctorate was unnecessary; what was important was to do good mathematics. Most of us ignored his advice, except for Hans Heilbronn, who indeed went on to do very well.

What was your experience of research at Cambridge?

I was allocated to Philip Hall as my research supervisor—I had no idea who Philip Hall was, as the allocation was made by someone else, I don't know who. I started my research working on a topic which at the time was just too early, on rings of non-associative polynomials; this problem was only solved later, and not by me. I worked on it until Christmas 1934 and then I realised that it would not make for a PhD thesis in the months remaining. Then I remembered something I had started a few years earlier and had not really pursued, and looked at it again, and within a very few days I realised I had struck oil. I worked on it and worked on it and one day in May 1935 I said to myself "I must stop now and write up", otherwise it would just go on and on and on.

I saw Philip Hall once a week, when I would look him up in King's College after dinner. He would offer me a cigarette. We then talked about everything under the sun. He was very well informed over a wide range: about rhizomorphs in botany, about the political situation in European countries, everything. At about ten o'clock or so he might ask me a question or two about my research work, but never pointed me in any particular direction (indeed he did not interfere in my false starts). In fact, at that time I knew a bit more about infinite groups than he did. This didn't last; later he knew a tremendous amount about infinite groups. Anyway, the experience of being supervised by Philip Hall was very pleasant.

The oral examination for my thesis was over lunch in my supervisor Philip Hall's rooms. He was one examiner, and Max Newman was the other. They asked me two questions: did I prefer beer or wine with my lunch, and would I like my coffee black or white. I must have answered these questions to their satisfaction, for I received my PhD.

Meanwhile Hanna was in Germany throughout these years?

Hanna was in Germany over this period. We had become engaged in 1934, and corresponded in secret through my parents and her old geography teacher. In 1936 we managed to spend a fortnight together in Denmark, where I stopped off on my way back from the ICM in Norway.

In that year, too, 1936, Hanna took her teachers examination, the *Staatsexamen*. She had been warned by a good friend that this would have involved her being questioned in the oral examination by Ludwig Bieberbach on "political attitudes", which was a new requirement. Because he suspected her of being friendly with Jews, he would certainly have failed her. So the oral was arranged for the long summer vacation, when Bieberbach was away. In the event it was conducted by Neiss, who was more sympathetic and reliable. But clearly it was impossible for Hanna to take her doctorate at Berlin, as she wanted, so she moved to Göttingen to continue her research under Helmut Hasse. She got on well there, but after three semesters she saw the way the wind was blowing, abandoned her research (it was only completed a few years later, I think by André Weil), and came to join me in England in July 1938 where we got married.

You had a job by this time?

Yes, after completing my Cambridge doctorate I stayed on there for a while. At that time Olga Taussky was in Cambridge, teaching a course on algebraic number theory; this needed a preparatory course which I was asked to give. At the end of these lectures the students who had attended gave their judgement of the lecturer in a letter delivered to one of the members of staff who was a confidential go-between. I got given a sealed letter with the results of the survey. I eagerly opened it, to find it said: "No comment". I was paid £10 for that course. The year after they offered me the same course again, for which they would pay £50. If I had stayed on giving that course I would be rich now.

But by that time I was in Cardiff, in Wales. I had applied for every job going, and was interviewed by University College, Cardiff, who wanted a temporary assistant for three years and had shortlisted one mathematician from the north of England, and myself. I got the job, I suspect because I was not English. It was temporary because they had a very bright student who had just finished her first degree and had gone off to Cambridge to take a PhD, and they wanted to keep an opening for her for when she had finished. After those three years the war had started, and things were very different. In fact, she didn't come back after three years but after four years, by which time I was no longer in Cardiff, I was in the army.

What happened to you during the War?
At first I continued to teach in Cardiff, living there with Hanna and with my parents, who had come to join us, after much persuasion, just before the outbreak of war. In May 1940 there were a lot of scare stories in the press about enemy aliens and we were moved away from Cardiff, which was a port, and went to live in Oxford, safely inland. After a few days I was interned, at first in Southampton and then in Lancashire. By autumn of that year internees were being released if their former employer asked for them. My former employer, University College, Cardiff, made no move at all, so I decided to join the Army. When later Cardiff asked me to come back I said "No", since they did not support me and try to secure my release when they could have done.

I served for two-and-a-half or three years in the Pioneer Corps, an interesting outdoor life building Nissen huts and the like, and when we were allowed to volunteer for combat service I transferred to the Royal Artillery where I had a slightly more mathematical role using surveying equipment and doing basic numerical work. Later I was in the Intelligence Corps.

After the fighting had stopped I volunteered to go with a unit of the Intelligence Corps to Germany, as I hoped to make contact with Hanna's family near Lübeck. When I arrived with a kitbag full of food tins, my mother-in-law became further reconciled to our marriage which she had not at first been at all enthusiastic about. Of course my having produced three grandchildren for her, with a fourth on the way, was a great help in bringing her round.

So after the war you didn't return to Wales?
No, I turned down their invitation to return, since they did nothing for me during the War, and instead took a lectureship at University College, Hull. Shortly afterwards Hull offered a job also to Hanna, who had her DPhil by now, supervised at Oxford by Olga Taussky. She stayed there for twelve years, but in 1948 I was recruited by Max Newman to join the mathematics department at Manchester.

Why did Max Newman lure you to Manchester? Of course, you had long known him, as he was your PhD examiner at Cambridge.
It wasn't just that. What happened was that Hanna and I decided to organise a meeting, a colloquium, of British mathematicians in Hull. We hoped the London Mathematical Society would support it, but some members were a bit lukewarm about the idea. In particular, our own professor of mathematics in Hull, George Steward, was rather dismissive of the idea of holding a colloquium of mathematicians in Hull. The problem was that he had been appointed quite young to the Chair in Hull, and in about 1936 he had died, but no-one told him he had died, so he carried on living until his nineties, when in fact he had been dead for many years before that.

So there was no mathematical colloquium in Hull, but meanwhile Max Newman, who was putting a lot of energy into building up the department in Manchester, learned through his LMS contacts of our proposal which he thought an excellent one. The upshot was that he invited me to join the faculty at Manchester, and the following year, 1949, we were able to organise the first British Mathematical Colloquium, in Manchester.


Three octo- and nono-geraniums (as they called themselves) met again at the 2000 Christmas meeting of the British Society for the History of Mathematics, held in University College, London: the late Robert Rankin (left) with two refugees from Nazi Germany, Bernhard Neumann and Walter Ledermann.

Alan Turing was also on the staff at Manchester. Was he someone you knew there?
I did not know him well, but he showed me the computer they were developing, which was a matter of pink string and sealing wax, down in the basement. In the corner was a big column which was the memory. It was a strange contraption. He was the brains behind it. He gave a number of talks, from which it was quite clear that he was a genius. He was not easy to understand, as he would stumble over the words—he thought so much faster than he could speak—but it was very clear he was a genius. There is no doubt about that.

It was in Manchester too, I understand, that you developed your interest in the history of mathematics?
I had an engineer friend who worked for Ferranti in Manchester, B. V. Bowden (later Lord Bowden) who was very concerned with computers and their history, and one day said to me that he had found papers belonging to Ada Lovelace which he had on loan from the family. These were largely letters from Ada Lovelace to her mathematics tutor, Augustus De Morgan, with some of his replies. I read these papers and found them fascinating—they included also notebooks from her daughter's study with the first professor of mathematics at Owen College, Manchester—and as they were in disarray I put some effort into arranging them in chronological order, using watermarks, internal evidence, and so on. I read as much as I could about her and De Morgan and their circles, including Augustus De Morgan's son William de Morgan, who became famous for his tiles and also for writing novels. In fact, my father gave me a copy of William De Morgan's first novel, *Joseph Vance*, to read on the journey when I went to Cambridge in 1933. Eventually the Lovelace papers went back to the family, but my son Peter made photocopies of them and I have kept up my interest in the history of that time. I later wrote a paper about this which appeared in the *Mathematical Gazette*.

Do you think history of mathematics can help to stimulate and inform students' interest in learning mathematics?
Well, for example, Charles Curtis's book on the history of group representations will do a lot to introduce students to the work of Frobenius, Schur, Burnside, and so on. And my son Peter has done a lot of work in history, including a forthcoming edition of the work of Burnside, which should help further in bringing mathematics from the past alive to students today.

In 1962 Bernhard and Hanna Neumann moved to Australia, where he took up the Foundation Chair in mathematics at the Institute of Advanced Studies, Australian National University in Canberra. Hanna was appointed a Professorial Fellow there, and shortly afterwards became head of the pure mathematics department in the School of General Studies.

Interview with Sir Roger Penrose

part 2

Interviewer : Oscar Garcia-Prada

In part 1 of this interview (in the previous issue), Roger Penrose described his work in twistor theory and cosmology. He now talks about his work on tilings and impossible objects, and about his popular books on mathematics.

In the early 1970s you discovered two 'chickens' that can tile the plane in a way that must be non-periodic. How did you find these non-periodic – or perhaps I should say aperiodic – tilings?

Yes, aperiodic tile sets, I suppose, but the tilings are non-periodic. Tiling problems have always been a doodling side interest of mine, just for fun; if I got bored with what I was doing I'd try and fit shapes together, for no particular scientific reason – although I supposed that there was some connection with my interest in cosmology, in that there seem to be large structures in the universe that are very complicated on a large scale, whereas one believes that they should be governed by simple laws at root. So I tried to find a model where we have simple structures that produce great complication in large areas; I had an interest in types of hierarchical design.

So I played around with such hierarchical tilings, where you form bigger shapes out of smaller ones; the bigger ones you produce have the same character but are on a larger scale than what you just did. I also had an interest in Escher and his work and met him on one occasion: I had produced single tile shapes that would tile only in rather complicated ways, and Escher himself used one of these in his last picture.

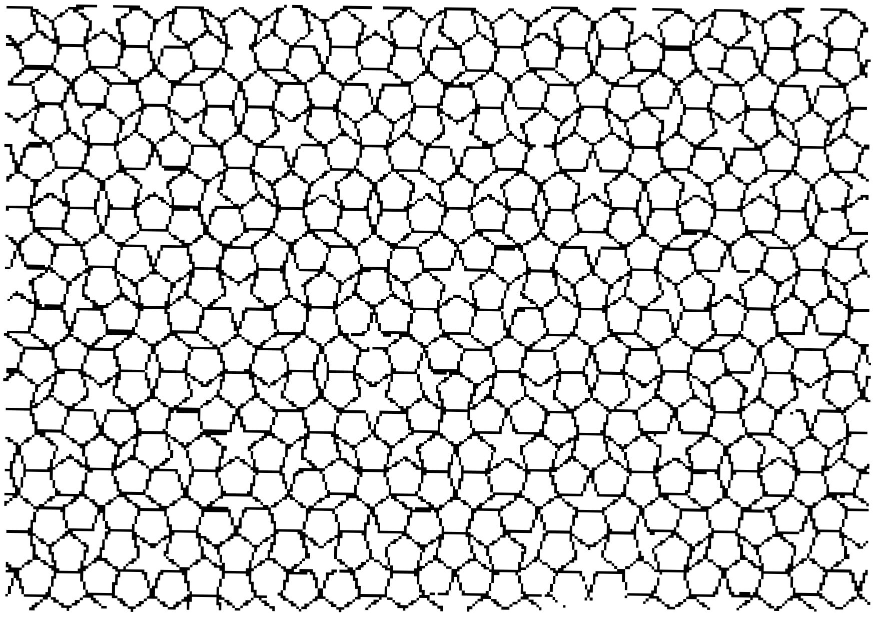
What was the name of these tiles? The magic something?

That's different: those are the impossible objects. The staircase and the tribars that people now call the 'impossible triangle' were things my father and I played around with. Later, Maurits Escher incorporated them in some of his pictures: *Ascending and descending* used the staircase and the waterfall used the triangle. And he actually used ours, because we sent him a copy of our paper.

I met Escher once, and left him a copy of a puzzle I'd made which consisted of wooden pieces which he had to try and assemble. Well, he managed to do this all right, and somewhat later when I explained the basis on which it was constructed he produced a picture called *Ghosts* – as far as I'm aware it was his last picture, when he was quite ill – and it's based on this tile I'd shown him – twelve different orientations of this shape.

But that was just a sideline, an amusement really, and the way the tilings came about was in two stages. I'm sure I owe a debt to Kepler, although I didn't realise it at the time, because my father owned a book showing the picture that Kepler designed which had a number of different tilings that he played with. Some of these were of pentagons, and these tilings with pentagons are very close to the tiling shapes I produced later.

Now I was aware of these things because I'd seen them, but they were not what I thought of when I was producing my own. They just coloured my way of thinking, which must be rather similar to what happened to Shechtman when he discovered quasi-crystals. He didn't think about my tilings, but when I spoke to him later he said he was aware of them. I suspect that it's the kind of thing that puts you in a kind of frame of mind, so that when you see something, you're more receptive to it than you would have been otherwise. So yes, I'm sure it's true of me with Kepler that I was more receptive of his kind of design .



A Penrose tiling

These three-dimensional forms of your tiles have appeared in recent years, as quasi-crystals. Did you ever anticipate such applications of your non-periodic tilings?

Well I did, but I was overcautious I suppose, because I certainly knew this was a theoretical possibility. But what worried me was that if you ever tried to assemble these them you'd find it very hard, and without kind of foresight it's difficult not to make mistakes. I sometimes gave lectures on these tilings, and people asked me 'does this mean that there's a whole new area of crystallography' – and my response would be 'yes, that's true – however, how would Nature produce things like this, because they would require this non-local assembly?'. And it seemed to me that maybe you could synthesise such objects with great difficulty in the laboratory, but I didn't see how nature would produce them spontaneously.

Now I think, although people now understand them better, the situation is much the same. I still don't think we know how they're produced spontaneously, and there are different theories about how they might come about – maybe there was something a little bit non-local, something basically quantum-mechanical, about those assemblies which I came to think is probably true, but it's not an area that people are agreed about – in fact, it's not totally agreed that quasi-crystals are this kind of pattern, although I think its getting pretty well accepted now.

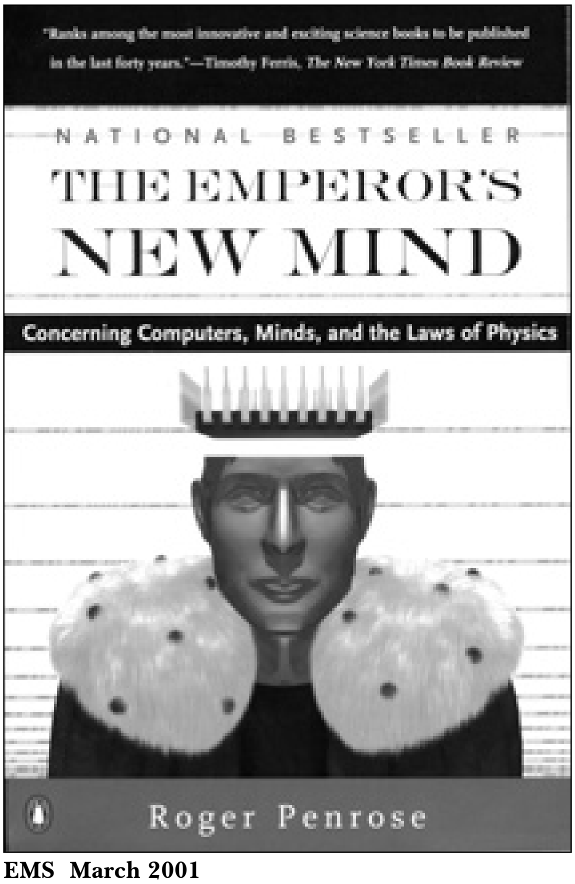
I was first shown the physical objects, the diffraction patterns, by Paul Steinhardt at a conference in Jerusalem to do with cosmology. I was talking about general relativity and energy and he was talking about inflationary cosmology, and he came up to me and said 'look, I want to talk to you about something nothing to do with this conference'. He showed me these diffraction pictures that he'd produced, and it was quite startling but very gratifying – in fact, curiously enough, I wasn't completely surprised. I suppose I felt that it must be right and nature is doing it somehow. Nature seems to have a way of achieving things in ways which may seem miraculous; this was just another example of that.

Have other examples of your recreational mathematics appeared in nature or physics?
One thing I got from my father is that you never draw a line between the two. He was like that – he did things for fun, which might be making children's toys out of wood – puzzles, or gadgets connected with his work. He'd make things like complicated slide rules that were supposed to test some statistical results. He made a bust of one of his patients, I seem to remember, and then he spent his later years producing wooden models that reproduce themselves. There was no line – you couldn't say what was recreational and what was professional work.

In 1989 you published a best-selling book, 'The Emperor's New Mind', where you're concerned with computers and artificial intelligence, the mind, the laws of physics, and many other things. What is the central question you address in this book?
I think I mentioned earlier that I had formulated a certain view while I was a graduate student. Before that, I'd been quite sympathetic to the idea that we were all computers, but it seemed to me that Godel's theorem tells us that there are aspects of our understanding which you cannot encompass in a computational picture. Nevertheless, I still maintain a scientific viewpoint that something in the laws of physics allows us to behave the way we do, but that the laws of physics are much deeper. My view is that we know much less about them than many people would maintain.

So I was quite prepared to believe that there was something outside computation. I've been interested in mathematical logic for a long time, and I'd known for a long time that there are things of a mathematical nature that are outside computation; that didn't frighten me – it just seemed to me 'all right, why not?' Then I saw a television programme where Marvin Minsky, Edward Fredkin and others were making outrageous statements about how computers were going to exceed everything we could do. What they were saying was logical if we were indeed computers – but since I didn't believe that, it seemed to me that this was something they'd completely missed – and not only *they* had missed it, I'd never seen it anywhere else. So as I'd previously considered writing a popular or semi-popular book on physics – something I thought I'd do at some stage in life, but perhaps not until I retired – this provided an opportunity: 'All right, let's explain things about physics and what the world is like, as far as we know, but with a different focus: let's explore the laws of physics to see whether there's scope for something of a non-computational character'. I'd never seen anybody put this forward as a serious viewpoint. Since it seemed to me that it needed to be put forward, that's what I did.

So this was an attack on artificial intelligence; but you also questioned the fact that as quantum mechanics is incomplete, the understanding of physical laws has to precede understanding the functioning of the mind?
Yes, I'd felt that if there was something non-computational it needed to be outside the laws that we presently understand in physics, because they seem to have this computational character. And it also seemed to me that the biggest gap in our understanding is when quantum theory relates to large-scale objects, where the rules of quantum mechanics give us nonsense – they tell us that cats can be alive and dead at the same time, and so on, which is nonsense; we don't see our world like that. Yet quantum theory was supposed to be so absolutely accurate, so why are we not aware of the manifestations of that theory on a large scale? It seemed to me that the theory can't be quite accurate and that there must be some changes that take place when it gets involved with large-scale objects.



I think I'd already thought this was to do with when gravitational phenomena start to become entangled with quantum effects – that's when the changes start to appear, and there are good reasons for believing that. So that is what I believed at the time, and still believe; but when writing *The Emperor's New Mind* I didn't really have any clear idea where in brain function quantum effects could start to become important and have an influence on large-scale effects, and where these new physical processes that should be non-computable could come in.

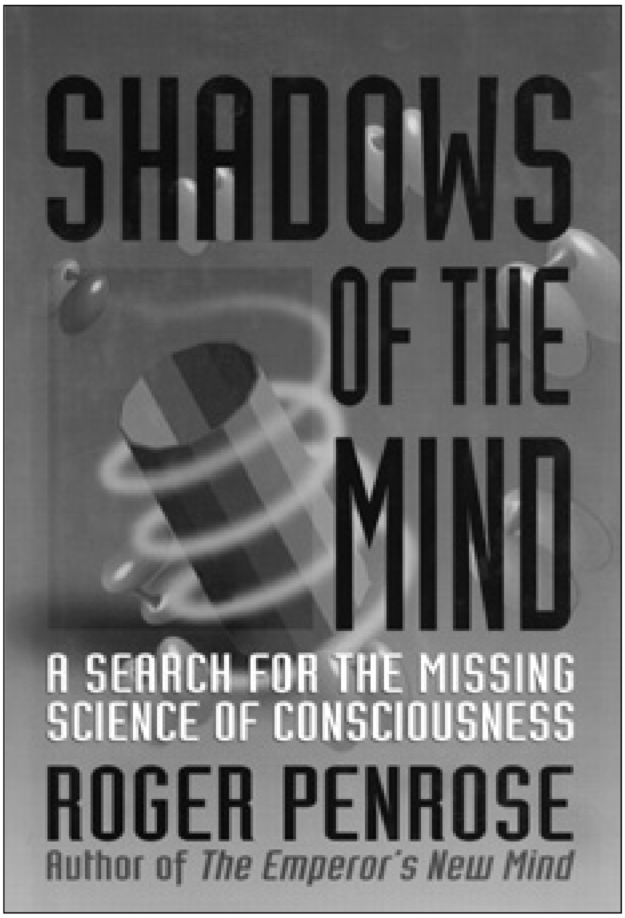
So I started writing the book, expecting that by the time I'd finished I'd have some clearer ideas on this. This happened to some degree – I was very ignorant about lots of things to do with the brain when I started, and I had to study to write the chapters specifically on them, and in particular the idea of 'brain plasticity', that the connections between neurons can change and that these changes can take place quickly – it seemed to me that this was very important, and that the new physics comes in to regulate these changes.

So has this given you any clue as to what changes are needed in quantum mechanics?
A little, but the physical motivations are largely independent. I did, however, think about the needed changes in quantum mechanics a little more seriously than before and I changed my views between writing the two books.

You're now referring to your second book 'Shadows of the Mind'. Do you pursue the same problems in this book?
Yes, but *Shadows of the Mind* had slightly ambivalent purposes. Originally I started to write it to address some of the points that arose out of people's criticisms and misunderstandings of *The Emperor's New Mind*, and in particular my treatment of Gödel's theorem. I just didn't expect the kind of vehement response that I got. I was very naïve, perhaps. I didn't realise that people would feel attacked in the way they did and would therefore respond by attacking me, while misunderstanding a lot of what I was trying to say.

The main point that I was making about Gödel's theorem was that if you have a system which you believe in and which you believe might be usable as mathematical proof, then you can produce a statement which lies beyond the scope of the system, but which you must also believe in. Now there is an assumption here that the system is consistent, something which I didn't bother to stress particularly, because it seemed to me quite obvious that there's no point in using the system if you don't think it's consistent: the proof is no proof if it's in a system you don't thoroughly believe in and therefore don't trust its consistency. That seemed to me to be obvious, but I didn't make those points strongly and so there are loopholes that people could point to, which of course they did. So I felt it necessary to address these issues with a great deal more care in *Shadows*. It was not meant to be a particularly long or popular book; it was just addressing these points and was quite technical and complicated in places, but in the process of writing this book, two things happened.

One of them was that I received a letter from Stuart Hameroff telling me about the cytoskeleton whose structures inside cells I was totally ignorant of. But most people who work in artificial intelligence didn't seem to know about them either; Marvin Minsky didn't, as he told me afterwards. But it seemed to me that here was a completely new area for which it was much more plausible that quantum effects could



be important. They are much smaller structures than neurons and are much more tightly organised structures. The most relevant of these were microtubules, where one has a much more believable place for coherent quantum phenomena to take place. It is still hard to see how this takes place, because it is difficult to maintain quantum coherence on the large scale that one needs in order for these ideas to work. One needs to go beyond what can be done in any physics lab today, and there is no physical experiment performed today that can achieve the kind of quantum coherence at the level that I would need in order for the kind of phenomena to take place that I suspect are taking place all the time in our brains. So nature has been a lot cleverer than physics has been able to be so far, but why not? It seems to me quite plausible that this is the case. The cytoskeleton, and in particular microtubules, seem to me to be structures where quantum coherence is much more plausible. So I changed the nature of this book. I wanted to put in microtubules and the cytoskeleton, and so I needed to learn a little bit more about it and to express why I think that's important in brain action.

The other thing which happened was that I somewhat shifted my viewpoint on quantum state reduction, in relation to gravity. The viewpoint I'd held for quite a long time, and which is expressed in *The Emperor's New Mind*, is more or less that if you have too big a discrepancy between two states, then they don't superpose and the state reduces. This discrepancy is to be measured in terms of space-time geometry; I called it the *one graviton criterion*. It is to do with how many gravitons come into this difference between the two states.

Now in work that I did subsequently, and also in work that had been done by others (particularly Diósi, a Hungarian, and Ghirardi in Italy) who had developed different ideas in connection with quantum state reduction, it seemed to me that I needed to modify the view that I had before. I think it's quite a significant modification. Basically, when you have two states that are significantly different from each other, then their superposition becomes unstable, and there is a calculable time scale involved in how long it takes for the superposition to 'decay' to one state or the other. The details are probably a bit too technical for here, but there is a time scale, rather than an instantaneous reduction, and this time scale produces figures that are much more plausible – also, it is easier to use and it may be much more relevant to brain action. One can see how to use it, and these ideas I developed with Stuart Hameroff. We produced a number of suggestions about how this idea could be carried forward, but again we found a great deal of opposition. A lot of these ideas are clearly speculative, but I don't think it is *that* speculative that something like this is going on. It seems to me it has got to be. Consciousness seems to be such a different phenomenon from the other things we see in the physical world that it's got to be something very special, in physical organisation. I can't see that it's really just the same old physics put together in more complicated systems. It's got to be something of quite a different character from other things that are important in the way the world operates. This new physics would be only occasionally employed in a useful way, and you have to have a very careful organisation that takes advantage of whatever is going on in state reduction and channels it in a direction which makes us operate. But it is very rarely actually taken advantage of in physical systems, where most things don't use this phenomenon in any useful way at all.

In these books you reveal yourself to be a philosopher. How have you come to terms with the Great Mystery?

Well, there are lots of hugely unanswered questions – there's no doubt about that. I'd certainly want to emphasize that even if everything that Stuart Hameroff and I say turns out to be absolutely correct, it would not answer these questions. I hope we are moving a little in the right direction towards answering those questions. However, I think there's very little progress towards answering the deep questions of what is going on in mentality, who we are, what is consciousness, why are we here and why does the universe allow beings who can be aware, or is there life after death? Any questions of that nature seem to me to require us to know more about what the world is like – we really know very little.

People say, and physicists often say: we nearly have the solution to the grand theory of the universe which is just around the corner, the theory of everything. I simply just don't believe that. I think there are major areas of which we have almost no understanding at all, and it's quite curious that one can have a view which seems to encompass (at least in principle) most of the things that you see around you, why they behave this way and that way.

One of the major things that isn't explained is simply ignored and just swept under the carpet by physicists generally, which is quantum state reduction. They say: quantum theory is a beautiful theory; it works perfectly well and describes how tiny particles behave. But, to put it bluntly, it gives you the wrong answer. What the theory tells us is that, for example, if you had Schrödinger's famous cat, the cat could very easily be put into a state of being alive and dead simultaneously. That's simply wrong; it doesn't do that. So what is it? I mean, there is something big missing from our view of the world, it's huge and it's not just a tiny phenomenon which we haven't quite got because we've got to get the last decimal place right and the coupling constant or something: it's a huge aspect of the way the world behaves which we simply do not understand, and understanding it is, in my view, one small step towards understanding what mentality is. I think it must be part of it, but it is not going to answer the question of mentality. We may well know what state reduction is (and I expect we will know if we don't destroy ourselves first); then that theory will have as part of its nature some completely different way of looking at the world from the way we have now. We've already seen that happen in Einstein's general relativity, because before that we had Newton's theory which told us how bodies attracted each other with forces and moved around and so on. It's beautifully accurate: Newton's theory is incredibly precise. It tells you how the planets move around in their orbits to almost complete precision – not quite, but almost. You might think it only requires a little tiny modification to make it completely right, but that's not what happened. Einstein produced a theory that is completely different. Its structure is utterly different from that of Newton's theory, but it gives almost exactly the same answers. The philosophical framework of that theory is quite different. The very nature of space is warped, and that changes our whole outlook. Now what I am saying is that when we see how quantum theory is to be changed to accommodate state reduction as a phenomenon, with the measurement process as a phenomenon, we shall have to come to terms with a completely different way of looking at what matter is and what the world is like.

Are you saying that this is a step that will help us to address questions that are typically addressed, by some people at least, by religion?

Well it will, I think so. But you see I'm more… 'tolerant' isn't quite the right word … I think I'm a little bit more supportive of religious viewpoints than many totally scientific people would be. It's not that I believe in the dogma that is attached to any of the established religions, because I don't. On the other hand, religions are trying to address questions which are not addressed by science, particularly moral issues. I regard morality as something with an absolute 'platonic' component which is outside us. Is there really a platonic absolute notion of 'the good'? I have to say I'm inclined somewhat in that direction. I think morality is not just man made, but there are things outside us which we have nothing in the way of scientific understanding of at the moment, but nevertheless they are part of a big overall picture which maybe someday will come together. So I mean these questions are nowadays considered not to be part of science, but they're part of religion, you see. Well, as I say, I don't believe in the dogma of religion, but I do think that religion is groping for something which we don't know the answers to yet, and which is outside traditional science. So I suppose what I think is that the whole scientific enterprise must broaden its scope and eventually change its character.

Roger Penrose and Jean-Pierre Bourguignon, Durham 1982

We have touched on only a fraction of your work but what is the result, theorem or theory that you are most happy with?

Well, I'd have to say twistor theory. The non-periodic tilings are nice, and they're something to show to somebody. But this is not something which is as deep, and it's not something I've devoted so much of my life to. Even when I call it 'twistor', this is slightly inappropriate, because we don't know what the theory is yet, the real theory. But if I can answer your question in that way, I think I'd say that the whole programme of representing Einstein's theory in terms of twistors is what I'm proudest of. I don't know if you'd call that an answer to your question, because it's not a theorem, it's not one result, it's a body of ideas. I suppose in amongst those I would think the 'non-linear graviton construction' is probably the thing which I feel most pleased about so far, but that is part of the programme, and I don't regard that as an end-point; it's something on the way. I hope that when one really understands how the Einstein equations can be incorporated into twistor theory, we'll see something, a much broader picture of which that is just part. But we don't quite have that fully yet.

How do you actually work? How do you select a problem? I've seen you many times in your lectures and seminars making pictures – do you visualise things that way?

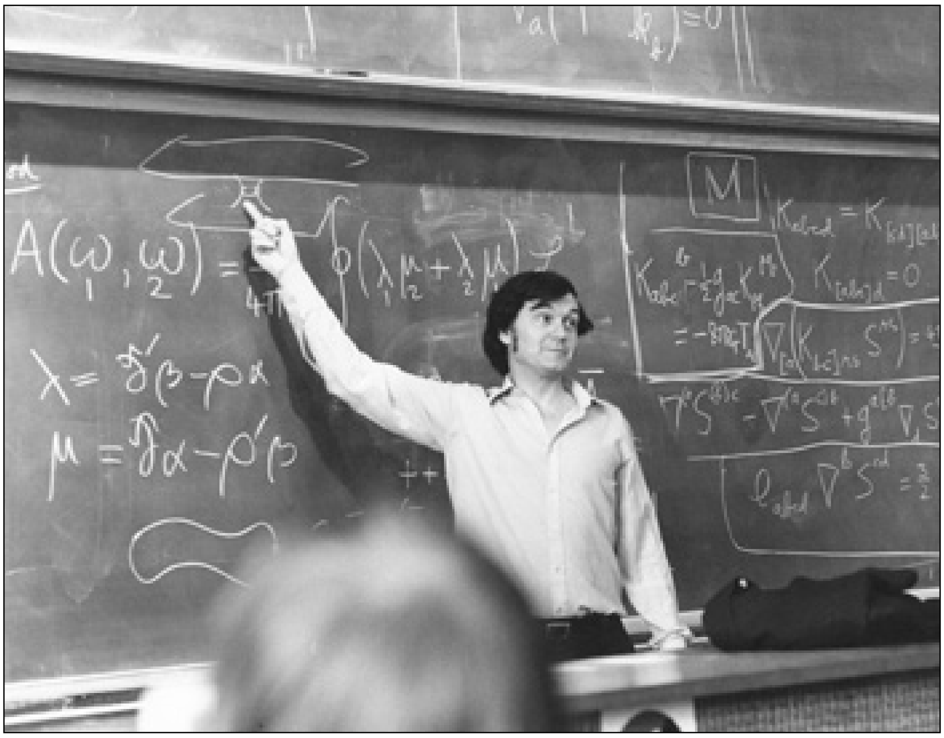
A lot is very visual, but not entirely visual. Certainly some things I've done are not entirely visual; for example, algebraic things aren't. But I do find visual imagery absolutely essential in my work, and that's the way I do it usually. I often start to write something down, but it doesn't help very much. I may see a picture sometimes, but even drawing it on a piece of paper doesn't help because it's not something you can express very well that way. It's an image which is hard to put down, but I do find expressing things by drawing pictures reasonably accurately sometimes helps, but sometimes it's an accuracy that's very misleading. You've got to know what it means. I mean, the pictures are not really accurate because I might draw a picture of something which has got the wrong number of dimensions and it's really in a complex space rather than a real space, but you get a feeling for knowing what's reliable and what isn't in a picture. In some ways it's a relief when one can do a calculation. If you can reduce something to a calculation you can deal with it, but so few of the things I do actually find their way into calculations, because that's not the problem. The problem is a conceptual or a geometrical problem – often conceptual: you have to look at things in the right way. And that can be quite hard sometimes. But I suppose what I am probably best at, when it comes to mathematics, is the geometrical, where I can visualise things well. I don't find it very easy to work with complicated formulae or analytic notions. It's an uphill job sometimes. To a certain extent, things in analysis can be looked at geometrically.

What are you working on right now?

Well, what I think about most of the time when I'm not doing something else like trying to write up endless things one after the other, is this problem about the Einstein equations and twistors, which I think is almost there or is very close to being resolved; but it's not completely clear. I regard that as the major problem. I also try to make progress with the quantum state-reduction problem – even with some possible experiment.

You've mentioned a number of mathematicians and physicists, but who is your most admired mathematician or physicist?

That's a tough one – there are a lot of them. I'm not sure there's a single one as a mathematician. I always had a tremendous admiration for Riemann because he was a miracle man. As a mathematician I think it probably would be him, I guess, but it's not quite clear because on the physics side I've always thought of Galileo, Newton, Maxwell and Einstein as being the four most major figures. Of those, I suppose one would have to say that Newton was a more impressive figure than Einstein, no matter how impressive Einstein is. I mean, he's had absolutely wonderful ideas. General relativity is a fantastic theory – of any physical theory that I've seen, I'd say put general relativity at the top because it's amazing. But Newton was such a powerful mathematician, and Einstein was less so. Einstein had these tremendous physical insights, but Newton had this great power as a mathematician as well as deep physical insights. And I've always had a soft spot for Maxwell, but also Galileo – I think I've always admired him from a long time back. I don't know – I'm not trying to single out any one in particular. Riemann as a mathematician I suppose, possibly more than Gauss I would say. Archimedes also, I suppose, was a very impressive character; also Euler.



Durham 1982

What is your opinion about the direction in which research in mathematics and physics is going nowadays?

Something I've found slightly discouraging about the way things go these days, which is not the fault of the mathematicians or the physicists, is a problem of technology. Although technology is a wonderful thing, it has the effect of magnifying fashions. It's so easy to communicate ideas from one end of the world to the other instantaneously, and this means that the fashions have global control over what goes on. It means that a lot of progress can be made in fashionable areas, but there's something which is lost in there, I feel. It's a bit silly to hark back or think about things in this way, but when communications were much more difficult there were these little pockets of people working on different things. Maybe I have this starry eyed view of what it was like; it probably wasn't like that. Fashions were still important in the old days too, but somehow there's something about the global nature of the fashions these days which I find a bit disturbing. But it's worse in physics than it is in mathematics, I think. I always used to think that mathematics was immune from this kind of thing. You would have these people working away and developing their wonderful ideas in relative isolation, and occasionally getting together, and some things would spring from the coming together of different viewpoints. But now it's much more as if you can go anywhere and they're all working on the same thing, which is rather discouraging. In physics it is particularly like that. This applies to highly theoretical work where there is no stabilising input from experiment.

Communication is obviously beneficial, but the aspect you're remarking on is actually a negative one.

It is a negative one, I think. And there's another thing that goes along with this. It's not relevant in mathematics, but in physics it's to do with the expense of big experiments, which means that you have to build bigger and bigger machines to look at higher energies, and so on. I can see why they do that, but since the experiments are so expensive, they require a lot of money and government backing and huge organisations, and therefore you must have committees to decide which to support, and so on. Committees have to decide where the money's going, so they consult people who are considered to be the experts in the relevant areas, and therefore the things tend to get locked in certain directions because the experts have got there, as they were the ones who were important in the development of the current theories. It's hard to break away from this.

It becomes a political thing as well.

It does become political as well, because money is involved. One doesn't have the free-ranging way of thinking about things that was there before. So I'm only expressing the negative points, because maybe the positive ones are more obvious. Obviously there's huge activity – all over the world you find people who work in areas and who have never before had a chance to think seriously about science. Now the internet allows them to get involved. That's all positive and I agree with that, but I'm just pointing out that there's a downside also, which I find disturbing.

Are you questioning the way in which what's important and what's not are decided?

It is hard to advise them, you see, because they're caught up in the system, and if young researchers want to get jobs after doing research, they must work in an area which is going to be recognised by the people who employ them. If I were talking from the point of view of science I'd say that in quantum state reduction there are some important problems: you see why quantum mechanics needs modification. But if they're working on that, it's regarded as marginal at best, and crackpot at worst. I could even say that with twistor theory: in mathematics it seems to have caught on, but as a physical theory – if you work in twistor theory you'll find it hard to get a job. There are very few people in physics departments who know about this subject and consider it important.

I remember reading in one of your papers that twistor theory was an esoteric subject from that point of view. Do you still maintain this view?

Yes, it's not much studied as a physical theory. I'm not unhappy from my own personal point of view, because when it gets studied by lots of people it becomes too complicated to find out what they're doing. I'd have to learn and understand their notation, which would probably be different from mine – and that's hard work. But if I know that nobody's working on it, then that's fine – I'm not rushed, and I don't have to think I've got to get in there before someone else does!

That's right. But what recent development in science at large has made the greatest impact on you?
Gosh, I'd say cosmology is one of the areas. Gravitational lensing I worked on for a little bit at one point; it's an amazing thing. I'd say that astrophysics and cosmology are exciting areas.

What aspects do you find most interesting?
What I was talking about, gravitational lensing. I find it interesting because it's an effect of Einstein's general relativity, which I think people thought was very hard to measure. It was the first thing that convincingly suggested that Einstein's theory might be right. The Eddington experiment showed the deflection of light of the stars by the sun, but to see this effect on a cosmological scale, to see a galaxy focussed by another galaxy, would have seemed absolutely ridiculous. Nowadays it's an observational tool, people use it all the time – it's a way you can tell the mass of an object by how much focussing it exerts on the image behind it, and it's wonderful. It's not just that it's a powerful tool in cosmology, but because it uses something which is close to my heart I suppose; that's why I like that one so much.

But that's just one area; there are lots of other things. I suppose the experiments on quantum entanglements (non-locality): you can get two ends of the room, 12 metres apart – well, nowadays it's longer than that (10 kilometres) – by these quantum entanglement effects the two are connected through quantum mechanics, it's amazing. One knew it had to be there in quantum theory, but it's very impressive to see that it's real.

Quasi-crystals are remarkable. High temperature superconductors are amazing, and so are developments in molecular biology. Some of the things that people are now learning about cells and about cytoskeletons and microtubules I find fantastic. Partly this is because I didn't know what was going on in biology, and having got slightly involved in this subject I see some remarkable things.

I came across Schrödinger's book 'What is life', for which you wrote a preface.
That's right, and it mentions the aperiodic crystal ideas that he believes are at the heart of life.

Can you tell us something about this?
My father was very taken with the idea, I recall, and we had these mechanical devices I mentioned earlier which reproduce themselves, and he then developed much more elaborate devices which he made of wood, little things with levers which copied themselves. He sometimes referred to these things in Schrödinger's terminology as 'aperiodic crystals' – a crystal that went on for a while and then stopped growing, because that was how it came to an end. Life was to be thought of in that way. So it had some influence on him, and indirectly on me. But I don't know about the quasi-periodic tilings, whether that has much connection historically.

What books are you reading at the moment?
Gosh, I never get a chance, though sometimes I have to review a book. I'm not reading one right now. It's one of my regrets that I find myself so busy that I have hardly any time to read anything for fun, which I like to do.

Roger Penrose is the current Gresham Professor of Geometry, in London. Last year he met the earliest Gresham Professor, Henry Briggs.

If the day had 36 hours, what would you like to do?
If it had 36 hours, there should be a rule that the extra twelve were only allowed to be used for things that were not directly to do with one's work. I enjoy reading when I get the chance, and also going to the theatre, to films, and listening to concerts – all the things I'd love to do more of. But there are films that I never get the chance to see, including some wonderful ones that are going around now. I used to read quite a bit of science fiction, but I hardly have a chance to now. I sometimes read Michael Frayn; I find him tremendously funny.

What about music? Do you have a favourite composer?
On the whole I prefer classical music, but I enjoy jazz too – my wife's influence! My parents each had a favourite composer: for my father it was Mozart, who was his God, and for my mother it was Bach. I eventually realised that Bach is really my favourite by quite a long way; I've always regarded those two as a cut above the other composers. Bach I think I see much more in, there's something you can always go back to, and there's more and more of it. But I think it's the perfection in Mozart that I find somewhat magical. I've always rated him above Beethoven, who never had quite the same magic for me. I can see he had the power and originality, but somehow there's not quite the magic there. Maybe even with Schubert there's a bit of magic that I don't quite see in Beethoven. To go back further, I like Vivaldi and Purcell and others. But I also quite like some modern composers, such as Stravinsky, Prokofiev and Shostakovitch.

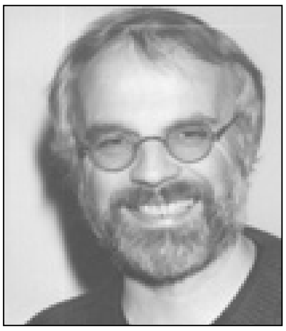
What do you consider the most profound development of the last century?
Einstein's general theory of relativity. I might have said quantum mechanics, but I think that that theory isn't finished yet, because of the measurement paradox. I discuss these things in my new book, *The Road to Reality*, which should be published sometime early in 2002. It's almost completed, but still there's work to be done on it. It's about mathematics and physics and the profound relation between the two. In it I try to give my views of some of the popular developments in modern theoretical physics – I may get myself into more trouble!

Finally, what will keep you busy in the future?
I have many more books in mind, so I'll keep writing. Also, I'll keep working on twistor theory, as there's a great deal to do in that subject. I have new ideas to do with quantum state reduction – even an experiment (FELIX) which I hope will be performed in space while I'm still alive! In addition to all this, I have a new son (Maxwell Sebastian – Max, for short) who was born on 26 May 2000 and will keep me even busier!

Problem Corner

Contests from Romania, part 3

Paul Jainta (Schwabach, Germany)



Competing against teams representing 81 countries, a team of six Romanian high-school students won six medals at the Fortieth International Mathematical Olympiad (IMO), held in their capital Bucharest in summer 1999. While the competition is between individuals, unofficial rankings placed the Romanian team fourth, after China, Russia and Vietnam.

It's no accident that Romania is exceptional in identifying mathematically able young persons. As Mark Saul, Bronxville School, N.Y., wrote in his foreword to a new collection of problems consisting mainly of difficult problems from Eastern Europe: 'Preparation for participation in a challenging contest demands a relatively brief period of intense concentration, asks for quick insight on specific occasions, and requires a concentrated but isolated effort'.

The rich Romanian Olympic ambience can serve as a model for studying the conditions that go to make great problem-solvers. For these young people an Olympiad problem is an introduction, a glimpse into a world of mathematics not afforded by the usual classroom situation, for a good Olympiad problem captures in miniature the process of creating mathematics: immersion in the situation, examination of possible approaches, and the pursuit of various paths to the solution. But struggling with tough questions often leads to fruitless dead ends. Grappling with a good problem provides practice in dealing with the frustration of working at material that refuses to yield, until a lucky solver catches sight of a silver lining that heralds the start of a successful solution. Like a well-crafted work of fiction, a good Olympiad problem tells the story of mathematical ability to create which apprehends a good part of the real experience, and leaves the participant wanting still more.

The Grigore Moisil Contest In Romania, thanks to Vasile Berinde, North University of Baia Mare, a student can choose between nine *intercounty competitions*. The biggest and most famous is the contest named after the great Romanian mathematician Grigore Moisil (1906-73). It was initiated in 1986 between the four counties of Maramures, Bistrita-Nasaud, Satu-Mare and Salaj, in the north-west of Romania, and alternates between the capital towns of the counties involved. The Moisil contest is open for pupils from grades 5-12, and is run as a team-contest with teams of 3 or 4 individuals for each grade, selected from the contestants who completed the county round of the National Mathematics Olympiad. Thus, the Moisil competition serves as additional screening for the national event. It is mainly supported by the Ministry of Education and also by the regional branch of the Romanian Society for Mathematical Sciences and private sponsors. Diplomas and prizes are awarded. Normally, the problems are chosen by an independent selection committee of experts outside the catchment area of the contestants.

Another tricky competition, similar to the Moisil contest, is named after the Romanian mathematician, *Traian Lalescu* (1882-1929). The Lalescu contest is for students from grades 5-12 in one of the four south-west counties Arad, Caras-Severin, Hunedoara and Timis. The Lalescu contest is organised by the Faculty of Mathematics, West University of Timisoara. Here the problems are first-hand, or emerge from prestigious journals such as *Gazeta Matematica* or *Revista Matematica din Timisoara*. The Lalescu competition has been running for fifteen years.

The following contests form a small portion of what is available to youngsters hungry for mathematics: the *Spiru Haret – Gh. Vrânceanu contest* takes place in the Eastern parts of Romania; the *L. Duican* competition is established in Brasov, and the N. Paun event occurs in and around Bucharest; the Gh. Mihoc tournament takes place in the south-east of the country; the D. V. Ionescu – Gh. Lazar contest occurs in the central region of Transylvania, the home of Count Dracula.

From this contest scene I've compiled a cross-section of questions; readers are invited to compete with the leading junior minds of Romania.

122 Let $A_1A_2A_3A_4A_5A_6A_7$ be a regular heptagon. Prove that $1/A_1A_2 = 1/A_1A_3 + 1/A_1A_4$.
(Romanian high school textbook)

123 The sequence $\{x_n\}$ satisfies $\sqrt{(x_n+2+2)} \le x_n \le 2$, for all $n \ge 1$. Find all possible values of x_{1986}.
(Romanian IMO selection test, 1986)

124 Find the real numbers $x_1, x_2, \dots, x_n$ satisfying
$\sqrt{(x_1 - 1^2)} + 2\sqrt{(x_2 - 2^2)} + \dots + n\sqrt{(x_n - n^2)} = (x_1 + x_2 + \dots + x_n)/2$
(Gazeta Matematica)

125 Prove that there is a perfect cube between n and $3n$, for any integer $n \ge 10$.
(Gazeta Matematica)

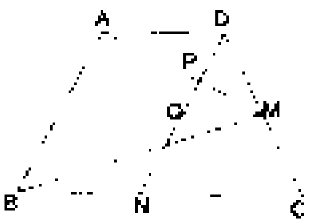
126 Show that if $\sqrt{7} - m/n > 0$ for the positive integers m, n, then $\sqrt{7} - m/n > 1/mn$.
(Romanian Mathematical Olympiad, 1978)

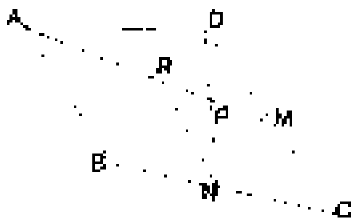
127 Find all positive integers x, y, z satisfying $1 + 2^x3^y = z^2$.
(Romanian IMO selection test, 1984)

Solutions to some earlier problems

110 The quadrilateral ABCD has two parallel sides. Let M and N be the midpoints of DC and BC, and let P be the common point of the lines AM and DN. If $PM/AP = \frac{1}{4}$, prove that ABCD is a parallelogram.

Solution *(Partially) solved by Niels Bejlegaard, Stavanger (Norway), Oddvar Iden, Bergen (Norway), J. N. Lillington, Dorchester (UK), Mr & Mrs Mudge, Pwl –Trap, St. Clears (Wales), Dr Z. Reut, London. No solver considered the two cases: AD parallel to BC and AB parallel to DC. Two submitters used plane coordinate geometry. Mr & Mrs Mudge even affixed to their submission:'The most inelegant proof of problem 110'.*
I shall outline an elementary geometrical solution.
Case 1: AD is parallel to BC (see the left-hand figure).
Let Q be the midpoint of DN.
Then QM, BC and AD are all parallel, and $QM = \frac{1}{2}NC = \frac{1}{4}BC$ and $QM = PM/PA \cdot AD = \frac{1}{4}AD$.
Hence AD = BC and ABCD is a parallelogram.
Case 2: AB is parallel to DC (see the right-hand figure).
Let R be the midpoint of AM. In the trapezium ABCM we then have $RN = \frac{1}{2}(AB + MC) = \frac{1}{2}AB + \frac{1}{4}DC$.
On the other hand, from similar proportions we have $RN = RP/PM \cdot DM = (3/2) \cdot DC/2 = \frac{3}{4}CD$
(for $PM = (1/5)AM$, $AB = (4/5)AM$ and $RP = (1/2)AM(1/5)AM = (3/10)AM$, giving $RP/PM = 3/2$).
It follows that $\frac{1}{2}AB + \frac{1}{4}DC = \frac{3}{4}DC$, which simplifies to AB = DC.





111 Let k be an integer and let p(x) be the polynomial $p(x) = x^{1997} - x^{1995} + x^2 - 3kx + 3k + 1$. Prove that the polynomial has no integer roots, and that the numbers p(n) and p(n) + 3 are relatively prime, for each integer n.

Solution *by Pierre Bornsztein, Courdimanche (France); also solved by Niels Bejlegaard, Oren Kolman, Jerusalem (Israel), Maohua Le, Guangdong (P.R. China) and Dr Z. Reut*
More precisely we first prove that for each integer n, $p(n) \neq 0 \pmod 3$.
Indeed, rewrite p(x) as $p(x) = x^{1994}(x^3 - x) + 3(k - kx) + x^2 + 1$.
Let n be an integer. It is well known that $n^2 = 0$ or $1 \pmod 3$, and thus $n^2 + 1 \neq 0 \pmod 3$.
From Fermat's Little Theorem, we have $n^3 - n = 0 \pmod 3$.
It follows that $p(n) = n^2 + 1 \pmod 3 \neq 0 \pmod 3$, as claimed.
We deduce easily that for each integer n, $p(n) \neq 0$ and thus p(x) has no integer root.
Now suppose, for a contradiction, that q is a prime number dividing both p(n) and p(n) + 3.
Then q divides p(n) + 3 – p(n) = 3, and hence q = 3.
Thus p(n) = 0 (mod3), which is impossible from the above.
It follows that, for each integer n, the numbers p(n) and p(n) + 3 are relatively prime.

112 Find the image of the function $f(x) = (3 + 2\sin x) / [\sqrt{(1 + \cos x)} + \sqrt{(1 - \cos x)}]$.

Solution *by Gerald A. Heuer, Moorhead, MN (USA); also solved by Pierre Bornsztein, J. N. Lillington, Dr Z Reut.*
The image is the interval [0.5, 2.5].
Since f is continuous and $f(x + 2) = f(x)$ for all x, it suffices to show that the minimum and maximum values of f(x) on $[-\pi,\pi]$ are 0.5 and 2.5, respectively.
We shall show that f(x) is decreasing on $[-\pi,-\pi/2]$, increasing on $[-\pi/2, \pi/2]$ and decreasing on $[\pi/2,\pi]$. Since $f(-\pi/2) = 0.5$, $f(\pi/2) = 2.5$ and $f(-\pi) = f(\pi) = 3/\sqrt{2}$, the stated result then follows.
For $0 \leq x \leq \pi$, $|\cos(x/2)| = \cos(x/2)$ and $|\sin(x/2)| = \sin(x/2)$,
so with $u = x/2$, and using the half-angle formulas $\sqrt{(1 + \cos x)} = \sqrt{2}\cos(x/2)$ and $\sqrt{(1 - \cos x)} = \sqrt{2}\sin(x/2)$,
we get $\sqrt{2}f(x) = g(u) = (3 + 4\sin u\cos u) / (\cos u + \sin u)$, $0 \leq u \leq \pi/2$.
Then $g'(u) = [(\cos u \ \sin u)(1 + 4\sin u\cos u)] / (\cos u + \sin u)^2$, which has the same sign as $\cos u - \sin u$.
Thus $g'(u) > 0$ when $0 < u < /4$, and $g'(u) < 0$ when $\pi/4 < u < \pi/2$.
It follows that f(x) is increasing on $[0, \pi/2]$ and decreasing on $[\pi/2,\pi]$.
For $-\pi \leq x \leq 0$, $|\cos(x/2)| = \cos(x/2)$ and $|\sin(x/2)| = -\sin(x/2)$, so with $u = x/2$ again,

$$\sqrt{2}f(x) = h(u) = (3 + 4\sin u\cos u) / (\cos u - \sin u).$$

Then $h'(u) = [(\cos u + \sin u)(7 - 4\sin u\cos u)] / (\cos u - \sin u)^2$, which has the same sign as $\cos u + \sin u$.
Thus $h'(u) > 0$ for $-\pi/2 < u < -\pi/4$ and $h'(u) < 0$ for $-\pi/4 < u < 0$.
It follows that f(x) is increasing on $[-\pi,-\pi/2]$ and decreasing on $[-\pi/2,0]$, establishing the claim.

113 Let $f(x) = ax^3 + bx^2 + cx + d$ be such that $f(2) + f(5) < 7 < f(3) + f(4)$.
Prove that there exist u, v such that $u + v = 7$ and $f(u) + f(v) = 7$.

***Solution** by Oren Kolman, Jerusalem; also solved by Niels Bejlegaard, Pierre Bornsztein, Gerald A. Heuer, J. N. Lillington, Claude Portenier, Marburg (Germany) and Dr Z Reut.*
Since the function $G(x) = f(x) + f(7 - x) - 7$ is continuous, and $G(2) < 0$, $G(3) > 0$, it follows from the Intermediate Value Theorem that there exists u_0 in (2, 3) such that $G(u_0) = 0$.
Now u_0 and $v_0 = 7 - u_0$ are as required.

114 Let f be a real function that satisfies the following conditions:
(i) $f(0, y) = y + 1$, for all y;
(ii) $f(x + 1, 0) = f(x, 1)$ for all x;
(iii) $f(x + 1, y + 1) = f(x, f(x + 1, y))$ for all (x, y).
Compute f(3, 1997).

***Solution** by Dr Ranjeet Kaur Sehmi, Chandigarh (India); also solved by Niels Bejlegaard, Pierre Bornsztein, Nira Chamberlain, Derby (UK), J. N. Lillington, Dr Z Reut.*
We have $f(0, 1) = 2$, by (i), $f(1, 0) = f(0, 1) = 2$ by (ii),
and by (iii), $f(1, 1) = f(0, f(1, 0)) = f(1, 0) + 1 = 3$.
Now suppose that $f(1, x) = x + 2$ for some x;
then $f(1, x + 1) = f(0, f(1, x)) = 1 + f(1, x) = 1 + x + 2 = (x + 1) + 2$.
Thus, by induction, $f(1, x) = x + 2$ for all x. (1)
Next, $f(2, 0) = f(1, 1) = 3$, by (ii), $f(2, 1) = f(1, f(2, 0)) = f(1, 3) = 3 + 2 = 5$, by (1).
Now suppose that $f(2, x) = 2x + 3$ for some x;
then $f(2, x + 1) = f(1, f(2, x)) = f(1, 2x + 3) = 2x + 3 + 2 = 2(x + 1) + 3$, by (1) .
Thus, by induction, $f(2, x) = 2x + 3$ for all x. (2)
Next, $f(3, 0) = f(2, 1) = 5 = 2^3 - 3$, by (ii) and (2), $f(3, 1) = f(2, f(3, 0)) = f(2, 5) = 13 = 2^{1+3} - 3$, by (2).
Suppose that $f(3, x) = 2^{x+3} - 3$ for some x;
then $f(3, x + 1) = f(2, f(3, x)) = 2f(3, x) + 3 = 2[2^{x+3} - 3] + 3 = 2^{x+4} - 3 = 2^{(x+1)+3} - 3$, by (2).
Thus, by induction, $f(3, x) = 2^{x+3} - 3$ for all x.
So $f(3, 1997) = 2^{1997+3} - 3 = 2^{2000} - 3$.
[Pierre Bornsztein indicates that this function is better known as Ackermann's function.]

115 Let $n \geq 3$ be an integer and x be a real number such that the numbers x, x^2 and x^n have the same fractional parts. Prove that x is an integer.

***Solution** by Gerald A. Heuer; also solved by Niels Bejlegaard, Pierre Bornsztein, Erich N. Gulliver, Schwäbisch Hall (Germany), Oren Kolman , J. N. Lillington, Maohua Le and Dr Z Reut.*
We have $x^2 - x = a$ and $x^n - x = b$, where a and b are integers.
We show first that if x is rational then it is an integer.
From $x^2 - x - a = 0$ we have $x = [1 \pm \sqrt{(1 + 4a)}]/2$.
If this x is rational, then so is $\sqrt{(1 + 4a)}$.
Thus $\sqrt{(1 + 4a)}$ is an odd integer, and $x = [1 \pm \sqrt{(1 + 4a)}]/2$ is an integer.
It therefore suffices to show that x is rational.
Now, $x^2 = x + a$, so $x^3 = x^2 + ax = (x + a) + ax = (1 + a)x + a$.
Suppose that $x^k = r_kx + s_k$ where r_k and s_k are integers.
Then $x^{k+1} = r_kx^2 + s_kx = r_k(x + a) + s_kx = r_{k+1}x + s_{k+1}$, where $r_{k+1} = r_k + s_k$ and $s_{k+1} = r_ka$.
It follows by induction that for each positive integer m, $x^m = r_mx + s_m$ for some integers r_m and s_m .
In particular, $x^n = r_nx + s_n$.
This, together with $x_n = x + b$ implies that $(r_n - 1)x + (s_n - b) = 0$,
and thus x is rational, provided that $r_n \neq 1$.
Note that $a \geq 0$ because x is real.
If $a = 0$, then $x = 0$ or 1, so is an integer.
In the remaining case $a \geq 1$. Now $r_2 = 1$ and $s_2 = a \geq 1$; $r_3 = a + 1 > 1$ and $s_3 = a \geq 1$.
Suppose that $r_k > 1$ and $s_k \geq 1$.
Then $r_{k+1} = r_k + s_k > r_k > 1$ and $s_{k+1} = r_ka \geq r_k > 1$.
It follows by induction that $r_k > 1$ for all $k > 2$.
Thus x is rational, and is therefore an integer.

That completes the Problem Corner for this issue. Please send me your Olympiad Contests and other suitable materials, as well as your solutions and suggestions or comments about the Problem Corner.

Applied Mathematics in our Changing World

September 2-6, 2001
Berlin, Germany

First SIAM-EMS Conference

ORGANIZED BY: EMS, SIAM and ZIB

CHAIRS:
R. Jeltsch, G. Strang and P. Deuflhard

INTERNET: http://www.zib.de/amcw01
E-MAIL: amcw01@zib.de

First Announcement
Call for papers and registration

PROGRAM COMMITTEE
- Vincenzo Capasso, Milano, Italy
- Peter Deuflhard, Berlin (chair)
- Heinz Engl, Linz, Austria
- Björn Engquist, Stockholm, Sweden
- David Levermore, Maryland, USA
- Volker Mehrmann, Berlin
- Bill Morton, Oxford, UK
- Stefan Müller, Leipzig, Germany

INVITED PLENARY SPEAKERS
- Medicine: Alfio Quarteroni, I / CH
- Biotechnology: Michael Waterman, USA
- Materials Science: Jon Chapman, UK
- Environmental Science: Andrew Majda, USA
- Nanoscale Technology: Michael Griebel, D
- Commumication: Martin Grötschel, D
- Traffic: Kai Nagel, CH
- Market and Finance: Benoit Mandelbrot, USA
- Speech / Image Recognition: Pietro Perona, USA
- Engineering Design: Thomas Y. Hou, USA

CONFERENCE OFFICE
SIAM/EMS Conference 2001
Erlinda C. Körnig ❒ Sigrid Wacker
Konrad-Zuse-Zentrum Berlin (ZIB)
Takustr. 7
D-14195 Berlin-Dahlem
Germany
INTERNET: http://www.zib.de/amcw01
E-MAIL: amcw01@zib.de

DEADLINES AND IMPORTANT DATES
March 31 Deadline for early registration
April 15 Deadline for submission of minisymposia proposals
May 31 Second Announcement Invited speakers and minisymposia
June 30 Deadline for submission of abstracts and posters
July 30 Program and collected abstracts

REGISTRATION FEES

SIAM / EMS Members		Non-Members	
Early Registration (prior to 04/01/01)			
US$	150,—	US$	200,—
DM	300,—	DM	400,—
EUR	150,—	EUR	200,—
Full Registration (after 03/31/01)			
US$	210,—	US$	260,—
DM	420,—	DM	520,—
EUR	210,—	EUR	260,—

Meals and accommodation expenses are not covered. SIAM and EMS are trying to raise special support for students and Eastern European scientists.

Keep observing our website.

IMPORTANT
There will be invited talks, minisymposia, contributed talks and posters. Please consult our website for registration, accommodation information and submission guidelines. The conference office prefers on-line registration and on-line submission of abstracts.

TOPICS:

1. Medicine
- medical imaging methods;
- computational assistence of surgery, therapy planning;
- hospital information systems;
- pharmacokinetics, tumor growth modelling;
- artificial organs, immune system modelling;
- infectuous disease control, epidemic spreading;
- physiology (e.g. dynamics of cardiovascular or of respiratory system).

2. Biotechnology
- biomolecular structural storage schemes, patent recognition and circumvention;
- conformational molecular dynamics, drug design, cell factory;
- mathematical modelling in biopolymerization;
- sequence alignment, fuzzy reasoning;
- density functional theory, ab-initio computation.

3. Materials science
- realistic modelling and simulation of composite materials, magnetic material, polymers, glass, and paper;
- crack propagation and further failure mechanisms;
- phase transitions, crystal growth, superconductivity, and hysteresis;
- control of phase transitions and solidification, modelling of ironmaking process;
- coupling of atomistic and continuum models, quantum-classical approximation and calculation.

4. Environmental science
- climate and climate impact research, stochastic climate modelling, intermediate complexity modelling;
- short and medium range meteorology and oceanography;
- pollution transport in air, water, and soil;
- atmospheric chemistry, ozone hole;
- computational hydrology.

5. Nanoscale technology
- integrated optics, optical networks;
- quantum electronics and optics, general microwave technology;
- nanoscale techniques in medicine, porous materials.

6. Communication
- telecommunication and optical networks: analysis, simulation, optimization;
- transmission rate optimization;
- survivable networks, network design;
- frequency assignment, channel allocation, load balancing.

7. Traffic
- optimal periodic train scheduling, network planning;
- schedule synchronization;
- discrete and continuous traffic flow models;
- traffic on-line simulation and control, route guidance and planning;
- traffic assignment

8. Market and finance
- financial mathematics and statistics;
- option pricing;
- derivative trading, risk management;
- economic time series.

9. Speech and image recognition
- signal analysis;
- pattern recognition.

10. Engineering design
- transport systems in air, in water, or on land;
- energy conversion, distribution and conservation;
- smart design of consumer products.

These include mathematical subjects like:
- PDE analysis and modelling,
- complex coupled PDE systems,
- optimal control of PDEs and heterogenous systems,
- variational principles,
- inverse problems,
- stability and bifurcation analysis,
- PDE computational finite element methods,
- spatial and temporal homogenization,
- spatial statistics,
- stochastic geometry,
- interacting particle systems,
- stochastic analysis,
- multiscale analysis and algorithms,
- multigrid and domain decomposition,
- wavelets,
- turbulence modelling.

Fondazione CIME

International
Mathematical Summer Center
2001 courses

The Fondazione CIME will present four courses in 2001: three will be held at Martina Franca (Taranto, Italy); the other will be at Cetraro (Cosenza, Italy).

Information concerning these courses is presented below. Further information can be found on the Web server http://www.math.unifi.it/~cime/

Participants can also address their requests to:
Fondazione C.I.M.E. c/o Dipartimento di Matematica 'U. Dini'
Viale Morgagni, 67/A - 50134 Firenze, Italy
tel: +39-55-434975 or +39-55-4237123
fax: +39-55-434975 or +39-55-4222695
e-mail: *cime@math.unifi.it*
Direttore del CIME: Prof. Arrigo Cellina [cellina@mat.unimi.it]
Segretario del CIME: Prof. Vincenzo Vespri [vespri@dma.unifi.it]

Applications
If you wish to attend any session you should fill in an application to the C.I.M.E Foundation at the above address one month before the beginning of each course (not later than 20 July for courses starting in September). In your application you must specify your field of current research. An important consideration in the acceptance of applications is the scientific relevance of the session to your field of interest. Participation will be allowed only to persons who have applied in due time and have had their application accepted. CIME will be able to provide partial support to some of the youngest participants. Those who plan to apply for support should mention this on the application form.

Sites and lodging
Martina Franca is a charming, beautifully preserved ancient city on the hills of Puglia in southern Italy. Participants are lodged at the Park Hotel S. Michele; which has a well-kept garden and a large swimming pool. The lectures will be at the Palazzo Ducale (City Hall), within a short walking distance.

Cetraro is a beatiful location on the Tirrenian coast of Calabria in southern Italy. The nearest train station is Paola, on the Roma-Salerno-Reggio line.

CIME activities are made possible thanks to the generous support received from: Ministero degli Affari Esteri; The European Commission, Division XII, TMR Programme 'Summer Schools'; Consiglio Nazionale delle Ricerche; Ministero dell'Università e della Ricerca Scientifica e Tecnologica; UNESCO-ROSTE, Venice Office.

Lecture notes
These are published as soon as possible after the session.

Course 1: 2-10 June in Cetraro (Cosenza): Topological Fluid Mechanics
Scientific direction: Prof. Renzo L. Ricca (University College London, UK) [ricca@math.ucl.ac.uk]
(a) *Topological methods in astrophysics* (5 lectures)
Prof. Mitch A. Berger, University College London (UK) [m.berger@ucl.ac.uk]
(b) *Applications of knot theory* (5 lectures)
Prof. De Witt Sumners, Florida State University (USA) [sumners@zeno.math.fsu.edu]
(c) *Elements of knot theory* (5 lectures)
Prof. Louis H. Kauffman, University of Illinois at Chicago (USA) [kauffman@uic.edu]
(d) *Topological methods in hydrodynamics* (5 lectures)
Prof. Boris Khesin, University of Toronto (Canada) [khesin@math.toronto.edu]
(e) *Invariants and energy relaxation techniques* (5 lectures)
Prof. H. Keith Moffatt, Isaac Newton Institute for Mathematical Sciences (UK) [hkm2@newton.cam.ac.uk]
(f) *From fluid knots to complex systems* (5 lectures)
Prof. Renzo L. Ricca, University College London (UK) [ricca@math.ucl.ac.uk]

Course 2: 1-8 July in Martina Franca (Taranto): Spatial Stochastic Processes
Scientific direction: Prof. Ely MERZBACH (Bar-Ilan University) [merzbach@macs.biu.ac.il]
(a) Mixing results for critical nearest particle systems via spectral gap estimates (5 lectures)
Prof. Tom Mountford, University of California, Los Angeles.
(b) *Level sets and excursions of the Brownian sheet* (5 lectures)
Prof. Robert Dalang, Ecole Polytechnique Federal de Lausanne [robert.dalang@cpfl.ch]
(c) *Weak convergence of set-indexed martingales* (5 lectures)
Prof. Gail Ivanoff, University of Ottawa
(d) *Set-indexed martingales and point processes* (5 lectures)
Prof. Ely Merzbach, Bar-Ilan University [merzbach@macs.biu.ac.il]
(e) *Stochastic geometry of spatially structured birth and growth processes: applications to polymer crystallization processes* (5 lectures)
Prof. Vincenzo Capasso, Università di Milano [Vincenzo.Capasso@mat.unimi.it]
(f) Local time and sample path properties of n-parameter processes. (5 lectures)
Prof. Marco Dozzi, Université de Nancy, E-mail dozzi@iecn.u-nancy.fr }}

Course 3: 2-8 September in Martina Franca (Taranto): Optimal transportation and applications
Scientific direction: Prof. Luis Caffarelli, University of Texas, Austin (USA) [caffarel@fireant.ma.utexas.ed]
Prof. Sandro Salsa, Politecnico di Milano, Italy [sansal@mate.polimi.it]
(a) The Monge-Ampere equation, optimal transportation and periodic media (6 lectures)
Prof. Luis Caffarelli, University of Texas, Austin [caffarel@fireant.ma.utexas.ed]
(b) *title to be announced* (6 lectures)
Prof. L. C. Evans, University of California Berkeley [evans@math.berkeley.edu]
(c) *Shape optimization problems through the Monge-Kantorovich equation* (4 lectures)
Prof.Giuseppe Buttazzo, Università di Pisa [buttazzo@dm.unipi.it]
(d) *Geometric PDEs related to fluids and plasmas* (4 lectures)
Prof. Yann Brenier, LAN-UPMC, 4 Place Jussieu, Paris VI [brenier@dmi.ens.fr]
(e) *Mass transportation tools for dissipative PDEs* (4 lectures)
Prof. Cedric VILLANI, University of Texas, Austin [villani@brahma.ticam.utexas.edu]

Course 4: 9-15 September in Martina Franca (Taranto): Multiscale Problems and Methods in Numerical Simulation
Scientific direction: Prof. Claudio Canuto, Politecnico di Torino, Italy [ccanuto@polito.it]
(a) *Multilevel methods in finite elements* (6 lectures)
Prof. James H. Bramble, Texas A. & M. University
(b) *Nonlinear approximation and applications* (6 lectures)
Prof. Albert Cohen, Laboratoire d'Analyse Numérique, Université Pierre et Marie Curie Paris VI
(c) *Wavelet methods for operator equations* (6 lectures)
Prof. Wolfgang Dahmen, Institut für Geometrie und Praktische Mathematik, RWTH Aachen
(d) *Variational multiscale methods, physical models and numerical methods* (6 lectures)
Prof. Thomas J. R. Hughes, Stanford University, USA

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

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: ttp://www.ma.hw.ac.uk/icms/current/britopol

9-12: British Mathematical Colloquium, Glasgow, UK
Information:
Web site: www.maths.gla.ac.uk/bmc2001

15-21: Spring School in Analysis, Paseky nad Jizerou, Czech Republic
Information:
e-mail: paseky@karlin.mff.cuni.cz
Web site: http://www.karlin.mff.cuni.cz/katedry/kma/ss/apr01/ss.htm *[For details, see EMS Newsletter 38]*

17-20: EuroConference: Applications of the Macdonald Polynomials, Cambridge, UK
Organisers: B. Leclerc, M. Nazarov, M. Noumi, J.-Y. Thibon
Topics: Macdonald polynomials and related special functions in mathematical physics, harmonic analysis, and representation theory. In particular: classical and quantum many-body problems, integrable models in statistical physics and quantum field theory, quantum symmetric spaces, deformations of Virasoro and W-algebras, quantum Knizhnik-Zamolodchikov equations
Speakers: H. Awata, J.-F. van Diejen, C. Dunkl, J. Faraut, P. Forrester, K. Hasegawa, G. Heckman, N. Jing, T. Koornwinder, K. Mimachi, T. Miwa, S. Odake, E. Opdam, E. Rains, S. Ruijsenaars, J. Shiraishi, J. Stokman, V. Tarasov.
Site: Isaac Newton Institute for Mathematical Sciences
Deadline: for receipt of applications, already passed
Information:
Web site: http://www.newton.cam.ac.uk/programs/sfmw02.html

18-20: Third Postgraduate Group Theory Conference, Imperial College London, UK
Theme: group theory
Aim: the conference is aimed at postgraduate students who are currently working towards obtaining a PhD in mathematics in an area that is related to group theory. It is meant to bring students together in a less intimidating atmosphere, and we encourage participants to give a talk
Main speakers: Roger Carter (Warwick), Dan Segal (Oxford)
Organising committee: Jason Fairley and Alain Reuter
Sponsors: (provisional) London Mathematical Society
Grants: (provisional) subsidy of registration fee
Notes: participation is restricted to postgraduate students
Deadlines: 16 March for registration
Information:
e-mail: jason.fairley@ic.ac.uk or alain.reuter@ic.ac.uk
Web-site: http://www.ma.ic.ac.uk/~jtf98 pggtc2001/

May 2001

May – July: Thematic Term on Semigroups, Algorithms, Automata and Languages, Coimbra, Portugal
Theme: semigroups, algorithms, automata and languages
Aim: to make Coimbra the gathering point of researchers in the subjects of semigroup theory and automata theory during May, June and July, besides providing a basepoint for the development of joint research projects
Topics: algorithmic aspects of the theory of semigroups and its applications, automata and languages, model theory, profinite topology and semigroups, semigroups and applications, presentations and geometry
Main speakers: J. Almeida (Porto), C. Choffrut (Paris VII), J. Fountain (York), S. Margolis (Bar-Ilan), L. Ribes (Carleton), M. Sapir (Vanderbilt), M. Volkov (Ekaterinburg), T. Wilke (Kiel), M. Branco (Lisbon), V. Bruyère (Mons), O. Carton (Marne-la-Vallée), A. Restivo (Palermo), T. Coulbois (Paris VII), H. Straubing (Boston College), P. Trotter (Tasmania), P. Weil (Bordeaux), K. Auinger (Vienna), M. Lawson (Bangor), W. D. Munn (Glasgow), A. Pereira do Lago (São Paulo), R. Gilman (Stevens Inst. of Tech.), D. McAlister (DeKalb), J. Meakin (Lincoln), S. Pride (Glasgow), N. Ruskuc (St. Andrews), B. Steinberg (Porto)
Programme: 2-11 May, School on Algorithmic Aspects of the Theory of Semigroups and its Applications; 4-8 June, School on Automata and Languages; 11-13 June, Workshop on Model Theory, Profinite Topology and Semigroups; 2-6 July, School on Semigroups and Applications; 9-11 July Workshop on Presentations and Geometry
Sessions: each school consists of several 5-hour courses held by prominent researchers. The workshops include 50-minute invited lectures and a limited number of 20-minute talks on the specific topics of the workshop, proposed by the participants
Languages: English and Portuguese
Programme and organising committee: Gracinda M. S. Gomes (Lisbon, CAUL), Jean-Eric Pin (Paris VII, CNRS), Pedro V. Silva (Porto, CMUP)
Sponsors (confirmed)**:** Centro de Álgebra da Universidade de Lisboa, Centro de Matemática da Universidade do Porto, Centro Internacional de Matemática, Fundação Calouste Gulbenkian, Fundação Luso-Americana para o Desenvolvimento, Fundação para a Ciência e a Tecnologia.
Proceedings: to be published
Site: Observatório da Universidade de Coimbra (Almas de Freire, Coimbra, Portugal)
Grants: A limited number of scholarships will provide funding for those participants in need of financial support, particularly postgraduate students
Deadlines: already passed
Information:
e-mail: term2001@cii.fc.ul.pt
Web site: http://alf1.cii.fc.ul.pt/term2001

27-2 June: Spring School in Analysis: Function Spaces and Interpolation, Paseky nad Jizerou, Czech Republic
Information:
e-mail: pasejune@karlin.mff.cuni.cz
Web site: http://www.karlin.mff.cuni.cz/katedry/kma/ss/jun01/ss.htm
[For details, see EMS Newsletter 38]

28-1 June: Harmonic morphisms and harmonic maps, Marseille, France
Information:
e-mail: ville@math.polytechnique.fr
Web-site: http://beltrami.sc.unica.it/harmor/
[For details, see EMS Newsletter 38]

June 2001

4-8: Conference on Algebraic Topology, Gdansk, Poland
Theme: algebraic topology
Topics: homotopy theory, topology of manifolds, geometric group theory, algebraic *K*-theory and homotopy theory in algebraic geometry
Main speakers: Gregory Arone (University of Aberdeen), Matthew Ando (University of Illinois at Urbana-Champaign), Mladen Bestvina (University of Utah), Alexander Dranishnikov (University of Florida), Nicholas Kuhn (University of Virginia), Jack Morava (Johns Hopkins

University), Fabien Morel (Universite de Paris VII,) Teimuraz Pirashvili (Georgian Academy of Sciences)
Organising committee: Stanislaw Betley (Warszawa), Tadeusz Kozniewski (Warszawa), Stefan Jackowski (Warszawa), Adam Przezdziecki (Warszawa), Andrzej Szczepanski (Gdansk)
Deadlines: for registration, 15 April
Information:
e-mail: cat01@mimuw.edu.pl
Web site: www.mimuw.edu.pl/~cat01

4-9: Fractals in Graz 2001, Analysis-Dynamics-Geometry-Stochastics, Graz, Austria
Information:
e-mail: fractal@weyl.math.tu-graz.ac.at
Web site: http://finanz.math.tu-graz.ac.at/~fractal/
[For details, see EMS Newsletter 38]

18-22: Fourth European Conference on Elliptic and Parabolic Problems: Theory, Rolduc, Netherlands
Information:
e-mail: rolduc@amath.unizh.ch, gaeta@amath.unizh.ch
Web site: http://www.math.unizh.ch/roldućgaeta
[For details, see EMS Newsletter 38]

18-23: Tools for mathematical modelling, St. Petersburg, Russia
Theme: mathematical modelling
Topics: mathematical modelling, applied mathematics, computer algebra, methods of approximation, discretisation and computation, design techniques, numerical methods, parallel and distributed algorithms, computer modelling in dynamical systems, shadowing, adaptive methods and integral equations, mathematical models in biology, medicine etc., applications to physics, electrotechniques and electronics, dynamic economic models, general macro-economic models, market models
Main speakers: N. Ajabyan (Armenia), V. Aladjev (Estonia), A. Alawneh (Jordan), M. Alrefaei (Jordan), M. Andramonov (Russia), I. Andrianov (Germany), V. Bakhrushin (Ukraine), V. Chiroiu (Romania), A. B. Dragut (Romania), J. Esquivel-Avila (Mexico), S. Gavryushin (Russia), V. Ivanov (Russia), H. Ji-Huan (China), D. Khusainov (Ukraine), M. Kulshrestha (India), M. Lopez Garcia (Spain), A. Markov (Russia), R. Meyer-Spasche (Germany), A. Mikitinskiy (Russia), A. Prykarpatsky (Poland), K. Pucher (Austria), J. Purczynski (Poland), G. K. Raju (India), A. Rasulov (Uzbekistan), R. Ravindran (India), M. Razzaghi (USA), G. Sadovoi (Russia), V. Samovol (Russia), M. Schahz (German), M. Shamolin (Russia), M. Stojanovic (Yugoslavia), A. Stulov (Estonia), M. Veljovic (Yugoslavia), V. Vladimirov (Ukraine), R. Volosov (Russia), M. Yunusi (Tajikistan)
Sessions: equations of mathematical physics, theory of control processes, group analysis of differential equations, statistic modelling and integral equations, economic models, stochastic modelling and data analysis, variational model for non-linear problems, mathematical models in biology
Languages: English and Russian
Call for papers: an abstract of a complete typewritten page should include the title of the paper, names of all authors, complete affiliations, addresses, e-mail. A collection of abstracts will be printed before the conference. The participants must send their abstracts (2 copies) in camera-ready format to the Organising Committee by normal mail. We do NOT use electronic versions of abstracts
Programme committee: S. M. Ustinov, P. A. Jilin, G. G. Malinechkii, V. M. Ivanov, G. Yu Riznichenko, A. G. Chenchov, V. N. Kozlov, A. V. Zinkovskii, A. F. Andreev, Yu. N. Bibikov, S. Yu Piliugin, N. N. Petrov, E. N. Rozenvasser, I. V. Miroshnik, A. V. Timofeev, V. N. Fomin, N. E. Barabanov, Yu.V. Churin, E. K. Ershov, A. S. Matveev, V. B. Smirnova, A. I. Shipiliavui, A. V. Flegontov (all Russia)
Organising committee: conference chair, George Osipenko, St Petersburg Technical Univ.; Valentin Zaitsev, Russian State Pedagogical Univ.; Dmitrii Arseniev, Institute of International Education Program. Secretary, Lidiya Linchuk, St Petersburg State Technical Univ.
Sponsors: Russian foundation for Basic Research, Laboratory of Nonlinear Analysis, St Petersburg Technical Univ., Editorial Board of the Electronic Journal 'Differential Equations and Control Processes', Institute of International Education Programs
Proceedings: it is suggested that refereed Conference proceedings including full versions of selected papers accepted for presentation will be published
Site: St Petersburg State Technical University
Deadlines: for abstracts and registration forms, 15 April
Information: contact Lidiya Linchuk, MATHTOOLS'2001, Dept. of Mathematics, State Technical University, Polytechnicheskaya st., 29, St Petersburg, 195251, Russia,
fax: +7-812-5343314, +7-812-5527770.
e-mail: mt2001@osipenko.stu.neva.ru
Web page: http://www.neva.ru/journal

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]

25-28: Banach Algebras and Cohomology, Newcastle, UK
Information:
Web site: http://www.ncl.ac.uk/icbacn

25-29: Cmft2001, Computational Methods and Function Theory, Aveiro, Portugal
Theme: function theory, scientific computation, complex variables (including generalisations like quaternions, etc.), approximation theory and numerical analysis
Main speakers: · Alan Beardon (UK), Percy Deift (USA), Richard Delanghe (Belgium), Toby Driscoll (USA), Alexandre Eremenko (USA), Klaus Gürlebeck (Germany), Doron S. Lubinsky (South Africa), Andrew Odlyzko (USA), Lawrence Zalcman (Israel)
Organising committee: Helmuth R. Malonek (Aveiro), Nicolas Papamichael (Cyprus), Stephan Ruscheweyh, (Würzburg), Edward B. Saff, (South Florida)
Sponsors: Fundação para a Ciência e a Tecnologia, Sociedade Portuguesa de Matemática, COSTED, The British Council, Universidade de Aveiro UI&D 'Matemática e Aplicações' (as of 31 October 2000)
Proceedings: as with past CMFT meetings, the conference proceedings of CMFT2001 will appear in a carefully refereed volume distributed by a noted mathematics publisher. The style-file cmft.sty and the description-file cmft-manual.ps will be available for downloading from the homepage of CMFT 2001 by 1 April. Both files are also available from the local organizing committee upon request
Site: University of Aveiro, Campus de Santiago, Aveiro
Deadlines: for final registration, payment of conference fee (US$150) already passed; for payment of late conference fee (US$180), 25 June; for submission of papers for the proceedings, 15 October
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]

3-7: Barcelona 2001 EuroPhD Topology Conference, Bellaterra, Barcelona
Invited speakers: O. Cornea (Université de Lille), N. P. Strickland (University of Sheffield), P. Salvatore (Università degli Studi di Roma), D. J. Green (Universität Wuppertal), S. Schwede (Universität Bielefeld), S. Whitehouse (Université d'Artois), W. Chachólski (Yale University), P. Turner

(Heriot-Watt University)
Scientific committee: Antonio Viruel (Conference Coordinator) (Universidad de Málaga), Jérôme Scherer (Université de Lausanne), Natàlia Castellana (University of Aberdeen)
Site: Centre de Recerca Matemàtica
Information:
Web site: http://www.crm.es/b2001etc
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
Information:
e-mail: p.rowlinson@maths.stir.ac.uk
Web site: http://www.ma.hw.ac.uk/icms/current/graph/index.html
[For details, see EMS Newsletter 38]
9-22: European summer school 'Asymptotic combinatorics with application to mathematical physics', St Petersburg, Russia
Information:
e-mail: emschool@pdmi.ras.ru
Web site: www.pdmi.ras.ru/EIMI/2001/emschool/index.html
[For details, see EMS Newsletter 38]
10-15: Advanced Course on Symplectic Geometry of Integrable Hamiltonian Systems, Bellaterra, Barcelona
Speakers: Michèle Audin (Strasbourg), *Lagrangian and special lagrangian submanifolds*, Ana Cannas da Silva (Lisboa), *Symplectic toric manifolds*, Eugene Lerman (Illinois), *Symmetries of symplectic and contact manifolds*
Coordinators: Carlos Curràs-Bosch, Eva Miranda
Site: Centre de Recerca Matemàtica
Information:
Web site: http://www.crm.es/sgihs
15-20: Algorithms for Approximation IV International Symposium, Huddersfield, UK
Information:
e-mail: A4a4@Hud.Ac.Uk
Web-site:
Http://Helios.Hud.Ac.Uk/A4a4/
[For details, see EMS Newsletter 38]
17-23: Advanced Course on Global Riemannian Geometry: Curvature and Topology
Speakers: S. Markvorsen (Denmark), *Distance geometric analysis on Riemannian manifolds*, M. Min-Oo (McMaster University), *K-area, mass and assymptotic geometry*
Coordinator: Vicent Palmer
Site: Universitat Jaume I, Castelló de la Plana
Information:
Web site: http://www.crm.es/geom2001
18-28: Advanced Course on Modular Forms and *p*-adic Hodge Theory, Bellaterra, Barcelona
Speakers: Christophe Breuil (Université Paris-Sud), *p-adic Hodge theory, deformations and local Langlands*, Bas Edixhoven (Université de Rennes 1), *Modular forms, Galois representations and local Langlands*
Coordinators: Xavier Xarles, Adolfo Quirós
Site: Centre de Recerca Matemàtica,
Information:
Web site: http://www.crm.es/tn2001
23-27: 20th IFIP TC 7 Conference on System Modelling and Optimization, Trier, Germany
Information:
e-mail: ifip2001@uni-trier.de
Web site: http://ifip2001.uni-trier.de
[For details, see EMS Newsletter 38]

August 2001

5-18: BALTICON 2001, Banach Algebra Theory in Context, Krogerup Hojskole, Humlebaek, Denmark
Information:
e-mail: balticon2001@math.ku.dk
Web site:
http://www.math.ku.dk/conf/balticon2001/
[For details, see EMS Newsletter 38]
5-18: Groups St Andrews 2001, Oxford, UK
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]
12-18: 39th International Symposium on Functional Equations, Denmark
Organising committee: Peter Friis and Henrik Stetkaer (Aarhus University)
Information:
e-mail: isfe39@imf.au.dk
Web site: http://www.mi.aau.dk/isfe39/
12-19: Summer School 2001 Homological Conjectures for Finite Dimensional Algebras, Nordfjordeid, Norway
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/
[For details, see EMS Newsletter 38]
19-25: 9th Prague Topological Symposium, International Conference on General Topology and its Relations to Analysis and Algebra, Prague, Czech Republic
Topics: topology (mainly set-theoretical topology, continua, descriptive topology, categorical topology, geometrical topology), topological groups and semigroups, topology of Banach spaces, topology and computer science, topological dynamics
Main speakers: A. V. Arhangelskii (Moscow and Athens, OH), Z. Balogh (Oxford, OH), M. Bell (Winnipeg), A. Bouziad (Rouen), D. Dikranjan (Udine), A. Dow (Charlotte, NC), I. Farah (Staten Island, NY), D. Fremlin (Essex, UK), P. M. Gartside (Oxford, UK), G. Godefroy (Paris), G. Gruenhage (Auburn), N. Hindman (Washington, D.C.), I. Juhász (Budapest), H.-P. Kuenzi (Cape Town), K. Kunen (Madison, WI), D. Lutzer (Williamsburg, VA), W. M. Marciszewski (Warsaw), M. Megrelishvili (Ramat-Gan), J. van Mill (Amsterdam), P. Nyikos (Columbia, SC), J. Pelant (Prague), V. Pestov (Wellington), M. Reed (Oxford, UK), D. Repovs (Ljubljana), M. E. Rudin (Madison, WI), D. Shakhmatov (Matsuyama), L. Shapiro (Moscow), S. Solecki (Bloomington, IN), M. Tkachenko (Mexico), V. Tkachuk (Mexico), S. Todorcevic (Belgrade and Paris), V. V. Uspenskiy (Athens, OH), S. Watson (York), Y. Yajima (Yokohama)
Programme committee: Simon Donaldson (representative of IMU), B. Balcar, M. Husek, J. Pelant, P. Simon, V. Trnková
Organising committee: B. Balcar, M. Husek (Chairman), J. Pelant, P. Simon, V. Trnková, P. Holický, O. Kalenda, A. Klíc, J. Coufal, R. Rohácková
Sponsors: International Mathematical Union, Mathematical Institute of Czech Academy of Sciences, Department of Mathematics of Prague Institute of Chemical Technology, Department of Mathematics of Economical University and Faculty of Mathematics and Physics of Charles University.
Deadlines: for abstracts and registration, 31 May
Information:
Web site: http://www.karlin.mff.cuni.cz/~toposym/
e-mail: toposym@karlin.mff.cuni.cz
24-30: 10th International Meeting of European Women in Mathematics, Malta
Information: contact Dr. Tsou Sheung Tsun (EWM01), Mathematical Institute, 24-29 St. Giles, Oxford OX1 3LB, UK, fax: +44-1865-273583
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
Information:
e-mail: equadiff@math.cas.cz
Web site: www.math.cas.cz/~equadiff/
[For details, see EMS Newsletter 38]

September 2001

2-6: First SIAM-EMS Conference, Berlin, Germany
Topic: Applied Mathematics in Our Changing World
Information: contact Peter Deuflhard (Chair of the Local Organizing Committee), SIAM/EMS 2001 Conference Office c/o Konrad-Zuse-Zentrum Berlin (ZIB), Takustr. 7, 14195 Berlin-Dahlem, Germany

fax: +49 (30) 841 85-107
e-mail: amcw01@zib.de
Web site: http://www.zib.de/amcw01/

3-8: Sixth International Conference on Function Spaces, Wroclaw, Poland
Topics: the topics are connected with functional analysis, e.g. operator theory, interpolation, geometry, topology, approximation in function spaces.
Programme: plenary lectures (about 45 minutes) and short communications (not more than 20 minutes)
Organiser: Institute of Mathematics, Wroclaw University of Technology
Organising committee: M. Burnecki (secretary), R. Grzaslewicz (chairman), H. Hudzik, J. Musielak, Cz. Ryll-Nardzewski
Site: Institute of Mathematics, Wroclaw University of Technology
Information:
Web site: www.im.pwr.wroc.pl/~fsp/
e-mail: fsp@im.pwr.wroc.pl

5-7: LMS Workshop on Domain Decomposition Methods in Fluid Mechanics, Greenwich, UK
Aim: to disseminate amongst graduate students, researchers and industrialists the state-of-the-art domain decomposition methods applied to various engineering problems related to fluid mechanics. The workshop may be served as a short intense course for graduate students who will be exposed to review and overview lectures and current research interests and results
Inivited speakers: C. Bailey (Greenwich), X.-C. Cai (Boulder), M. Garbey (Lyon), I. G. Graham (Bath), G. Lube (Göttingen), F. Nataf (Paris)
Organisers: C.-H. Lai, M. Cross, K. A. Pericleous, A. K. Parrott
Grants: some scholarships are available to graduate students with priority given to those from UK mathematics departments
Information:
Web site: http://cms1.gre.ac.uk/conferences

12-14: Seventh Meeting on Computer Algebra and Applications (EACA-2001)
Topics: effective methods in algebra, analysis, geometry and topology; algorithmic complexity; scientific computation via symbolic- numerical methods; development of symbolic-numerical software; analysis, specification, design and implementation of symbolic computation systems; applications to science and technology
Speakers: Hoon Hong (North Carolina State University), Jacques Calmet (Universität Karlsruhe), Marc Chardin (Institut de Mathématiques, CNRS, Paris), Eladio Domínguez (Universidad de Zaragoza), y Luis Español (Universidad de La Rioja), Laureano González-Vega (Univesidad de Cantabria), y Rafael Sendra (Universidad de Alcalá)
Programme: invited speakers will deliver one-hour lectures on current and future trends in their research fields. A number of sessions for presentation of 30-minute talks are planned
Local organisers: Julio Rubio, Departamento de Matemáticas y Computación, Universidad de La Rioja, Edificio Vives, Calle Luis de Ulloa s/n, E-26004 Logroño (La Rioja, España)
Site: Ezcaray (La Rioja, Spain)
Note: this is a Spanish forum with international participation
Information:
e-mail: eaca2001@unirioja.es
Web site: http://www.unirioja.es/dptos/dmc/eaca2001/

12-15: EuroConference on Combinatorics, Graph Theory and Applications, Bellaterra, Barcelona
Invited speakers: Noga Alon (Tel Aviv University), Peter Cameron (Queen Mary and Westfield College), David Epstein (University of California), Levon Khachatrian (University of Bielefeld), Jiri Matousek (Charles University), Kevin Phelps (Auburn University), Vera T. Sós (Alfréd Rényi Institute of Mathematics), Carsten Thomassen (Technical University of Denmark), Nick Wormald (University of Melbourne)
Local organising committee: Gabor Lugosi (Universitat Pompeu), Fabra Conrado Martínez (Universitat Politècnica de Catalunya), Marc Noy (Universitat Politècnica de Catalunya), Josep Rifà (Universitat Autònoma de Barcelona), Oriol Serra (local Chairman) (Universitat Politècnica de Catalunya)
Site: Centre de Recerca Matemàtica
Information:
Web site: http://www.crm.es/comb01

14-18: International Conference: Function Spaces, Proximities and Quasi-uniformities, Italia, Caserta
[on the occasion of Som Naimpally's 70 birthday]
Information:
e-mail: topological.sun@unina2.it
Web site: http://www.unina2.it/topological.sun/homesun.html

16-22: Conference of the Austrian Mathematical Society and the German Mathematical Society, Vienna, Austria
[please note corrected dates]
Plenary speakers: V. Capasso (Milano), M. H. A. Davis (London), I. Ekeland (Paris), H. P. Schlickewei (Marburg), 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 organisation: Karl Sigmund (University of Vienna)
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.mathematik@univie.ac.at
Web site: http://www.mat.univie.ac.at/~oemg/Tagungen/2001/index.html

17-26: Functional Analysis VII, Dubrovnik, Croatia
Topics: operator algebras, probability theory, harmonic analysis, representation theory
Main speakers: Drazen Adamovic (Croatia), Anne-Marie Aubert (France), Damir Bakic (Croatia), Chongying Dong (USA), Detlef Gronau (Austria), Boris Guljas (Croatia), Jorgen Hoffmann-Jorgensen (Denmark), Jing-Song Huang (China), David R. Larson (USA), Bojan Magajna (Slovenia), Allen Moy (USA), Goran Muic (Croatia), Pavle Pandzic (Croatia), Manos Papadakis (USA), Goran Peskir (Denmark), Gilles Pisier (France), Zoran R. Pop-Stojanovic (USA), Mirko Primc (Croatia), Murali Rao (USA), Ludwig Reich (Austria), David Renard (France), Paul J. Sally (USA), Boris Sirola (Croatia), Renming Song (USA), David Soudry (Israel), Marko Tadic (Croatia), Mitchell H. Taibleson (USA), David A. Vogan (USA), Guido Weiss (USA)
Programme: series of lectures, single lectures and a limited number of short communications
Organising committee: Hrvoje Kraljevic (Croatia), Davor Butkovic (Croatia), Murali Rao (USA), Damir Bakic (Croatia), Pavle Pandzic (Croatia), Hrvoje Sikic (Croatia), Zoran Vondracek (Croatia)
Site: Inter-University Center, Dubrovnik, Croatia
Deadlines: to register and submit abstracts, 1 April 2001
Information:
e-mail: congress@math.hr
Web page: http://www.math.hr/~congress/Dubrovnik01/

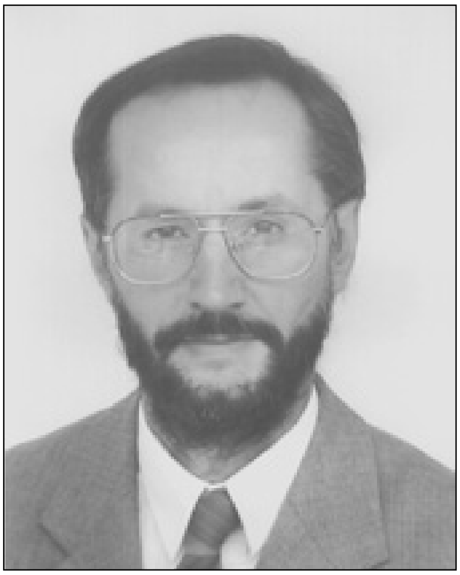
18-22: Euro Summer School on Proper Group Actions, Bellaterra, Barcelona
Speakers: Guido Mislin (ETH Zürich), *Equivariant K-homology of the classifying space for proper actions*, Alain Valette (Université de Neuchâtel), *Topological K-theory of group C*-algebras*
Coordinator: Carles Casacuberta
Site: Centre de Recerca Matemàtica
Information:
Web site: http://www.crm.es/group-actions

24-28: Fourth European Conference on Elliptic and Parabolic Problems: Applications, Gaeta, Italy
Information:
e-mail: rolduc@amath.unizh.ch, gaeta@amath.unizh.ch
Web site: http://www.math.unizh.ch/rolducgaeta
[For details, see EMS Newsletter 38]

24-28: III International Conference, Analytic and Probabilistic Methods in Number Theory, Palanga, Lithuania
[in honour of J. Kubilius]
Theme: analytic and probabilistic methods in number theory
Organizing committee: B. Juodka (Chairman), A. Laurincikas (Programme Director), E. Manstavicius, (Vice-chairman), V. Stakenas (Vice-chairman)
Proceedings: to be published
Information:
e-mail: palanga01@centras.lt
Web site: http://www.mif.vu.lt/ttsk/palanga.htm

Recent books

edited by Ivan Netuka and Vladimír Souček



Books submtted for review should be sent to the following address:
Ivan Netuka, MÚUK, Sokolovská 83, 186 75 Praha 8, Czech Republic.

M. Aschbacher, *Finite Group Theory*, *Cambridge Studies in Advanced Mathematics **10**, Cambridge University Press, Cambridge, 2000, 304 pp., £19.95, ISBN 0-521-78145-0 and 0-521-78675-4*
The second edition of Aschbacher's *Finite Group Theory* differs from the first edition in three aspects. The first edition contained many misprints: using it for an occasional reference I was aware of about twenty misprints in those parts I read with greater care (some sixty pages). Of these twenty misprints all but two have disappeared, and the second edition seems much more reliable. Some of the exercises are quite difficult. The second edition has an additional thirty pages devoted to solutions of the more important and more difficult exercises. The author found his extension of Bender's proof of the solvable signaliser functor theorem to odd primes too complicated, and he decided to return to Bender's original result which covers only abelian 2-subgroups. The new proof is not much shorter, but is presented in more detail and is easier to follow.

The book covers most of the standard basic material (series, semi-direct, central and wreath products, linear representations and characters, extensions, presentations, classical groups, Coxeter groups and root systems, extremal p-groups, transfer), and emphasises themes that are relevant to the Classification of Finite Simple Groups (e.g., extra-special groups). The more advanced topics include Thompson factorisation, fusion, central extensions, and various theorems on complements. The book also has a chapter on buildings, BN-pairs and Tits systems.

The exposition is often quite terse and the development of structures outside the group theory is done only to a minimal extent, which makes applications within group theory possible. The purpose of the book was to lay foundations for the proof of the CFSG, and the book finishes with a chapter on finite simple groups, including an introduction to CFSG and to its proof. (ad)

G. Bachman, L. Narici and E. Beckenstein, *Fourier and Wavelet Analysis*, *Universitext Springer, New York, 2000, 505 pp., DM119, ISBN 0-387-98899-8*
This excellent book is intended as an introduction to classical Fourier analysis, Fourier series, Fourier transforms and wavelets, for students in mathematics, physics and engineering. The text includes many historical notes to place the material in a cultural and mathematical context. The topics are developed slowly for a reader who has never seen them before, with a preference for clarity of exposition in stating and proving results.

The first three chapters present requisite background material, and these could be read as a short course in functional analysis. The standard features of Fourier analysis – Fourier series, Fourier transform, Fourier sine and cosine transforms – are developed in Chapters 4 and 5. More recent developments, such as the discrete and fast Fourier transforms and wavelets, are covered in the last two chapters. Each section concludes with a set of exercises with hints for many of these. (knaj)

C. Bandt, S. Graf and M. Zähle (eds.), *Fractal Geometry and Stochastics II*, *Progress in Probability **46**, Birkhäuser, Basel, 2000, 292 pp., ISBN 3-7643-6215-4*
This book includes the main contributions to the second conference on fractal geometry and stochastics, held at Greifswald, Germany in 1998. The conference and its proceedings reflect recent rapid and interesting research developments on the boundary between fractal geometry (of objects that show considerable irregularities of magnitude) and probability theory.

The topics covered are fractal dimensions of measures and sets, self-similar, self-affine sets and measures generated by iterated function systems, constructions of random fractals via contractions, random coverings, etc., dynamical systems and fractals, and harmonic analysis on fractals. The contributions range in style from survey papers to standard mathematical articles and an open problems collection. (jstep)

A. J. Berrick and M. E. Keating, *An Introduction to Rings and Modules with K-theory in View*, *Cambridge Studies in Advanced Mathematics **65**, Cambridge University Press, Cambridge, 2000, 265 pp., £35, ISBN 0-521-63274-9*
This is an introductory text for beginning graduate students who intend to move on to study algebraic K-theory. The fundamentals of ring and module theory are developed from scratch, accompanied by numerous examples and exercises.

After presenting the basics, the authors devote a chapter to direct-sum decompositions and short exact sequences (including a section on IBN-rings). The following two chapters on (non-commutative) noetherian and artinian rings include the classical Wedderburn-Artin theory. In this part, an interesting construction is presented of a stably free non-free right ideal over the two-variable polynomial ring over any skew-field which is not a field. This is in sharp contrast with the validity of Serre's conjecture which is well known in the field case.

The final two chapters deal with Dedekind domains and modules over them. The class group is introduced and the primary decomposition theorem is proved for finitely generated torsion modules. Besides general theorems, explicit computations are also presented; for example, in Section 5.3, the factorisation type of pO is completely determined when p is a prime and O is the ring of integers in the quadratic extension $\mathbf{Q}(\sqrt{d})$. The class group of $\mathbf{Q}(\sqrt{d})$ is explicitly computed for small values of d. (jtrl)

A. J. Berrick and M. E. Keating, *Categories and Modules with K-theory in View*, *Cambridge Studies in Advanced Mathematics **67**, Cambridge University Press, Cambridge, 2000, 361 pp., £35, ISBN 0-521-63276-5*
This book is an introduction to category theory, with particular emphasis on module categories. The exposition starts with basic material on categories, functors and

natural transformations; this includes first facts on functors, categories and universal objects. Next, the authors deal with additive and abelian categories, and introduce the Grothendieck group of a *G*-exact category. There is also a chapter on the tensor product of modules and the change of ring functors. Ext*n* and Tor*n* are introduced (with homological details left as exercises). Chapter 4 deals with a fundamental application of category theory to modules: the Morita equivalence theory. Another important construction, the direct and inverse limits, is explained in Chapter 5. The next chapter deals with the localisation of rings and modules. Localisation is first treated in terms of rings and modules of fractions, and then more generally, as a quotient functor with the universal property. The final chapter deals with completions and with local-global methods. Particular attention is paid to applications to lattices over Dedekind domains. The rings and modules of adèles are introduced, and projective modules over lattices are characterised. The book may be viewed as a continuation of Vol. **65** (see above), but it is of independent interest as well. (jtrl)

F. Blanchard, A. Maass and A. Nogueira (eds.), *Topics in Symbolic Dynamics and Applications*, *London Mathematical Society Lecture Note Series* ***279****, Cambridge University Press, Cambridge, 2000, 245 pp., £24.95, ISBN 0-521-79660-1*

Symbolic dynamics studies iterations of continuous selfmaps of spaces of symbolic spaces. These spaces are equipped with the Cantor (product) topology and are homeomorphic to subspaces of the Cantor middle-third set. Symbolic dynamics originated in the study of geodesics on surfaces with negative curvature. It is used for coding smooth transformations and has important connections with computer science.

This volume contains the courses given at the CIMPA-UNESCO Summer School on Symbolic Dynamics and its Applications held in Temuco, Chile, in January 1997. The volume is divided into eight chapters, each corresponding to a course given at Temuco and devoted to an active area of symbolic dynamics or applications to ergodic theory or number theory. The authors and topics are V. Berthé, *Sequences of low complexity: automatic and Sturmian sequences*, B. Host, *Substitution subshifts and Bratteli diagrams*, M. Boyle, *Algebraic aspects of symbolic dynamics*, B. Kitchens, Dynamics of $\mathbf{Z}^d$ actions on Markov subgroups, Z. Coelho, *Asymptotic laws for symbolic dynamical systems*, V. Bergelson, *Ergodic theory and Diophantine problems*, Ch. Frougny, *Number representation and finite automata*, R. Labarca, *A note on the topological classification of Lorenz maps on the interval*. (pkur)

J. M. Borwein and A. S. Lewis, *Convex Analysis and Nonlinear Optimization. Theory and Examples*, *CMS Books in Mathematics 3, Springer, New York, 2000, 273 pp., DM139, ISBN 0-387-98940-4*

The authors offer convexity as a tool which allows for transition from classical to modern analysis, from smooth to non-smooth problems, from linear to non-linear optimisation, and from functions to multi-functions. They present a wide spectrum of results on convex analysis in finite-dimensional spaces, their applications and some extensions. The well-known results on duality theory and the classical necessary and sufficient conditions for non-linear optimisation are included in a succinct way and their non-smooth versions are developed. The roles of polyhedral sets and functions, of fixed-point theorems, and of variational inequalities are explained. The lucid discussion of the place of the assumed finite-dimensionality indicates possible generalisations. Eigenvalue optimisation is an example of a less frequent type of application. Algorithms for solving optimisation problems are not the subject of the book.

The text consists of short sections, each accompanied by an extensive set of exercises marked into three categories: easy illustrative examples, more advanced examples and additional theory, demanding examples and peripheral theory. The style is not strictly formal, with definitions included in the text without numbering, and with proofs and technical details mostly omitted or left as exercises. (The overall ratio is 45:55 in favour of exercises.)

This is an up-to-date, well-written advanced text which aims at a broad mathematical audience. The general requirements correspond to a master's level in pure or applied mathematics, and selected sections and exercises may serve as an underlying text for advanced masters' courses on optimisation. With a detailed list of named results, the book can be used as a compendium and a source of reference. (jdup)

C.-P. Bruter, *La construction des nombres, Histoire et épistémologie*, *Ellipses, Paris, 2000, 237 pp., ISBN 2-7298-7959-5*

This interesting book is a combination of mathematics and its history with history. The author carefully describes the long history of mathematical thinking on the creation and extension of the concept of a number, up to the nineteenth century. The author prefers to present the most significant problem in the history of numbers so that the reader can appreciate the history of mathematics at first hand. This book helps the reader to understand the reason for the creation of the positive integers, integers, rational and irrational numbers, complex numbers, quaternions, octonions, and the so-called Clifford numbers (elements of Clifford algebras).

For each type of number, the author explains how they were discovered and constructed, their symbolic and geometrical representations, their properties and uses in geometry and physics. The last chapter contains a philosophical answer to the question of what the word 'number' really means. At the end of the book, there are three appendices with a bibliography and two indices.

The book is nicely written and provides an important source for university students interested in mathematics and its history. (mnem)

E. B. Burger and M. Starbird, *The Heart of Mathematics. An Invitation to Effective Thinking*, *Springer, New York, 2000, 646 pp., DM130, ISBN 1-55953-407-9*

This book is a wonderful and fascinating excursion into the realm of mathematics and the world of creative and effective thinking. The authors explain the mathematical ideas and results in such a way that the reader can discover the basic strategies of thought and use them in real life. In spite of this, the excursion is made as pleasant as possible, with many references to history, philosophy and the fine arts, without a lot of computation. The book can be read by teachers, students and anyone who is not afraid of thinking and who wants to discover what mathematics really is. (ec)

R. P. Burn, *Numbers and Functions. Steps into Analysis*, *Cambridge University Press, Cambridge, 2000, 356 pp., £19.95, ISBN 0-521-78836-6*

The main purpose of this textbook is to help students with the transition from high-school calculus to mathematical analysis as it is taught at universities. Through several hundreds of exercises, students are led from practical examples to the theoretical foundations of rigorous analysis. Solutions of all the exercises are given at the end of each chapter.

The topics presented in this book include mathematical induction, sequences and series of real numbers, functions, differentiation and integration and sequences of functions. Since the book is written in a very comprehensible but exact way, it may serve as an excellent guide through the basic course of mathematical analysis at university. Unlike standard textbooks, most of the contents are presented in the exercises, which provide the student with enough motivation for the definitions and theorems. Each chapter contains a summary of the preceding theory and a few historical notes. Each item in the bibliography is commented on in a few words, so that even a beginner can easily find his/her way to the appropriate materials. (jvy) (= J. Vybiral)

N. L. Carothers, *Real Analysis*, *Cambridge University Press, Cambridge, 2000, 401 pp., £19.95, ISBN 0-521-49749-3 and 0-521-49756-6*

This book presents a course on real analysis. It consists of three parts: metric (and normed) spaces, function spaces, and Lebesgue measure and integration (on the real line). It does not suppose detailed knowledge of a large amount of material: a basic course of analysis (including deeper facts such as the Bolzano-Weierstrass theorem, completeness, a certain familiarity with ε-δ-techniques, the Riemann integral, etc.) is sufficient to read the book. The exposition is clear, easily understandable, and written in a way accessible to non-specialist students. Good examples treated in sufficient depth (Cantor function, Peano curve, nowhere-differentiable continuous functions) and a great number of exercises (484, 231 and 280 in the three abovementioned sections) will be appreciated by those who use the book for the self-study. The author also includes some historical remarks and comments, more than 15 pages of references, and symbol and topic indices. The book will be enjoyed by students: in several hundred pages it contains almost all that a non-specialist mathematician should know about real analysis on **R**. (jive)

C. Cheverry, ***Systèmes de Lois de Conservation et Stabilité BV***, *Mémoires de la Société de Mathématique de France* ***75***, *Société Mathématique de France, Paris, 1998, 106 pp., Ffrs150, ISBN 2-85629-072-8*
This short book considers questions connected with the existence of weak solutions of the Cauchy problem for strictly hyperbolic systems of conservation laws. While the classical results give the existence in the large for data which are small in both the supremum and the total variation norms, this book tries to relax the assumption of the smallness of the total variation. It is shown that under some additional assumptions on the growth and (genuine) non-linearity of the flux function, the total variation on intervals of fixed appropriate length is decreasing. As a consequence, the compactness properties of the solution operator are proved, and the existence in the large for periodical initial data is proved in the case when the BV-norm of these data is large but BV-norm by period remains small.

This book will be appreciated both by specialists in the field and by (postgraduate) students interested in basic questions connected with the solvability of systems of hyperbolic conservation laws. (mrok)

A. Darte, Y. Robert and F. Vivien, ***Scheduling and Automatic Parallelization***, *Birkhäuser, Boston, 2000, 264 pp., DM158, ISBN 0-8176-4149-1 and 3-7643-4149-1*
This book deals with a very specific subject: an automatic parallelisation of nested loops in a sequential computer program. The core of the book is a detailed description of both classical and recent state-of-the-art techniques in this quite specialised field. The book also covers the necessary preliminaries that are essential for understanding the mathematical background of the techniques presented.

The book consists of five chapters, of which the first three deal with uni-dimensional problems (task graph systems and decomposed cyclic scheduling) and the last two with multi-dimensional systems (recurrent equations and loop nests). Chapter 1 covers classical results on task graph scheduling with no communication cost under both unlimited and limited resource constraints. Chapter 2 is the counterpart of Chapter 1 when taking communication costs into account. Chapter 3 is devoted to cyclic scheduling, which constitutes a transition from task graph scheduling to loop nest scheduling, the main subject of this book. Chapter 4 provides mathematical foundations for the core chapter of the book, Chapter 5, which deals with loop nests and loop parallelisation algorithms.

The readers are assumed to have only basic mathematical skills and some familiarity with standard graph and linear programming algorithms. However, due to its high specialisation, this book is orientated more towards graduate students and researchers interested in loop nest parallelisation than to undergraduate students or the general mathematical public. (jkrat)

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

P. Dehornoy, ***Braids and Self-Distributivity***, *Progress in Mathematics* ***192***, *Birkhäuser, Basel, 2000, 623 pp., DM178, ISBN 3-7643-6343-6*
In 1986 Richard Laver published a short remark that connected non-trivial elementary embeddings in set theory to systems with one binary operation, in which the left-distributive law $x \,.\, (y \,.\, z) = (x \,.\, y) \,.\, (x \,.\, z)$ is satisfied (the LD-systems). An LD-system induced by a non-trivial elementary embedding exhibits a certain property (the acyclicity) which implies its freeness (with respect to left-distributivity). However, for some time there was no direct proof that a free monogenerated LD-system is acyclic. This was a rather strange situation, since non-trivial elementary embeddings imply the existence of large cardinals.

Patrick Dehornoy started to contribute to the theory of LD-systems in the late 1980s, and in 1994 he published a proof of acyclicity that avoids large cardinals. His result was preceded by a systematic investigation of a (partial) monoid which is generated by such transformations of binary terms that correspond to an LD-expansion at a certain term position. The identities that are fulfilled within this monoid led Dehornoy to consider a connection with the braid group, and this connection led to many further discoveries, some of which are concerned just with the braid group.

This book presents the fruits of Dehornoy's research up to 2000. It is divided into three parts. Part A establishes the connection to braids, and then studies divisibility in a wide class of monoids that includes the braid monoid (and which is later shown to contain also a monoid that is induced by LD-expansions). The applications to braids include new linear orderings and a new normal form. Part B is devoted to a study of free LD-systems. It starts by showing that any two LD-equivalent terms can be expanded to the same term. This observation is then refined in various ways. First, a (right) normal form for free LD-systems is given, and then various results concerning the monoid that is induced by LD-expansions are obtained. These results then point to an extension of the braid group that is so important for Dehornoy's proof of acyclicity. Part C is concerned with connections with set theory and with certain finite LD-systems that appear naturally in this context and that yield a number of formidable open problems.

The book is written very carefully and requires almost no preliminary knowledge. Nevertheless, many readers will probably regard it as quite difficult, since it penetrates deeply into structures that are far from conventional mathematical interests. The book seems to me to be a major achievement: its only weakness is perhaps a rather restricted attention to results of other authors active in the field. Readers who have already come across some LD-systems (such as symmetric spaces) should be warned that the book is mainly about non-idempotent LD-systems, in contrast to various idempotent LD-systems that are induced by reflection and knot colouring. (ad)

A. M. Etheridge, ***An Introduction to Superprocesses***, *University Lecture Series* ***20***, *American Mathematical Society, Providence, 2000, 187 pp., US$33, ISBN 0-8218-2706-5*
Measure-valued processes (also known as superprocesses), as treated by this monograph, constitute an important and frequently visited topic of modern probability theory. The basic example and a source of motivation for the underlying mathematical research, the Dawson-Watanabe superprocess (also called super-Brownian motion) is known as a limit of branching Brownian motions and recently became a principal tool in mathematical population dynamics with the random size of the population governed by the Feller diffusion. Among the topics in this book are branching Brownian

motion, the DW superprocess as a martingale problem, the duality theorem for DW processes, the Fleming-Viot superprocess and its relation to the DW superprocess, discrete approximations, superprocesses in partial differential equation theory, and catalytic and competing species models.

This monograph is aimed at graduate students and probabilists interested in stochastic analysis who, the reviewer believes, will appreciate it as a deep and technically accessible summary of the developments in the field during the last decade. (jstep)

M. V. Fedoryuk (ed.), *Partial Differential Equations V*, *Encyclopaedia of Mathematical Sciences* ***34****, Springer, Berlin, 1999, 247 pp., DM158, ISBN 3-540-53371-0*

This book is a collection of six papers by V. M. Babich, N. S. Bakhvalov, M. V. Fedoryuk, A. M. Il'in, V. F. Lazutkin, G. P. Panasenko, A. L. Shtaras, and B. L. Vainberg, published originally in 1988 by VINITI, Moscow. This edition presents an English translation of these papers by J. S. Joel and S. A. Wolf.

Each article considers contemporary techniques in the study of properties of partial differential equations – in particular, the asymptotic behaviour of solutions; for example, one of the articles studies the equations with rapidly oscillating solutions, using the Maslov canonical operator technique. Another article deals with the asymptotic expansion of solutions of exterior boundary problems for hyperbolic equations, as the time approaches infinity. The remaining articles consider problems connected with semi-classical asymptotics of eigenfunctions, the higher-dimensional WKB method, boundary-layer problems, and averaging methods (the methods of homogenisation).

As a whole, the book presents a collection of papers dealing with particular topics in the theory of asymptotic and boundary behaviour of solutions of partial differential equations. It cannot be considered to be a textbook on PDEs but will be valued mostly by specialists working in the field. (mrok)

C. Goffman, T. Nishiura and D. Waterman, *Homeomorphisms in Analysis*, *Mathematical Surveys and Monographs* ***54****, American Mathematical Society, Providence, 1997, 216 pp., ISBN 0-8218-0614-9*

This book describes the interesting role played by homeomorphisms in real function and measure theories. More precisely, consider a function f from a certain family F. What can be said about the class $f \circ h$: h is a homeomorphism on the domain of f?. Here there is a typical example of the Maximoff theorem: let f be a real function on the interval (0, 1); then there is a homeomorphism h: (0, 1) to (0, 1) such that $f \circ h$ is a derivative if and only if f belongs to the Baire class 1 and has the Darboux property.

The first part of the book deals with the one-dimensional case and classes of Baire 1-functions, absolutely measurable functions, continuous functions of bounded variation, continuously differentiable functions and approximate derivatives. Chapters on Lebesgue equivalence, density topology and the Zahorski classes are included. The second part, *Mappings and measures on* $\mathbf{R}^n$, is concerned with one-to-one transformations defined on intervals in Euclidean space $\mathbf{R}^n$. There are chapters on bi-lipschitzian homeomorphisms, lengths of non-parametric curves, extensions of homeomorphisms and constructions of deformations. The final chapter in this part contains a discussion of the connection between Blumberg's theorem, Baire spaces and self-homeomorphisms of dense subsets. The last part of the book is devoted to Fourier series, and includes such topics as the behaviour of Fourier series, uniform and absolute convergence, Bohr theorem, convergence of Fourier series after change of variable, and absolutely measurable functions. The appendix contains a supplementary material including Baire, Borel and Lebesgue sets and functions, Hausdorff dimension, non-parametric length and area, and approximately continuous maps. Brief discussions of the historical background and other relevant matters are contained in remarks to some chapters.

The monograph contains many results of the authors. To read it with understanding, an advanced knowledge of real analysis and topology is needed. (jl)

G. Grätzer, *Math into LaTeX*, *Birkhäuser, Boston, 2000, 584 pp., DM108, ISBN 0-8176-4131-9 and 3-7643-4131-9*

This book is written by a mathematician for mathematicians and/or for other scientists (physicists, engineers,...) who use many mathematical formulas in their texts. The core of the book consists of typesetting such formulas, and all the practical aspects of LaTeX are discussed. For typesetting mathematics, the use of the AMS packages is strongly recommended by the author. In 1999 the American Mathematical Society released version 2.0 of the AMS packages; the third edition of the book covers the changes made in this release. In addition, this third edition contains three new chapters: Chapter 12 *Books in LaTeX* is devoted to typesetting large documents in LaTeX; the other new chapters are *TeX, LaTeX, and the Internet* and *Putting LaTeX on the Web*. The latter explains how to publish LaTeX articles, reports and books on the world wide web. (mdont)

R. L. Harris, *Information Graphics: A Comprehensive Illustrated Reference*, *Oxford University Press, Oxford, 2000, 448 pp., £32.50, ISBN 0-19-513532-6*

This is an excellent reference for those wishing to describe data using graphs (of any nature). The book covers the full spectrum of charts, graphs, maps, diagrams, and tables, ranging from the most basic to very specialised ones. I was surprised how many types of graphs have been suggested in the literature; this book offers more than 1000 different types. The approximately 4000 illustrations, prepared specially for this book, complement the text. The book is arranged alphabetically for easy reference and extensive cross-referencing is used throughout.

In addition to a detailed description of each type of information graphics, the book includes: construction details such as grids, symbols, text, lines, axes, legends, etc.; features that might mislead viewers such as scale breaks and perspectives; specific applications such as break-even graphs, population pyramids, candlestick charts, and quality control charts; and general terminology, such as variable, class interval, cell, stub, coordinate, etc.

The audience for this book will not be from those who specialise in pure mathematics. However, I can imagine many applied statisticians, engineers, people from business and/or newspapers etc., for whom this reference could represent an important addition to the library. (jant)

H. Hida, *Modular Forms and Galois Cohomology*, *Cambridge Studies in Advanced Mathematics* ***69****, Cambridge University Press, Cambridge, 2000, 343 pp., £42.50, ISBN 0-521-77036-X*

The groundbreaking work of Wiles (completed by Taylor-Wiles) on the modularity of Galois representations and elliptic curves was one of the most significant events in number theory in the 1990s. The main result can be summarised as an isomorphism $R = T$ between a Galois-theoretic object R (a universal deformation ring) and a modular object T (a suitable Hecke algebra). The range of technicalities involved in this work is enormous, which is why it is not easy to give a comprehensive introduction to the subject. This book is based on a series of graduate courses given by the author at UCLA. It does not aim at maximum generality, but concentrates on the proof of $R = T$ in the ordinary case with trivial tame level.

The book consists of five chapters. Chapter 1 gives a brief introduction to the subject, an overview of the book and a reinterpretation of class field theory in terms of the Hecke algebra for *GL(1)*. Chapter 2 is devoted to basic results in the representation theory of profinite groups, including deformation theory of representations and pseudo-representations. Chapter 3 is the heart of the book. It covers the following: an adelic description of classical modular forms and Hecke algebras; p-adic Hecke algebras; Galois representations with values in Hecke algebras; deformations of unramified local Galois representations; Taylor-Wiles systems and the proof of $R = T$ in a special case.

The key part of the proof is a construction of a Taylor-Wiles system of Hecke algebras, which is in turn based on calculations involving duality theorems for Galois cohomology. The latter is the subject matter of Chapter 4; the proofs closely follow Milne's book *Arithmetic Duality Theorems*. Chapter 5 gives, first, a reinterpretation of the equality $R = T$ in terms of a 'generalized class number formula' relating the special value of the L-function $L(1, Ad(f))$ and the order of a suitable Selmer group (still in the ordinary case). The final sections give a few new results on p-adic Hecke algebras and deformation rings.

This book will be useful to graduate students and researchers in number theory. Having gone through Chapters 1-3 (backed up, if necessary, by Chapter 4), the reader can proceed to the original work of Wiles or to its detailed exposition in the book *Modular Forms and Fermat's Last Theorem* (eds. G. Cornell, J. Silverman and G. Stevens). (jnek)

A. A. Ivanov, *Geometry of Sporadic Groups I: Petersen and Tilde Geometries*, *Encyclopedia of Mathematics and Its Applications* ***76****, Cambridge University Press, Cambridge, 1999, 408 pp., £45, ISBN 0-521-41362-1*

This is the first volume of a two-volume set on Petersen and tilde geometries. There is an infinite family of tilde geometries associated with non-split extensions of symplectic groups over the two-element field. Besides them, there are 12 exceptional Petersen and tilde geometries. These geometries are related to some sporadic simple groups, including the Monster group. The first volume presents a construction of each of the exceptional geometries; these constructions also provide an independent proof of the existence of the corresponding automorphism groups. Various applications, in particular to the representation theory of the Monster, are given. The book is intended for researchers in finite groups, geometries and algebraic combinatorics. (jtu)

A. M. Kamchatnov, *Nonlinear Periodic Waves and Their Modulations*, *World Scientific, Singapore, 2000, 383 pp., £33, ISBN 981-02-4407-X*

The book presents mathematical treatment of non-linear waves. Although there has lately been great progress in the mathematical approach to these phenomena, the techniques involved are quite difficult. It is the aim of the author to present some of the theory clearly through applications to physics.

The first part of the book consists of a thorough treatment of a few important examples of equations, where the essential features of the theory are shown. The theory is backed up by appropriate physical background and motivation. The most important examples in this section are the Burgers and Kortweg-de Vries equations, which describe waves on shallow water, wave breaking, and non-linear effects of viscosity. The non-linear Schrödinger equation, which describes electromagnetic pulses in dispersive media, is also discussed in detail in this section. The author shows that the Kortweg-de Vries and Schrödinger equations have more universal validity in the study of non-linear waves.

The second part of the book presents the basic concepts of the Whitham theory of modulations, which describes the evolution of the parameters of periodic solutions. This theory serves as a basis for the development of some modern techniques of the treatment of non-linear periodic waves. The concepts are then again applied to the Kortweg-de Vries and Schrödinger equations and some more applications are added.

At the end of each chapter a few exercises are provided to help the reader understand the topic. Solutions to the exercises are given in appropriate detail at the end of the book. Some of the mathematics used throughout the book is explained in the appendix. Each chapter is followed by bibliographic remarks with useful comments. The book is especially valuable for the author's attempt to interconnect the mathematical approach with its applications to physics, and it will undoubtedly be of great interest to both mathematicians and physicists. (tf) (= T. Furst)

R. Korn and E. Korn, *Option Pricing and Portfolio Optimization*, *Graduate Studies in Mathematics* ***31****, American Mathematical Society, Providence, 2001, 253 pp., US$39, ISBN 0-8218-2123-7*

Modelling financial markets by probabilistic diffusion models has received a considerable acceleration since the Nobel prize Black-Scholes formula for the fair pricing of the (European) options proved to be applicable to real trading processes. As a result, many other types of very complex derivative have been used by financial markets, each of them calling for an original application of the stochastic Ito calculus. This monograph offers a mathematically sophisticated treatment of the following subjects: modelling security prices, trading strategies and wealth process, principal properties of the continuous-time market model, option pricing based on the replication principle, arbitrage bounds, and the construction of optimal portfolios by the martingale and stochastic control methods. The pricing methods are developed for European, American and exotic options.

The treatment of financial topics is accompanied by mathematically rigorous excursions into stochastic analysis. The authors explain and, where possible, prove results such as the Ito formula, the Girzanov theorem and the Bellman principle. The relevant mathematics is inserted to the text when the results are first needed. Theory is presented as far as possible without an application of the Doob-Meyer theorem.

The book is meant as lecture notes and the authors claim it to be accessible to all those familiar with a basic course in probability. The reviewer does not completely accept this claim, but has no reservations about the exceptional quality and usefulness of the text. (jstep)

S. G. Krantz and H. R. Parks, *The Geometry of Domains in Space*, *Birkhäuser Advanced Texts, Birkhäuser, Boston, 1999, 308 pp., DM108, ISBN 0-8176-4097-5 and 3-7643-4097-4*

This book serves as a comprehensive treatment of domains in space and emphasises the interaction between analysis and geometry. Usually, analysis on Euclidean spaces is based on a study of classical groups (rotations, dilations and translations) acting on the space. Here the authors focus on domains in space and on properties that arise from the intrinsic geometry of the domain.

The first chapter contains a brief presentation of basic facts on smooth functions, defining functions and measure theory. The next chapters are devoted to rudiments of differential geometry and measure theory (rectifiability, Minkowski content, a space-filling curve, covering theorems, domains with finite perimeter, the area and co-area formulas and Rademacher's theorem). A short chapter on Sobolev spaces deals with restriction and trace theorems and domain extension theorems. The following chapters are devoted to smooth mappings, Sard's theorem, Stokes' theorem, the Whitney theorem, various kinds of convexity, the Krein-Milman theorem, Steiner symmetrisation, the isoperimetric inequality, quasi-conformal mappings and Weyl's theorem on eigenvalue asymptotics.

The book is understandable with a good knowledge of multi-variable advanced calculus and linear algebra, and can be used as a text for graduate students. The monograph also offers pleasent reading to anybody who enjoys the interplay between analysis and geometry. (jl)

G. R. Krause and T. H. Lenagan, *Growth of Algebras and Gelfand-Kirillov Dimension*, *Graduate Studies in Mathematics* ***22****, American Mathematical Society, Providence, 1999, 212 pp., US$39, ISBN 0-8218-0859-1*

This book is based on invited lectures at the Euroconference held under the same title at Bielefeld university in September 1998. The main topic is the role of infinite length modules in the representation theory of algebras. The book consists of 23 survey papers written by leading experts in the field.

The scene is set in a survey by Ringel containing many illuminating examples. There follow papers on algebraically compact modules (by Huisgen-Zimmermann and Prest), decomposition theory (Eklof, Facchini, Göbel and Pimenov-Yakovlev), dimension theory (Bavula, Lenagan and Schröer), functor categories (Kuhn and Powell), homological methods (Martsinkovsky, Schwartz and Smalo), localisation and moduli spaces (Rickard and Schofield), modular representations of finite groups (Benson and Carlson), and tameness (Bautista, Krause, Lenzing and Zwara).

This book is indispensable for anyone interested in current trends and methods of representation theory. (jtrl)

S. Levy, *The Eightfold Way: The Beauty of Klein's Quartic Curve*, *MSRI Publications 35, Cambridge University Press, Cambridge, 1999, 331 pp., £35, ISBN 0-521-66066-1*
The Klein quartic is the complex curve in the complex projective plane given by the simple equation $x^3y + y^3z + z^3x = 0$ and it has many remarkable and amazing properties. Felix Klein discovered it in 1879, and since then it has appeared in many branches of mathematics (complex analysis, geometry, algebraic geometry, number theory and topology). It has an exceptionally high degree of symmetry. The Hurwitz theorem asserts that the automorphism group of a curve of genus g has at most $84(g - 1)$ elements; the Klein quartic is one of two curves where this upper bound is reached.

In this book, the reader can find an English translation of Klein's original paper, together with several review papers on the role of the Klein quartic in the further development of mathematics. The article by H. Karcher and M. Weber describes its geometry, derives its classical equations and computes its Jacobian. Its role in number theory is treated in the paper by N. D. Elkies. A short paper by A. M. Macbeath reviews automorphism groups of Riemann surfaces. Two papers by A. Adler treat more general questions concerning rings of invariants of representations of certain finite groups, and prove Hirzebruch's earlier results for certain symmetric Hilbert modular surfaces. A historical review by J. Gray (first published in the *Mathematical Intelligencer*) is reprinted here.

A sculpture inspired by properties of Klein's quartic was created by H. Ferguson and since 1983 has attracted visitors at the Mathematical Sciences Research Institute in Berkeley. The book starts with W. Thurston's speech at the occasion of its inauguration and includes an essay written by the sculptor. (vs)

N. Limnios and M. Nikulin (eds.), *Recent Advances in Reliability Theory. Methodology, Practice, and Inference*, *Statistics for Industry and Technology, Birkhäuser, Boston, 2000, 514 pp., DM178, ISBN 0-8176-4135-1 and 3-7643-4135-1*
This book discusses reliability, asymptotic theory of processes (with or without switching), semi-Markov processes, mixing processes, asymptotic consolidation of state spaces, bootstrap, accelerated life models, Bayesian models, software reliability.

Conceiving reliable systems is a strategic issue for any industrial society – and this has been also the theme of the most important international conference in the past couple of years, MMR'2000, held in Bordeaux in July 2000, in which more than 350 people from all over the world participated.

The main topics covered are stochastic models and methods useful for reliability, including the asymptotic theory of processes (with or without switching), the theories of semi-Markov processes and mixing processes, the asymptotic consolidation of state spaces, the statistical methods of bootstrap, of accelerated life models, of point processes, Bayesian models and software models, and so forth.

This volume contains a selection of invited and contributed papers in the above topics that describe the state-of-the-art in their disciplines. The 31 chapters are grouped into eight parts: General approach, Probability models and related issues, Asymptotic analysis, Statistical models and data analysis, Methods common to reliability and survival analysis, Software reliability, Statistical inference and Asymptotic methods in statistics. For more details, see http://www.mass.u-bordeaux2.fr/MI2S/MMR2000 (jant)

H. Lüneburg, *Die euklidische Ebene und ihre Verwandten*, *Birkhäuser, Basel, 1999, 207 pp., DM49,80, ISBN 3-7643-5685-5*
This book is a nice introduction to the theory of affine and projective planes that can be described by two- and three-dimensional vector spaces over some fields. Special attention is paid to connections between properties of the planes (including finite ones) and the fields, e.g. Desargues' or Pappus planes and the corresponding fields. The book also contains a description of the theory of conic sections, collineations and metric properties of conics. In the final chapter, a geometrical characterisation of the real plane among all affine planes is given. The book deals with basic questions of elementary geometry and can be especially appreciated by teachers. (lbic)

A. Mader, *Almost Completely Decomposable Groups*, *Algebra, Logic and Applications Series **13**, Gordon and Breach Publishers, Singapore, 2000, 354 pp., US$90, ISBN 90-5699-225-2*
The structure of rank one torsion-free abelian groups – the subgroups of the additive group of rationals – is well known and completely described in the terms of types. Arbitrary direct sums (finite or infinite) of rank one groups are called completely decomposable groups, and their structure is also well known. A torsion-free group is called almost completely decomposable if it is a finite extension of a completely decomposable group. Using regulating subgroups, regulators and near-isomorphisms and collecting known results, the monograph presents a systematic study of the structural properties of this class of groups. (lbic)

V. Maillot, *Géométrie d'Arakelov des variétés toriques et fibrés en droites intégrables*, *Mémoires de la SMF **80**, Société Mathématique de France, Paris, 2000, 129 pp., FRF150, ISBN 2-85629-088-4*
Arakelov geometry combines algebro-geometric invariants of an arithmetic variety X, a regular flat scheme of finite type over $\mathbf{Z}$ with hermitian geometry of the complex manifold $X(\mathbf{C})$.

In this monograph the author studies Arakelov geometry of smooth projective toric varieties over $\mathbf{Z}$ – a natural generalisation of projective spaces. Such varieties and line bundles on them can be described in purely combinatorial terms. The corresponding complex analytic line bundles admit natural hermitian metrics; however, these are not C8 in general. As a result, the author first develops a generalisation of arithmetic intersection theory of Gillet-Soulé, in which one can make sense of the first arithmetic Chern class for line bundles with 'integrable' hermitian metrics. Applications of this theory to toric varieties include a formula for the height of a hypersurface in terms of a generalised Mahler measure and an arithmetic version of a theorem of Bernstein-Konshnirenko. (jnek)

V. P. Maslov and P. P. Mosolov, *Nonlinear Wave Equations Perturbed by Viscous Terms*, *de Gruyter Expositions in Mathematics **31**, Walter de Gruyter, Berlin, 2000, 329 pp., DM298, ISBN 3-11-015282-7*
This book is an extended and revised version of the Russian original publication, translated from Russian to English by M. A. Shishkova. It deals with the classical system of equations describing the motion of a one-dimensional compressible gas – the one-dimensional Navier-Stokes equations, the continuity equation and state equation, and the equations similar to these. The authors obtain sharper *a priori* estimates than is usual in this context, and using these estimates, they are able to give necessary and sufficient conditions for the existence of smooth solutions of the classical system for vanishing viscosity. Various possibilities on the form of modelling equations and their solution are discussed, including the form of the viscosity perturbation, boundedness of non-linearities, etc.

This book provides a skilled insight into the contemporary problems connected with the solvability of the specified class of partial differential equations, and can be recommended both to specialists in the field and to young mathematicians beginning their mathematical career in PDEs. (mrok)

A. S. Matveev and A. V. Savkin, *Qualitative Theory of Hybrid Dynamical Systems*, *Control Engineering, Birkhäuser, Boston, 2000, 348 pp., DM148, ISBN 0-8176-4141-6 and 3-7643-4141-6*
Hybrid dynamical systems combine continuous and discrete dynamics and involve both continuous and discrete state variables. A well-known instance of a hybrid system is a dynamical system described by a set of ordinary differential equations with discontinuous or multi-valued right-hand sides. Such mathematical models can be used to describe various engineering systems with relays, switches, and hysteresis. In the linear control area, a typical example of a hybrid system is that which is created when a continuous-time plant described by differential equations is controlled by a digital regulator described by difference equations. These

types of systems are studied in modern control engineering courses under the name of computer-controlled systems, or sampled-data systems.

The book is primarily a research monograph that presents some recent research in a unified fashion. The book consists mainly of the authors' original results and is essentially self-contained. The main concepts are differential automata, cyclic linear differential automata and switched single server flow networks. The authors study asymptotic behaviour of these models – in particular, the existence of limit cycles. (pkurk)

V. Maz'ya, S. Nazarov and B. Plamenevskij, *Asymptotic Theory of Elliptic Boundary Value Problems in Singularly Perturbed Domains, I*, *Operator Theory Advances and Applications* ***111****, Birkhäuser, Basel, 2000, 435 pp., DM268, ISBN 3-7643-6397-5 and 3-7643-2964-5*

This book is devoted to the development and applications of asymptotic methods to boundary value problems for elliptic equations in singularly perturbed domains. The first volume contains Parts I-IV, in which boundary value problems with perturbations near isolated singularities of the boundary of the domain are studied. The second volume contains Parts V-VII, which deal with other kinds of perturbations (problems with perturbations of the boundary of singular manifolds, problems in thin domains, and problems with rapid oscillations of the boundary of domain or coefficients of differential operators). In Part I the authors discuss boundary value problems for the Laplace operator. Part II is devoted to the study of general elliptic boundary value problems. Parts III and IV deal with expansion of functionals over solutions of boundary value problems and eigenvalues in the asymptotic series. In Part V the authors study boundary value problems in domains perturbed near multi-dimensional singularities of the boundary. The behaviour of solutions of boundary value problems in thin domains is investigated in Part VI. Part VII deals with elliptic boundary value problems with oscillating coefficients or boundary of domain. (dmed)

N. Mukhopadhyay, *Probability and Statistical Interference*, *Statistics: Textbooks and Monographs* ***162****, Marcel Dekker, New York, 2000, 665 pp., US$95, ISBN 0-8247-0379-0*

This book covers standard topics belonging to a two-semester introductory course of mathematical statistics. The first four chapters introduce basic concepts such as probability and conditional probability, expectation, variance, moments, and moment generating functions of the common discrete and continuous distributions, multivariate random variables and their characteristics, some standard probability inequalities, and functions of random variables, with a brief discussion on χ^2, t, and F-distributions. Chapter 5 is devoted to concepts of stochastic convergence. The remainder of the book develops concepts of statistical inference. The author deals with sufficiency, completeness and ancillarity (including Basu's theorem), point estimation (method of moments and of maximal likelihood, Rao-Blackwell theorem, Lehmann-Scheff, theorems), tests of hypotheses, confidence interval estimation (including multiple comparisons), Bayesian methods, likelihood ratio tests, large-sample inference, and two-stage procedures for sample size determination.

The only prerequisite is a one-year course of calculus. In individual chapters the reader finds numerous examples, and at the end of each chapter a long list of exercises is presented. The text contains interesting historical remarks and the author gives selected biographical notes on some exceptional contributors to the development of statistics in an appendix to the book.

This is a nice textbook. The text is written in a very understandable way and the explanation is illustrated with many carefully selected examples. The book can also be helpful as a supplementary text in courses for graduate students. It is a pleasure to read and I can recommend it to students and teachers of mathematical statistics. (jand)

L. C. G. Rogers and D. Williams, *Diffusions, Markov Processes and Martingales, Vols. 1, 2*, *Cambridge University Press, Cambridge, 2000, 386 and 480 pp., £22.95 and £24.95, ISBN 0-521-77594-9 and 0-521-77593-0; First and second editions published by John Wiley & Sons 1979, 1994, reissued in 2000 by Cambridge University Press.*

These books present a systematic treatment of topics on the title of the monograph and differ significantly from their first edition.

Volume 1, *Foundations*, is divided into three chapters, each adopting its own individuality as far as the purpose and the style of presentation are concerned. Chapter I (Brownian motion, Gaussian and Lévy processes) is designed as an introduction that the reader both theorems and heuristics and reasons why the topics are worth studying. Chapter II has been transformed to a consistent treatment of what could be called a 'handbook of probabilistic measure theory for young probabilists'. Its major subjects are the elements of measure and probability theory, measure and probability theory on Lusin spaces, the Daniell-Kolmogorov theorem, and discrete- and continuous-time martingales. The authors treat these subjects in a highly up-to-date manner; for example, the continuous-time martingale theory is presented for the processes with trajectories that are continuous on the right with limits on the left, and the sophistications as augmented filtrations are discussed with rigorous mathematical details. Chapter III (mostly identical with the first edition) is a semi-advanced treatment of Markov processes. It presents a neat treatment of Feller, Lévy and Ray processes, allowing sufficient space for results on additive functionals and Martin boundary.

Volume 2, *Itô Calculus*, presents perhaps the most attractive topic in modern probability (stochastic analysis) to interested and mathematically cultured audiences, in a manner based on both intuition and formal mathematical reasoning. The text differs from its previous editions in having many new examples and proofs. The authors justify the volume's title by providing many examples that help readers to develop their calculation abilities. Chapter IV covers the standard theory of the stochastic integral (of a previsible process with respect to a continuous semimartingale) up to the level of the semimartingale local time as an occupation density. Chapter V is devoted to the strong and weak theory of stochastic differential equations, and such other topics as pathwise uniqueness and uniqueness in distribution, and martingale problems are treated with an additional emphasis on one-dimensional SDEs. The subject of stochastic differential geometry receives here an original and clear exposition. Chapter VI extends the stochastic integration theory to local martingales with trajectories that are right continuous with limits on the left, the general Meyer theorem and Itô excursion theory being the topics whose presentation the reviewer considers the highlights of the volume.

The monograph as a whole is warmly recommended to post-PhD students of probability and will be welcomed as a good and reliable reference. (jstep)

J.-E. Rombaldi, *Thémes pour l'agrégation de mathématique*, *EDP Sciences, Les Ulis, 1999, 205 pp., Ffrs160, ISBN 2-86883-407-8*

This is a thorough and mathematically neat textbook on matrix theory. The algebraic and topological properties of the matrix vector algebra (over both the real and complex numbers) are presented in a self-contained manner, starting with a condensed treatment of the normed vector spaces that can be easily followed by any reader familiar with the elements of linear algebra. Standard results of classical matrix theory are proved comfortably via the endomorphism interpretation, and applications to systems of linear differential equations are delivered carefully with respect to possible numerical problems. Each chapter is accompanied by a collection of relevant solved exercises.

The textbook is meant as a teaching text at first- or second-year graduate level to provide a background for a course on numerical analysis, for example. Some readers might miss applications to linear programming or Markov chains. (jstep)

D. B. Shapiro, *Compositions of Quadratic Forms*, *De Gruyter Expositions in Mathematics* ***33****, Walter de Gruyter, Berlin, 2000, 417 pp., DM248, ISBN 3-11-012629-X*

A composition formula of size [r, s, n] is a sum-of-squares formula of the type

$$(x_1^2+x_2^2+ \dots + x_r^2).(y_1^2+y_2^2+ \dots +y_s^2) = z_1^2+z_2^2+ \dots +z_n^2,$$

where $X = (x_1, x_2, \dots , x_r)$ and $Y = (y_1, y_2, \dots , y_s)$ are systems of indeterminates and each $z_k = z_k(X, Y)$ is a bilinear form in X and Y. The first part of the book, 'Classical compositions and quadratic forms', is devoted to classical sizes [r, n, n] and the second one, 'Compositions of size [r, s, n]', gives some partial answers to the possible sizes [r, s, n] and the dependence on the field of coefficients using the methods of algebraic topology, combinatorics and linear algebra and geometry. (lbic)

A. Schinzel, *Polynomials with Special Regard to Reducibility*, *Encyclopedia of Mathematics and Its Applications **77**, Cambridge University Press, Cambridge, 2000, 558 pp., £60, ISBN 0-521-66225-7*

As the title indicates, the book deals with reducibility aspects of polynomials. It covers mainly those reducibility results that hold over large classes of fields; in particular, results valid only over the rational field, or over finite and local fields, are not included. The book also contains many related results (e.g. Ritt's theorems, or the Mahler measure).

The titles of the chapters are: Arbitrary polynomials over an arbitrary filed (80 pp.), Lacunary polynomials over an arbitrary field (109 pp.), Polynomials over an algebraically closed field (62 pp.), Polynomials over a finitely generated field (52 pp.), Polynomials over a number field (75 pp.), Polynomials over a Kroneckerian field (91 pp.).

Since polynomials touch on a huge variety of topics, it is hard to expect that such a book could be completely self-contained and simultaneously cover a broad spectrum of results. Nevertheless, the book can be read fluently, and the eventual definitions and results from the theory of polynomials needed to follow the exposition are collected in ten appendices. For other standard results the reader is referred to standard textbooks on real and complex analysis or the theory of algebraic numbers.

The book is written in a lucid style and contains many notes and cross-references to recent improvements on stated results that makes the book very versatile. For instance, the last appendix (written by U. Zannier) contains Bombieri and Zannier's proof of one of the author's conjectures. Also very helpful are the indices of definitions and theorems. The bibliography consists of over 300 items. The book can also be recommended as a resource for anybody interested in reducibility problems or in related facets of the theory of polynomials. (šp)

E. Ya. Smirnov, *Stabilization of Programmed Motion*, *Stability and Control: Theory, Methods and Applications **12**, Gordon and Breach Publishers, 2000, 265 pp., US$110, ISBN 90-5699-256-2*

This monograph develops stabilisation and optimal stabilisation of so-called programmed motion controlled systems; this is a controlled system governed by the initial-value problem for a system of, in general non-linear, ordinary differential equations $dy/dt = f(t, y, w)$. The information for synthesising a stabilising control w can be extracted from (some components of) the response y, either continuously, or in specific time instances only, considering possibly a measurement error.

Chapter 1 treats the case of continuously receiving information, for both so-called stationary and non-stationary systems (usually called autonomous and non-autonomous systems). Reduction to a canonical form, Lyapunov's function, relay stabilisation, or feedback control, are the methods used. Information about y received in discrete-time instances (combined possibly with continuously received information) is analysed in Chapter 2. Chapter 3 deals with various variants of the linear/quadratic optimal control problem. Finally, Chapter 4 is devoted to the so-called orbit stabilisation of variable-structure systems.

The book is based mostly on results from the Russian school (about 85% of the references are published in Russian), a large part (about 30%) being the author's original research. The book, requiring only a three-year university course in mathematics, is designed both for researchers in control theory and for graduate students. (trou)

M. Stern, *Semimodular Lattices: Theory and Applications*, *Encyclopedia of Mathematics and its Applications **73**, Cambridge University Press, Cambridge, 1999, 370 pp., £50, ISBN 0-521-46105-7*

The theory of semimodular lattices is the part of lattice theory with most connections to other areas of mathematics – in particular, to discrete mathematics and combinatorics, and especially to matroid theory. Other parts have relations to group theory – namely, to the structure of subgroup lattices. Other connections are to the foundations of geometry. The author develops the theory of semimodular lattices and their generalisations, and presents applications to the areas of mathematics mentioned above.

The book will be valuable to researchers, not only in lattice theory but also in discrete mathematics, combinatorics and general algebraic systems. (jtu)

P. Taylor, *Practical Foundations of Mathematics*, *Cambridge Studies in Advanced Mathematics **59**, Cambridge University Press, Cambridge, 1999, 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 (page 72), after Chapter I entitled 'First order reasoning' and after the first paragraph of Chapter II entitled '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 $\Phi[x]$ is a predicate on X, then $\{x: X \mid \Phi[x]\}$ is also a set). From Chapter IV, his basic mathematical tool is category theory. The use of categories as a base of 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 recently. 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 very 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 of potential readers. (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 the symmetric spaces such as $\mathbf{R}^n$ and the Poincaré 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 outside of mathematics. Several applications are included, such as 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)

WORLD MATHEMATICAL YEAR 2000

Last October an Italian WMY2000 stamp was issued. It features the WMY2000 logo, a fractal pattern and Archimedes' sphere inside a cylinder

New Members

We welcome the following new members who have joined in the past year.

Australia
Knopfmacher, John

Austria
Schmidt, Klaus
Teichmann, Josef

Belgium
Bellemans, M. J.
Bergh, Michel
Borrey, Sabine
Botterman, Stefaan
Kalinde, Ibert
Kuijken, Elisabeth
Luyckx, D.
Mielants, Wim
Plastria, Frank
Quarta, Lucas
Sebille, Michel
Toint, Philippe
Warrinnier, Alfred

Benin
Houehougbe, Antoine

Botswana
Cowen, R.

Canada
Brunner, H.
Guastavino, Marc

Czech Republic
Bohac, Zdenek
Francu, Jan

Denmark
Fuglede, Bent
Hoholdt, Tom
Lind Jensen, Allan
Nilsson, Dennis

Finland
Astola, Laura
Granlund, Seppo
Heili, Matti
Huuskonen, Taneli
Hyry, Eero
Jussila, Tapani
Laine, Marko
Nevanlinna, Veikko
Peltonen, Petri
Pirinen, Aulis
Pohjolainen, Seppo
Salli, Arto
Stenberg, Rolf
Suuntala, Sauli
Vuorinen, Matti

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Chipot, Michel
Clement, Emmanuele
Cordier, Stephane
Coudrais, Jacques
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Delaruelle, Christian
Di Maio, Pierre
Dias, Frederic
Diener, Francine
Donato, Patrizia
De Reffye, Jerome
Di Menza, Laurent
Diener, Marc
El Badia, Abdellatif
Foucher, Francoise
Fournier, Yvan
Gallot, Sylvestre
Gilquin, Herve
Giovangigli, Vincent
Guillaume, Anne
Guillas, Serge
Intissar, Abdelkader
Iooss, Gerard
Jacob, Christine
Jaffard, Stephane
Joly, Pierre
Kassel, Christian
Keller, Bernard
Kold Hansen, Soeren
Lasry, Jean Michel
Launay, Genevieve
Laurencot, Philippe
Le Roux, Alain Yves
Lemay, Robert
Leruste, Christian
Maisonobe, Philippe
Massot, Marc
Merindol, Jean-Yves
Pelletier, Michele
Penot, Jean-Paul
Picavet, Gabriel
Richard, Denis
Sablonniere, Paul
Schuman, Bertrand Marc
Short, Hamish
Simonot, Francois
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Thieullen, Michele
Tollu, Christophe
Treimany, Catherine
Werner, Wendelin
Wirtz, Bruno

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Ballmann, Josef
Benner, Peter
Carstensen, Carsten
Czech, Ingo Sigurd
Forster, Brigitte
Fritz, Gregor
Gagelmann, Ursula
Grötschel, Martin
Hatala, Michael
Herber, T.
Jäger, Willi
Korte, Ulrike
Lügger, Joachim
Morgenstern, Brigitte
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Schmidt, Wolfgang
Trapp, Monika
Ueberberg, Johannes
Weber, Gerhard-W.
Weber, Horst
Winkler, Jörg

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Sharma, A. K.

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Berg, Y.
Braun, Amiram
Rudnick, Zeev

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Brenti, Francesco
Calabri, Alberto
Capparelli, Stefano
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Ciliberto, Ciro
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Dedo, Ernesto
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Diomede, Sabrina
Emmer, Michele
Fedeli, Alessandro
Ferrara, Massimiliano
Ferrari, Fausto
Frosini, Patrizio
Gabelli, Stefania
Galletto, Dionigi
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Manzi, Gilberto
Marino, Maria Corinna
Mennella, F.
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Peccati, Lorenzo
Petronio, Carlo
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Ricca, Renzo
Schiavi, V. A.
Sernesi, Edoardo
Simonetti, Maura
Turrini, Cristina
Vaio, Franco
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Swylan, E.

Netherlands
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New Zealand
Glynn, David

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Kubarski, Jan

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Llovet, Juan
Lobillo, Francisco Javier
Maestre Vera, Manuel
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Martinez Ansemil, Jose Maria
Mata Hernandez, Agueda
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Milan Lopez, Francisco
Mira Ros, Jose Manuel
Montes Lozano, Antonio
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Zhang, P.

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Fossum, Robert
Guidotti, Patrick
Lawvere, William
Lee Keyfitz, Barbara
Maltese, George
Michaelis, Walter
Milea, Constantin
Robson, Robby
Sagle, A.A.
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Vogtmann, Karen

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Pouroutidou, S.
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The Institut des Hautes Études Scientifiques,

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hosts each year 200 to 250 mathematicians and theoretical physicists from all over the world and for various periods (2 or 3 days up to 1 or 2 years).

Created in 1958, the IHÉS is a Private Foundation of international standing with the purpose of "enhancing theoretical research in Pure Mathematics, Theoretical Physics, Human Sciences Methodology and every other disciplines which could be linked to those". The IHÉS is financed by the French Ministére de la Recherche, some European research agencies, the US National Science Foundation, and several French and foreign foundations and companies.

EUROPEAN PROGRAMME

In February 2000, the European Commission acknowledged the IHÉS as a Large European Research Infrastructure centre. A contract has thus been signed with the Commission aiming to develop and promote access to the Institute for European researchers (European Union and associated countries). This contract, valid through 2002, endows the Institute with financial support of 450,000 Euros over a 3 year period. These funds will be used to support approximately 50 visitors doing research in mathematics or theoretical physics and originating from countries of the European Union or associated countries. More information about conditions of application through the European programme are available on http://www.ihes.fr/APPLICATION/ProgEC/europe2A.html
Applications are reviewed and selected by the IHÉS Scientific Committee twice a year: in January and in September.

WILLIAM HODGE FELLOWSHIPS

The Engineering and Physical Sciences Research Council has been supporting the IHÉS for a number of years and recently decided to foster closer links between British Institutions and French research centres of excellence. British mathematicians and theoretical physicists are invited to apply to the IHÉS to visit and additionally perhaps to use the opportunity to visit research groups in the Paris region. More information is given on the IHÉS website. In addition, the EPSRC and the IHÉS are offering annualy two 1-year fellowships under the name of the eminent British mathematician, Sir William Hodge, whose main interests were algebraic and differential geometry. The fellowships will enable outstanding young mathematicians and theoretical physicists to spend time at the IHÉS.

Conditions for application for the fellowship 2002 / 2003

PhD in Mathematics or Theoretical Physics obtained in 1998 or later.

One of the two grants will be exclusively awarded to an applicant who has received his/her PhD from a UK University or has spent the last year in a UK university or institution.

Selection of Applicants

Applications will be reviewed and selection made based only on the criterion of excellence by the IHÉS Scientific Committee in January 2002. This Committee consists of the permanent professors, the Director, and some external members.

Starting date of the fellowships

September or October 2002.

How to apply

The application file should be sent under the name of "Hodge Fellowships" through the IHÉS website (www.ihes.fr) and should include: a CV, a publication list, a research project and two or three letters or recommendation.

Deadline for applications: December 31, 2001.

Information

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