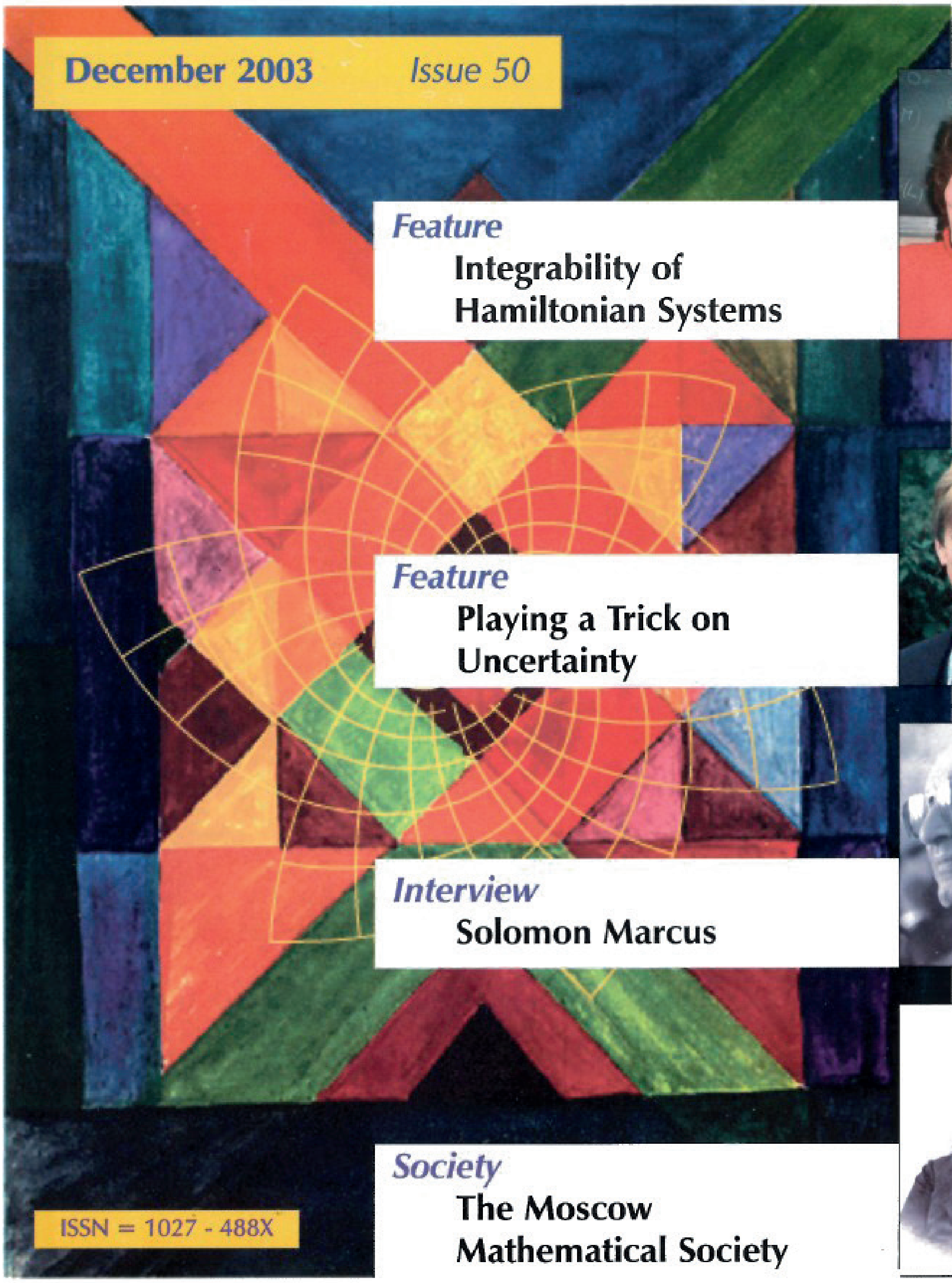
European Mathematical Society

December 2003 Issue 50



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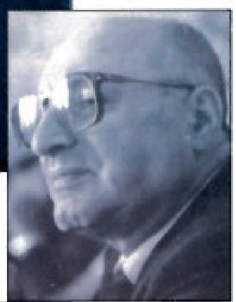

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NEWSLETTER

EUROPEAN MATHEMATICAL SOCIETY

NEWSLETTER No. 50

December 2003

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NOTICE FOR MATHEMATICAL SOCIETIES

Labels for the next issue will be prepared during the second half of February 2004. 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 80 euros; an invoice will be sent with a sample copy of the Newsletter.

EMS Committee

EMS Agenda

2004

31 January
Closing date for nominations for delegates to EMS Council to represent individual members
Contact: Tuulikki Mäkeläinen, e-mail: tuulikki.makelainen@helsinki.fi

1 February
Deadline for nominations for the EMS Prizes and the Felix Klein Prize, to be awarded at 4ecm
Nominations for the EMS Prizes to 4ecm Organising Committee, Prof Ari Laptev, Department of Mathematics, Royal Institute of Technology, SE-100 44 Stockholm, Sweden.
Nominations for the Felix Klein Prize to EMS Secretariat, Ms Tuulikki Mäkeläinen, Department of Mathematics, P.O. Box 4 (Yliopistonkatu 5), FIN-00014 University of Helsinki, Finland

15 February
Deadline for submission of material for the March issue of the EMS Newsletter
Contact: Martin Raussen, e-mail: raussen@math.auc.dk

20 February
Deadline for proposals for EMS Lectures, EMS Joint Mathematical Weekends and EMS Summer Schools in fundamental and interdisciplinary mathematics
(see announcement in Newsletter 49, September 2003, page 4)
Contact: Luc Lemaire, e-mail: llemaire@ulb.ac.be

28 February
Executive Committee Meeting in Helsinki (Finland), at the invitation of the Finnish Mathematical Society
Contact: Helge Holden, e-mail: holden@math.ntnu.no

25 June
EMS Executive Committee meeting at Uppsala (Sweden)
Contact: Helge Holden, e-mail: holden@math.ntnu.no

26-27 June
EMS Council meeting at Uppsala (Sweden)
Contact: Helge Holden, e-mail: holden@math.ntnu.no
or Tuulikki Mäkeläinen e-mail: tuulikki.makelainen@helsinki.fi

27 June - 2 July
4th European Congress of Mathematics, Stockholm
website: http://www.math.kth.se/4ecm

4-24 July
EMS Summer School at Cortona (Italy)
Evolution equations and applications

15-23 July
EMS Summer School at Bedlewo (Poland)
Analysis on metric measure spaces

30 August - 3 September
EMS Summer School at Universidad de Cantabria, Laredo (Spain)
Empirical processes: theory and statistical applications

Cost of advertisements and inserts in the EMS Newsletter, 2004

(all prices in British pounds)

Advertisements
Commercial rates: Full page: £230; half-page: £120; quarter-page: £74
Academic rates: Full page: £120; half-page: £74; quarter-page: £44
Intermediate rates: Full page: £176; half-page: £98; quarter-page: £59

Inserts
Postage cost: £14 per gram *plus* **Insertion cost:** £58 (e.g. a leaflet weighing 8.0 gram will cost 8x£14+£58 = £170) (weight to nearest 0.1 gram)

Editorial

History and Plans

Martin Raussen

Presentation

As the newly appointed editor of the *EMS Newsletter*, I have assigned the task of writing the editorial for this 'jubilee' issue 50 to myself. I should perhaps start by introducing myself: I am an associate professor at Aalborg University, North Jutland, Denmark (100 km south of the Northern tip of the peninsula). One of the reasons that I feel warmly about the EMS is that I have been affiliated with several European countries. I was born and raised in Germany, and studied mathematics and computer science at the Universities at Saarbrücken and Göttingen, where I earned a Ph.D. degree in 1981. During a year of studies in Paris, I met my Danish wife, and it is her fault that I moved to Denmark and finally became established at the (relatively new and reformed) university at Aalborg. My research interests are in geometry and topology; in recent years, I have tried to work with applications in theoretical computer science, notably concurrency theory.

History

Issue 50 of the *Newsletter* of the European Mathematical Society is of course an occasion to reflect on the development of the *Newsletter* and on what it might look like in the future.

The first newsletter appeared in September

Contents

We would like to thank Mrs. Beryl Betts and the staff in the Faculty of Mathematical Studies, University of Southampton, for typing this newsletter.

1991, almost a year after the foundation of the society itself. In its list of contents, you can see some of the items that would fill the later issues: agendas, announcements of forthcoming conferences, newspaper articles, advertisements, and so on - but no genuine mathematics at all! The *Newsletter* has developed a lot through the twelve years of its existence and many people have contributed to its contents (including some mathematics) and to its look. The editor for the past five years, Robin Wilson, reported in his editorial in the last issue 49 about many initiatives under his editorship. I would like to thank him very much for his good wishes, for his support, and for the tremendous work he has invested in the *Newsletter* since 1999.

Initially, the *Newsletter* was edited by David Singerman (Southampton) and Ivan Netuka (Prague). An editorial team from Glasgow Caledonian University, represented by Roy Bradley and Martin Speller, then took over from 1996 to 1998. As Carles Casacuberta explained in his editorial for issue 41, the *Newsletter* has reached maturity in its content and layout, but constant work will be necessary to maintain a journal that is interesting for the members of the Society and as such an asset for the EMS.

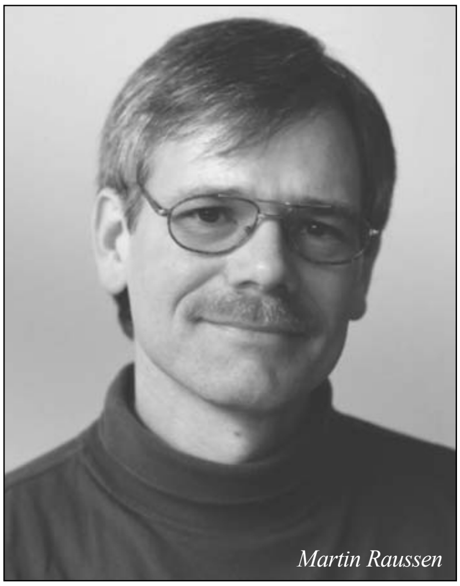
Future

From next year, you will have to cope with an editor who is not a native English speaker. Fortunately, Robin Wilson has agreed to carry on work for the *Newsletter* as an associate editor, and the Society has promised to find some help with the necessary revisions of the English language for contributions from outside the British Isles.

When beginning my job as an editor, I had of course to reflect on how I would like the *Newsletter* to develop in the future. My only experience in this business is my affiliation with the newsletter *Matilde* of the Danish Mathematical Society. It was founded in 1999, and we have only recently reached issue 18. I have been in the editorial board from the very beginning, and have mainly worked with the interview section. For certain issues and for the past year, I was the editor-in-chief, and I hope that I will be able to use some of my experience.

In my view, the most important lesson is that a newsletter - as any journal, for that matter - relies on a collaborative effort. When all members of an editorial board divide the tasks and do their best in finding good articles, then there is every chance for a good result that readers will appreciate. This newsletter is not a specialised research journal. On the other hand, its readership consists mainly of professional mathematicians whose main professional interest is mathematics. So, apart from spreading information about European mathematical affairs, we have to serve the reader with articles on the subject itself, on mathematical themes. Our aim is to include at least two feature articles in every issue - articles that inform the reader about newer mathematical themes (including connections with other disciplines, of course) in a non-technical manner, often in the form of a survey. As earlier, these will be complemented by articles on the history of mathematical developments and by interviews with significant mathematicians. The layout of the *Newsletter* will be a concern, too, that will be worked upon in collaboration with our Southampton printer and designer.

Jan Kosniowski (printer), Robin Wilson & Martin Raussen



Martin Raussen

How can we find articles that are well suited for the *Newsletter*? For the present issue, I was lucky. The society's committee on 'Raising Public Awareness' has recently run a competition for the best articles on mathematical themes that have been published in a newspaper or a periodical for a general readership; see the report by the committee's chair Vagn Lundsgaard Hansen in this issue. Some of the proposed articles report on topics that are not very well known among many professional mathematicians; one of these is included in this issue; others will probably follow. And of course, I have asked people I know for interesting surveys from their (electronic) drawers…

This strategy cannot be successful for a long period. This is why I hope to be able to 'steal' first-class papers from several of the excellent newsletters of the national mathematical societies, and have them translated. I have written to the editorial boards of the newsletters that I know of and invited them to collaborate. Some of them have given very supportive answers, and I hope for more to arrive soon. Let me use this opportunity to invite you all to tell me about well-written and up-to-date papers for a general professional mathematical readership.

Another idea is to develop the electronic side of the *Newsletter*. There is already an electronic archive covering the most recent issues, so that you can read or download most of the content. I would like to expand this service to a collection of searchable databases which, apart from the archive, contain the information from the *Recent Books* and the *Conferences* sections and thus make them more useful. When established over a range of years, users should be able to search for reviews of books on a particular topic, to connect electronically to other reviews or to the publisher of a book that they are interested in. We will experiment with this service over the coming year in collaboration with the suppliers of the *Recent Book* section from the Czech Republic; it will certainly take a little time before the readers can benefit from it.

All these projects can only work out with the active support from the editorial board of this *Newsletter*, from those of the member societies and from individual members. Please send me your contributions and your ideas, by ordinary or by e-mail. Thank you in advance!

Martin Raussen [raussen@math.auc.dk], Department of Mathematical Sciences, Aalborg University, Denmark.

EMS Executive Meeting in Lisbon

David Salinger, EMS Publicity Officer

David Salinger

The Executive Committee met on the afternoon of the 14th September, immediately after the very successful Joint Mathematical Weekend of the Portuguese Mathematical Society and the EMS. The Executive Committee might have been gloomy, in view of the lack of success in bidding for funds from the 6th Framework Programme. In the event, so much was going on that cautious optimism was the order of the day.

The President had attended the very impressive Kolmogorov meeting in Moscow and would also represent the Society at the forthcoming meeting of Spanish, Portuguese and South American societies in Santiago de Compostela.

The Treasurer reported that, while expenditure was running as forecast, additional membership would enable the Society to spend a little more money than planned. It was agreed that some of this would go to support planned EMS meetings in 2004 that had not obtained EU funding.

The Executive Committee with guests and Portuguese hosts

Fourteen mathematical institutes, members of ERCOM, had joined the Society. Individual membership had also increased, to around 2400: the President stressed the importance of individual membership in strengthening the voice of the Society.

None of the applications to the EU Framework Programme had been successful, but one - the project to support Summer Schools and other meetings - had been placed on the reserve list. This gave some hope that the Society would succeed in the second round. The Committee would encourage the Summer Schools planned for 2004 to go ahead. (Subsequently, the Committee has been heartened to learn that four of the Summer Schools will run, thanks to the enthusiasm of the organisers.)

A site visit had been made to Amsterdam to look at venues and arrangements for the fifth European Congress of Mathematics. The report was very positive and the Executive Committee would recommend the proposal to the EMS Council.

The schedule of the Fourth Congress in Stockholm was largely fixed (and all the information is now on the website). Council would meet in Uppsala before the Congress. Unfortunately, the EU would not support students attending the Congress.

There was a good prospect of having further mathematical weekend meetings in 2004 and 2005 in collaboration with two of our member Societies.

A Euroscience Open Forum had been organised for August 2004 in Stockholm, and the EMS would make a proposal for a session, based on emphasising subjects where applications had necessitated the development of new mathematics.

The Society would be represented at the EMS-SIAM-UMALCA meeting in Chile and would participate in ICIAM2007 in Zürich.

The Raising Public Awareness Committee had awarded three prizes for popular articles about mathematics. The Committee on Women in Mathematics had distributed its questionnaire in Ukraine and reported its findings.

The President had been encouraged by the willingness of mathematicians to join the EMS Scientific Advisory Panel, which appeared to work well in helping the Executive Committee judge the merit of proposals.

EULER was continuing as a consortium registered in Germany: The EMS wished to continue being involved and would appoint two representatives.

The Committee reaffirmed its support for Zentralblatt and the digital math library project.

The Publishing House would soon produce its first books and journals.

Then, news of the Newsletter itself. Martin Raussen was welcomed as the incoming Newsletter Editor. Robin Wilson was thanked for all the work he had put in. In his acknowledgement, Robin paid tribute to Jan Kosniowski's work on the design, which had played a big part in the Newsletter's success.

In an extra item of business, the Committee agreed to support the Belgian Academy's criticism of the blind use of the Impact Factor as an automatic formula determining a part of research funding.

After the local organisers had been thanked, the meeting closed.

Secretaries Tuulikki Mäkeläinen and Helge Holden at work

Mathematical Articles for the general public

Report on the EMS article competition

Vagn Lundsgaard Hansen (Lyngby, Denmark)

Background
In the current climate for intellectual activities in general, and for mathematics and science in particular, the future of a subject may strongly depend on stimulating articles about its treasures and importance for society. In this context, it is widely accepted that writing articles about mathematics for a fairly general public is a particularly hard task - but it is not impossible, as witnessed by such articles appearing from time to time in many countries. In order to encourage authors to produce mathematical articles with wide appeal in an international forum, the European Mathematical Society, through its committee for Raising Public Awareness of Mathematics (RPA), has recently run a competition for articles that have appeared in a newspaper, or some similar general magazine, in the home country of the author. All languages that could be read by more than one member of the RPA-committee were allowed.

By 31 December 2002, the deadline for submissions, we had received 26 proposals from 14 countries.

The jury
The jury consisted of the members of the RPA-committee:
Chris J Budd, (UK),
Mireille Chaleyat-Maurel, (France),
Michele Emmer, (Italy),
Andreas Frommer, (Germany),
Vagn Lundsgaard Hansen, Chair, (Denmark),
Osmo Pekonen, (Finland),
José Francisco Rodrigues, (Portugal),
Marta Sanz-Solé, (Spain).

The jury had a similar dilemma to that of the poster competition for World Mathematical Year 2000. Some articles were mathematically very elegant and attractive to mathematicians, but were probably not readable by a general reader. Other articles seemed too simple, and though readable by a general reader, were neither stimulating nor representative of mathematics.

After a careful selection, including evaluations of all proposals received, four proposals were selected for the final round.

The prize winners
Based on the evaluations, and placing emphasis on the general interest and readability of an article, the RPA-committee of the EMS made its recommendations for the prize winning articles to the Executive Committee of the EMS, which accepted the recommendations at its meeting in Lisbon, 13-14 September 2003.

FIRST PRIZE
Professor Nuno Crato, Department of Mathematics, Instituto superior de Economia e Gestão, Universidade Técnica de Lisboa, Rua Miguel Lupi 20, 1200 Lisboa, Portugal, for a three-part article *Cibersegredos invioláveis (Unbreakable ciber-secrets),* published in the Portuguese weekly newspaper *Expresso*, on 8, 22 & 29 September 2001.

Evaluation of the jury:
This is an excellent collection of three short articles for a general audience published in a weekly newspaper with large circulation. It is on a hot social and economic topic, where advanced mathematics plays a crucial role, even though it is not possible to explain the full technical aspects. Nevertheless, in the second article, the key mathematical idea is explained for a large audience, and in the third a clear message of the interdisciplinary aspects of the topic is given, not forgetting mathematics. It might be said that it is a somehow standard article on cryptography of which there are several similar around. The three-part article is, however, very well written, interesting and amusing, and shows how mathematics is useful for important issues in life. This article has wide appeal and deals with a timely topic in a style very suitable for the scientific section of a good newspaper.

The prize winning articles by Crato can be found in Portuguese and English at: *http://pascal.iseg.utl.pt/~ncrato/EMS/*

SECOND PRIZE
Professor F. Thomas Bruss, Dpt. de Mathématiques, Université Libre de Bruxelles, Campus Plaine, CP 215, B-1050 Bruxelles, Belgium, for his article *Der Ungewissheit ein Schnippchen schlagen (Playing a Trick on Uncertainty),* published in the magazine *Spektrum der Wissenschaft,* 6 June 2000, and a similar article in the daily German newspaper *Die Welt*, 17 May 2001.

Evaluation of the jury:
This is an excellent article. It immediately grabs the reader's attention with a practical problem, shows that this problem really is hard, inviting the reader to think what to do about it. It also shows the reader that mathematics is needed to solve the problem - without leaving them behind, and links the problem with the rest of the mathematical universe. Published in a high-level general scientific journal, it is probably most appealing to educated people.

The English version of the prize winning

Vagn Lundsgaard Hansen

article by Bruss is published in this Newsletter. The article can also be found in German and English under "Publications" at: *http://www.ulb.ac.be/facs/sciences/math/perso/bruss.html*

THIRD PRIZE
Professor Sava Grozdev (co-authors Ivan Derzhanski, Evgenia Sendova), Union of Bulgarian Mathematicians, Acad. G. Bonchev Street, Block 8, 1113 Sofia, Bulgaria, for their article *For those who think mathematics dreary,* published in the Bulgarian daily newspaper *Dnevnik*, 27 December 2001.

Evaluation of the jury:
This is a well-composed article with a positive message concerning mathematics. It is written in a charming personal style and it contains beautiful pictures. It is accessible for almost anyone as there are no mathematical formulas. This may make it superficial for the expert, but it will undoubtedly attract the general reader.

The prize winning article by Grozdev, Derzhanski and Sendova can be found in Bulgarian and English at: *http://www.math.bas.bg/ml/iad/dremat/dmathen.html*

Links to the winning articles can also be found at the URL containing the Internet information on the results from the article competition: *http://www.mat.dtu.dk/people/V.L.Hansen/rpa/resultartcomp.html*

In addition to the winning articles, the jury wishes to mention the runner-up in the competition. The article in question is an excellent one on symmetry. But after thorough consideration, the jury felt that it was addressed to a more mature mathematical audience than the articles on mathematics you would expect to find in a newspaper.

RUNNER-UP
Directeur de la Rédaction Philippe Boulanger (on behalf of Professor Alain Connes), Pour la Science, 8, rue Férou,75278 Paris Cedex 06, France, for the article *Symétries* (par Alain Connes), published in the French magazine *Pour la Science*, February 2002.

Evaluation of the jury:
This is an original and masterly article at a high level, and a beautiful expression of the unity of mathematics. The message concerning mathematics is (among other ideas) that some notions of mathematics like symmetry have a universal value. The author knows the history of mathematics and embeds his concepts in the historical and logical development of ideas. Reading the article requires a solid mathematical background but a university student of pure mathematics will undoubtedly find it extremely interesting. The article is, however, not readable by a general reader without a good level of mathematical knowledge and motivation: it is too abstract for the general public. There are interesting applications of permutations to problems in music, textile patterns and dancing, which would present the same material in a more relevant way and would have greater appeal. Nevertheless, it is an extraordinary pleasant and valuable read for a mathematically educated person.

Other articles
There were also other valuable articles submitted for the competition. I was particularly surprised by information on the occurrence of the numbers from 1 to 9 as the first significant digit of a number from everyday life (temperature, dates, prizes, quotations, etc.) given in an article on *La loi de Benford*. One meets many more numbers in daily life beginning with 1, 2, or 3, than with 7, 8, or 9! All mathematicians surely will appreciate a fascinating and interesting historical article on *Stefan Banach and the Lvov Mathematical School*. Finally, I will mention a well-written article on the incompleteness phenomenon in mathematical logic. Some of the articles mentioned might be of interest for the readers of the *Newsletter*.

More competitions?
The RPA-committee was impressed by the creativity shown in many of the submitted articles. It was a particularly difficult task to decide between articles with lesser depth for a broad public and articles with greater depth for a more mathematically educated public. I think we found some very good and representative winners, but there were also other deserving articles. This indicates that there is a good basis for further competitions.

The RPA-committee of the EMS might therefore arrange another competition fairly soon. To avoid the difficulty of deciding between articles on mathematics for a general public and popular articles on mathematics for an educated public, the RPA-committee suggests that the emphasis of a new competition should be given to popular articles on mathematics for the educated layman and professional mathematicians.

Let me finally thank all of the authors who submitted articles for the competition. I am happy to say that the RPA-committee was very satisfied with the number of submissions and with the generally good quality of the contributions.

Vagn Lundsgaard Hansen [V.L.Hansen@mat.dtu.dk] is chairman of the EMS-committee on Raising Public Awareness of Mathematics. He is a Professor of Mathematics at the Department of Mathematics, Technical University of Denmark, Lyngby, Denmark.

EMS Summer Schools 2003 and 2004

Two EMS Summer Schools have been held in 2003:
Stochastic Methods in Finance, Bressanone (Italy)
The CIME-EMS Summer School: “Stochastic Methods in Finance” (July 6-13, 2003), was attended by 115 scientists and researchers, coming from all continents: among them 85 were Europeans, 35 of which Italians.

The aim of the School was to provide a broad and accurate knowledge of some of the most up to date and relevant topics in Mathematical Finance. Particular attention was devoted to the investigation of innovative methods from stochastic analysis that play a fundamental role in the mathematical modelling of finance or insurance: the theory of stochastic processes, optimal and stochastic control, stochastic differential equations, convex analysis and duality theory.

The outstanding and internationally recognized lecturers have contributed in an essential way to the development of the theory and techniques that constituted the subjects of the lectures. The financial origin or motivation of the mathematical analysis undertaken was presented in a rigorous manner that facilitated the understanding of the interface between mathematics and finance. Great evidence was also put on the importance and the efficiency of the mathematical instruments for the formalization and the resolution of the given financial problem. Moreover, the direct financial origin of the development of some theories of remarkable importance in mathematics has emerged with clarity.

Short summary of the five courses:
Prof. Kerry Back, Univ. of St. Louis**:** *Partial and asymmetric information.*
In the context of economic equilibrium, a survey of incomplete and asymmetric information (or insider trading) models was presented. First, a review of filtering theory and stochastic control was introduced. In the second part of the course some work on incomplete information models was analyzed, focusing on Markov chain models. The last part was concerned with asymmetric information models, with particular emphasis on Kyle model and extensions thereof.
Prof. Tomasz Bielecki, Illinois Institute of Technology: *Stochastic methods in credit risk modelling: valuation and hedging.*
A broad review of the recent methodologies for the management of credit risk was presented in this course: structural models, intensity-based models, modelling of dependent defaults and migrations, defaultable term structures, copula based models. For each model the main mathematical tools have been described in details, with particular emphasis on the theory of martingales, stochastic control, Markov chains.
Prof. Christian Hipp, Univ. of Karlsruhe**:** *Financial control methods applied in insurance.*
The methodologies developed in modern mathematical finance have found wide use also in the applications to the control and the management of the specific risk of insurance companies. In particular, in the course it was shown how the theory of stochastic control and stochastic optimization can effectively be used and how it can be integrated with the classical insurance and risk theory.
Prof. Shige Peng, Shandong Univ: *Nonlinear expectations, nonlinear evaluations and risk measures.*
In this course the theory of the so-called ‘g-expectations’ was developed, with particular attention to the following topics: backward stochastic differential equations, F-expectation, g-martingales and theorems of decomposition of E-supermartingales. Applications to the theory of risk measures in a dynamic context were suggested, with particular emphasis on the issues of time consistency of the dynamic risk measures.
Prof. Walter Schachermayer, Technical Univ. of Vienna: ***Utility Maximization in Incomplete Markets.***
This course was mainly focused on the maximization of the expected utility from terminal wealth in incomplete markets. A part of the course was dedicated to the presentation of the stochastic model of the market, with particular attention to the formulation of the condition of No Arbitrage. Some results of convex analysis and duality theory were also introduced and explained, as they are needed for the formulation of the dual problem with respect to the set of equivalent martingale measures. Then some recent results of this classical problem were presented in the general context of semi-martingales financial models.

Marco Fritelli, Università di Firenze (Italy)

Dynamical Systems, Porto (Portugal)
The EMS Summer School in Dynamical Systems was held at the Department of Pure Mathematics of the Faculty of Sciences at the University of Porto from June 30th to July 4th, 2003. It was proposed as a 1-week training program for graduate students and young researchers, leading to an understanding of recent developments in Dynamical Systems and Ergodic Theory. The organizing committee received 103 applications of which 63, mainly post-graduate students from 18 countries, were able to attend the School.

The invited lecturers (Luís Barreira, Jean-Marc Gambaudo, Floris Takens, Marcelo Viana), from research centres on dynamical systems (the Technical University of Portugal, the University of Bourgogne in France, the University of Groningen in The Netherlands and the Institute of Pure and Applied Mathematics in Brazil, respectively) are experts in this area, and their lectures included material from their recent publications.

The School was financially supported by the European Mathematical Society, through UNESCO-ROSTE (contract number 875.600.3), and by Centro de Matemática do Porto/Centro de Matemática Aplicada do Porto, through the Portuguese Foundation for Science and Technology. More details and photos can be found on the web page http://www.fc.up.pt/cmup/sds/.

Maria de Fatima Carvalho (Centro de Matemática da Universidade de Porto, Portugal)

EMS Summer Schools in 2004
Plans for four EMS Summer Schools are about to be set up currently:
- Summer School on Evolution equations and applications
  Cortona, Italy, July 4-24, 2004.
- Analysis on metric measure spaces
  Bedlewo, Poland, July 15-23, 2004.
- Empirical Processes: Theory and Statistical Applications
  Santander, Spain, August 30 - September 3, 2004.
- Séminaire Européen de Statistique (SemStat): The Statistics of Spatio-temporal systems
  EURANDOM, Eindhoven, The Netherlands, December, 2004.

Latest News: The EMS summer schools planned for 2004 and 2005 will receive funding from the EU Framework Programme.

Playing a trick on uncertainty

F. Thomas Bruss (Bruxelles)

F. Thomas Bruss

The European Mathematical Society is grateful to Spektrum der Wissenschaft and to Deutsche Mathematikervereinigung for their kind permission to publish the English version of this article, that was awarded the second prize in the article competition of the EMS-committee Raising Public Awareness of Mathematics.

If you have to decide between two alternatives without knowing which one is more favourable, then you may quite as well flip a coin - Right?
No, you can do better.

You want to sell your house. Your ad "Sell for the best offer above 800,000 Euro" has been running for weeks already in the newspaper. But now, next Sunday is the deadline.

Two potential buyers have announced their definite interest. Mr. X from Paris called, saying that he will make an offer exceeding 800,000 Euro but that he would like to see the house again next Saturday before finalizing his exact offer. And then there is Mrs. Y who called from London to say essentially the same, except that she can come next Sunday only. Both Mr. X and Mrs. Y insisted that they would need your irrevocable Yes or No on the very day of their visit.

You would have liked so much to find out more! If you only had been able to obtain an indication of what limit Mr. X and Mrs. Y were prepared to pay!

However, all you got on the phone was a short laugh and something like "Please let me see the house again." True business people, both of them! You also have made already your inquiries: Both are serious and reliable, and both have the necessary funds. But then, it seems hard to guess who of the two could be expected to be the more interested one.

It is time to analyse the exact circumstances of your situation. Clearly, you will have again the opportunity to point out the splendid features of your house. However, this will not change your dilemma: If you accept the offer of Mr. X you will lose the one of Mrs. Y, and if you want to wait for the offer of Mrs. Y you lose the one of Mr. X. This seems like gambling! You will lose the better of the two offers with probability ½, won't you?

Another idea comes to your mind. Paris….London ...; it is not likely that Mr. X and Mrs. Y know each other. Should you perhaps try to push up the price by telling each of them how much interested the other one is? Perhaps trying with Mr. X first? - But no, you dismiss this idea, a man like Mr. X would hardly be impressed by this - rather on the contrary. Trying with Mrs. Y perhaps? But then, the day she comes, Mr. X is already out of the game and can no longer serve as a means of pressure.

And again you arrive at the same conclusion as before: You may as well flip a coin in order to decide. Perhaps you should simply make the deal with Mr. X to have at least your Sunday free!

Game with two cards

Such situations in real life occur in many different variations. A special offer in the supermarket, a nice apartment, an attractive job offer, or even the woman or man for life: One must so often decide without knowing whether something better is still to come.

To clear the view for the problem, we summarize the essence in terms of a little game: You ask your son and your daughter to write, each one secretly, and not consulting each other either, one arbitrary number on his/her card. You point out that "arbitrary" means really as they want: Large, small, negative, decimal point, everything is allowed. Then they place their cards, face down, on the table. You can now turn over the card of your son, inspect the number, and then decide whether you accept it. If you refuse it, then you receive automatically your daughter's card. Now both numbers are compared. If you have chosen the larger number you win, otherwise you lose.

The difference between these numbers is now without importance you just want to win. If the numbers happened to be the same, the game would be repeated, but this case is improbable. Further, if you think you may have some advantage from knowing your children well, you can imagine them being replaced by others. Alternatively, one person may also fill in both cards. This really looks now like a purified game of chance with win probability ½.

But now the surprise: There is a strategy with which you can increase your win probability above ½. It is based on an idea of Professor Thomas Cover (Stanford University). Let X and Y be the two different numbers on the cards.

Strategy: Think of an arbitrary number Z. Now uncover the first number, X, and choose this number if it is larger than Z, otherwise choose Y.

Why should this strange strategy be better than choosing X or Y at random?
Here is the proof:

Recall X is the first number, Y the second. Let Min=min{X, Y} be the smaller and Max=max{X,Y} the larger one. There are exactly three possibilities:

(A) Both numbers X and Y are not larger than Z,

Min — Max — Z

(B) Z lies between X and Y (possibly coinciding with the smaller one),

Min — Z — Max

(C) Both X and Y exceed Z.

Z — Min — Max

According to the strategy, you choose the number Y in case (A) and the number X in case (C). In these two cases you end up with a random choice between the larger and the smaller number, hence you win with probability ½. In case (B), however, you win with certainty, because if X is the larger of the two numbers you accept it, but if it is the smaller one, you refuse it. Thus your total win probability is now

$$w = a/2 + c/2 + b,$$

where a, b, and c denote the unknown probabilities of the events (A), (B) and (C) respectively. One of these events is bound to happen, of course, that is a+b+c=1, and hence

$$w = {}^{(a+b+c)}/_2 + {}^{b}/_2 = {}^{1}/_2 + {}^{b}/_2.$$

Thus the win probability exceeds equal chance by ${}^{b}/_2 > 0$, because (B) can occur.
[Remark: To make this precise it suffices to choose Z according to any density that is strictly positive everywhere on the real line.]

How can you apply this strategy most skilfully? Evidently you should try to make the case (B) as probable as possible. This means you should choose Z such that it has the largest possible probability of falling between X and Y. Since these two numbers are unknown, no general recommendation can be made. In concrete cases, however, one may quite well have some ideas.

Optimal choice of a threshold

Our house-selling problem is such a concrete case. On the first card is the offer of Mr. X and you will not know the number on the other card, the offer of Mrs. Y, when you must say Yes or No to Mr. X. The first difference to the card game with arbitrary numbers is that you know that both X and Y are above 800,000. The second difference is that the amount |X-Y| is now of real interest to you.

An offer of 900,000 Euro or more would be nice, but is not very likely. On the other hand, if you accepted Mr. X's offer of 801,000 Euro, say, then you would not suffer much regret if Mrs. Y would offer 802,000 Euro. There is no point in trying to hedge against a loss of too modest a magnitude. Therefore it may be best to choose Z clearly above 800,000 Euro, but then again not too large. If you asked me what I would do: I would toss a die and, for each eye of my result, add 5,000 Euro to the amount 800,500 Euro. So, for instance, if I obtained 3, I would choose Z=815,500. But, by all means, there is nothing special about this suggestion and you may be much happier with your own idea.

Why toss a die? Why not simply fix Z=820,000, say, if we feel this should be more or less in the right order of magnitude? Apart from our probability argument there is another reason: In such a game-theoretical situation, it is often better to be unpredictable. If we act in a predictable way, the other player may adjust his behaviour. Hence the introduction of a random component.

What is our strategy worth? - Definitely more than the random choice, as we have seen. We cannot really quantify the advantage compared with a random choice, but some additional 10,000 Euro or so may quite well be in it (in expectation.)

Let us go a step further and look again into our two-card game. Now you and I play the game. Suppose you are the one who writes the two numbers on the two cards and it is I who has to choose one. As before, I win if I choose the larger one. Suppose you would like to decrease my win probability. What should you do?

The answer is simple. You just choose two numbers that are very close to each other. Take 6.123455 and 6.123456, say. My advantage of using a Z-strategy is now hardly worth talking about because my chosen Z will have little chance of falling between these two numbers.

In real-world problems, things are often different, however. Real-world strategies are developed by one party and typically not communicated to the other party. What difference does this make?

To find this out, I made, several years ago, a test with Vesalius College business students. Everybody in the audience received two cards to write down his or her numbers, and then I passed from one to the other to make my choice. I had not mentioned Z-strategies before.

My score was 32 successes for 41 or 42 participants. With a random choice we would expect some 21, and some three or four more with a bit of luck. 32 however should not be explained by pure luck alone, as they knew. Even the best students were puzzled. It is difficult to see what one does not expect. But you, dear reader, you probably guess correctly: I had applied a Z-strategy, even a particularly naive one. I had chosen Z = 0.

Why was this so successful? – I think it was because I could prepare the field for the strategy: My remark "The numbers may also be negative" had seemingly succeeded in being sufficiently casual. The fact is that numerous students made use of negative numbers, and all those who had written down just *one* negative number made me automatically a winner.

This experiment shows that strategic thinking has no simple rules Some people preach that the key to success in strategic behaviour is always narrowing down the adversary's field of action. However, this is not true. If we believe that our adversary does not expect our strategy it can be unwise to narrow down the set of his or her options. The less one can do, the more one thinks about each step. Indeed, in our experiment, by allowing negative numbers we did not narrow down but actually enlarged the set of options for the students. This probably helped to distract from paying attention.

A few words about mathematics

You have just learned to know a little problem in a field of mathematics, which, compared to other fields, is still in its infancy: strategic thinking, as a part of probability theory. Even at this introductory level several questions are still open. For instance, does there exist a strategy for the two card game which is generally more efficient than a Z-strategy? - The proof of existence or non-existence would already be a true progress. However, at the current state of knowledge, I see no sufficiently safe foundation to attack such a proof, not even to make this question sufficiently precise.

Is it not truly surprising that nobody can optimise, in a strict mathematical meaning, the sale of a house to two potential buyers? Given that we see so many impressive things mathematics has achieved in our world, we would agree that it is, wouldn't we? Think of other optimisation problems from modern airplane engineering, for instance. Compared to such problems, our little problem seems ridiculously simple. However, this is not true. Airplane engineers have a huge time advantage: They can work, routinely, with many methods for which the mathematical foundations have been well established for two to three centuries. This is not the case for our little problem.

Such contrasts do exist in many fields of mathematics.

Is this a symptom of the eternal youth of a discipline?

Yes, I think it is.

Footnote: This is the author's English translation of his article *Der Ungewissheit ein Schnippchen schlagen* published in Spektrum der Wissenschaft (= German Edition of Scientific American). The latter was based on the author's *Unerwartete Strategien* published in Mitteilungen der Deutschen Mathematikervereinigung (German Mathematical Society.) The idea was instigated by Cover's Problem. (References below.)

Acknowledgement. The author would like to thank Professor Lundsgaard Hansen for his comments on the English version.

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Thomas M. Cover, *Problem 2.5 : Pick the largest number.* In: Open Problems in Communication and Computation, Springer Verlag, New York. (1987).

F. Thomas Bruss [tbruss@ulb.ac.be] studied Mathematics in Saarbrücken (FRG), Cambridge, and Sheffield (UK). He started his career as assistant and first assistant in Namur (B) from where he moved on to the United States, where he was Visiting Associate Professor at UC Santa Barbara, U of Arizona, and UCLA, successively. In 1990 he was appointed Professor at Vesalius College of the Vrije Universiteit Brussels. Since 1993 he is Professor of Mathematics and Statistics at the Université Libre de Bruxelles. His research is in probability: limit theorems, branching processes, probabilistic models, and optimal stopping. He is fellow of the Institute of Mathematical Statistics and Feodor-Lynen-fellow of the von-Humboldt Foundation.

Integrability of Hamiltonian Systems

Michèle Audin, Strasbourg

A satellite moves along its orbit around the Earth. A circular orbit, an apparently quiet revolution, nevertheless accompanied with various motions: the satellite oscillates, rotates, turns upside down.

The *attitude*, this is how physicists call these motions – motions that can obviously not be ignored. Let us pretend that the satellite decides (deplorable attitude) to turn its back to the Earth, the antennae and the cameras now looking at the other side.

This is obviously not what was intended when the satellite was put into orbit. It is thus necessary to know how to describe and control these changes in the attitude. Will the satellite always perform the same motion? Will it wriggle restlessly?

The mechanical system governing the motion of the satellite is a Hamiltonian system. The question I just asked can be made more precise and reformulated as *is this Hamiltonian system integrable?*. A theorem of Morales and Ramis can be applied to answer this question, using differential Galois theory. The aim of this article is to give an idea of the statement of this theorem and the ways to apply it.

Integrable systems

A *Hamiltonian system* is a mechanical system governed by the celebrated Hamilton equations

$$\begin{cases} \dot{q}_1 = \dfrac{\partial H}{\partial p_1}, \dots, \dot{q}_n = \dfrac{\partial H}{\partial p_n}, \\[2ex] \dot{p}_1 = -\dfrac{\partial H}{\partial q_1}, \dots, \dot{p}_n = -\dfrac{\partial H}{\partial q_n}. \end{cases}$$

The total energy H of such a system, a function of $q_1, \dots, q_n$ (think of positions) and $p_1, \dots, p_n$ (think of momenta), is constant, and it does not depend on time. It happens that other quantities are conserved as well. They are called *first integrals*.

If there are enough first integrals (and if they commute, in a sense that I will not make more precise here), Liouville showed, in the 19-th century, that the differential system (Hamilton equations) can be solved by quadratures (computing integrals); this is why the system is said to be integrable.

Examples

There are many well known mechanical systems that are integrable.

Let us carry out an entertaining experiment. Rather than putting a satellite in orbit (which is complicated and expensive), we just play with a spinning top. And we observe it spinning, looking carefully at the motion of the end of its axis.

For those of you who do not have a spinning top at home, Figures 1 and 2 show the object and the result of the experiment. The top is considered as a rigid body with a fixed point (the point O at which it meets the horizontal plane) in a constant (vertical) gravitational field. The rigid body has an axis of revolution in this case, so that, in addition to the total energy, the momentum with respect to this axis is a first integral. The end of the axis oscillates between two parallel circles on an (ideal) sphere.

Here is another easy experiment. We fix a ball at an end of a rod, the other end of which is fixed: what we get is a pendulum, usually called a *spherical pendulum*. Here again, the only force present is the gravitation. The momentum with respect to the vertical (direction of the gravitation field) is a first integral. The ball turns, stuck between two parallel circles on a sphere, as shown on Figure 4.

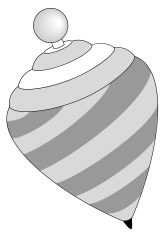


Figure 1: A spinning top

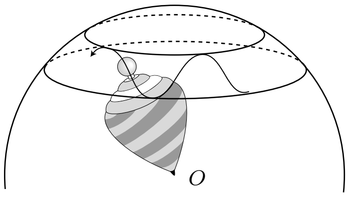


Figure 2: The end of the axis

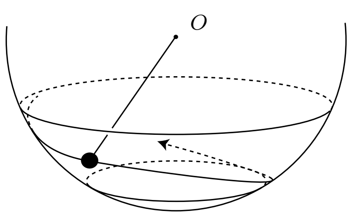


Figure 3: A spherical pendulum

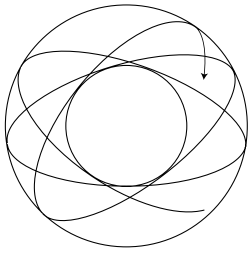


Figure 4: A trajectory of the spherical pendulum (from above)

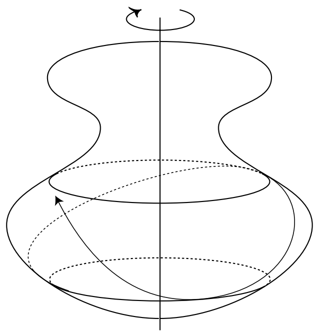


Figure 5: A geodesic on a surface of revolution

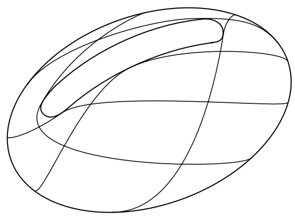


Figure 6: A geodesic on an ellipsoid

You may have noticed the similarities between these two experiments. A similar behaviour (oscillations in a band) can be observed in many other mechanical problems, as, for instance, the motion of a free particle on a surface of revolution or an ellipsoid. A free particle goes the shortest way – this is why the solutions are the geodesics on the surface. Figures 5-6 represent a geodesic on a surface of revolution and of an ellipsoid (respectively). In the case of the surface of revolution, the momentum of the particle with respect to the axis of revolution is a first integral. For a generic ellipsoid there is also a first integral, although this is less obvious (this is due to Jacobi).

A geometrical or dynamical expression of Liouville integrability (as defined above) is the regularity of the solutions. The motion described by an integrable Hamiltonian system is very regular, the trajectories wind on tori (this is part of the Arnold-Liouville theorem), each visiting regularly a neighbourhood of its initial point, and the motion is said to be *quasi-periodic*.

Figure 7 shows a quasi-periodic motion that is drawn in the configuration space (an annulus, on the sheet of paper), or in phase space (in more dimensions, on a torus) that looks very much like the previous ones. The Arnold-Liouville theorem is more precise – it states that these trajectories are *linear* in the sense of the affine structure of the torus, as shown in Figure 8.

Are all Hamiltonian systems integrable?

As we have seen, physics can provide first integrals as the momentum with respect to an axis of revolution (this is what happens for a spinning top, a spherical pendulum, a free particle on a surface of revolution, ...)

There are also many Hamiltonian systems that are *not* integrable. The most famous is the *three-body problem* dealing with three bodies (Sun-Earth-Moon) in gravitational interaction. It is known that the two-body problem (Sun-Earth) is integrable. It was actually to integrate this problem that Lagrange introduced the beginnings of symplectic geometry and Hamiltonian mechanics. Poincaré showed that the three-body problem could not have enough first integrals (*analytic* in positions and momenta).

The method I explain here allows us to prove that this is still true if we accept poles – namely, *meromorphic* first integrals.

Some Hamiltonian systems are suspected to be non-integrable because we have not been able to find enough first integrals and, more seriously, because some experiments or numerical simulations show a chaotic behaviour that seems to be incompatible with the Arnold-Liouville theorem. This is the case for the *Hénon-Heiles* system:

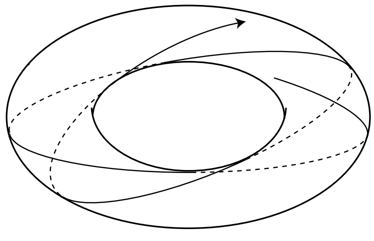


Figure 7: Trajectory on an annulus

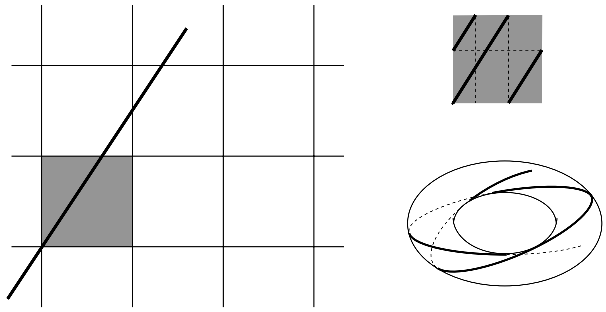


Figure 8: Linear trajectories on a torus

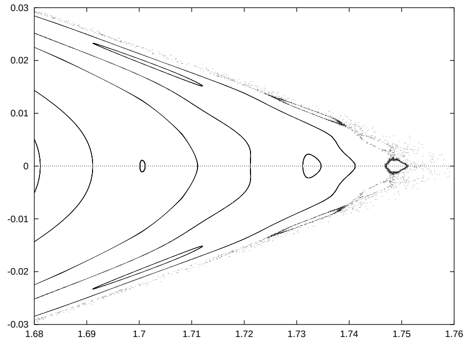


Figure 9: Chaotic behaviour of the Hénon-Heiles system

The Hénon-Heiles system is the Hamiltonian system defined by the Hamiltonian

$$H = \frac{1}{2}(p_1^2 + p_2^2) + \frac{1}{2}(Aq_1^2 + Bq_2^2) - q_1^2 q_2 - \frac{1}{3}\lambda q_2^3,$$

where A, B and λ are parameters. It is known to be integrable for some values of these parameters. Figure 9 comes from Morales' book and is supposed to illustrate the chaotic behaviour of this system. It shows part of the dynamics (the dynamics of the Poincaré map, to be precise) for the parameters $A = B = 0$ and $\lambda = 3/2$: it seems to indicate that the system is not integrable in this case. Using the method I am going to explain, it is possible to prove that, in general, the Hénon-Heiles system is *not* integrable.

And the attitude? Is the attitude of a satellite an integrable system?

The Galois group, an obstruction to integrability

Following a tradition that goes back, at least, to the *Mécanique céleste* of Poincaré, let us consider the *variational equation*, a linear differential equation that describes the solutions that are *infinitesimally close* to a given solution.

We assume that we know a solution $x(t)$ of the Hamiltonian system. Let $y(t)$ be another solution, that is very close to $x(t)$. Then we can write $y(t) = x(t) + Y(t)$ and, up to order 1, our Hamiltonian system becomes *linear* in Y:

$$\begin{aligned} \dot{Y} &= \dot{y} - \dot{x} \\ &= X(y(t)) - X(x(t)) \\ &= (dX)_{x(t)}(Y(t)), \text{ up to order } 1. \end{aligned}$$

This *linear* differential equation in Y is the *variational equation*.

The Hénon-Heiles example

In the simple case of the Hénon-Heiles system for $A = B = 0$ and $\lambda = 0$, the Hamiltonian is

$$H = \frac{1}{2}(p_1^2 + p_2^2) - q_2 q_1^2.$$

The Hamiltonian system is

$$\begin{cases} \dot{q}_1 = p_1, & \dot{q}_2 = p_2 \\ \dot{p}_1 = 2q_1 q_2, & \dot{p}_2 = q_1^2. \end{cases}$$

It is quite easy to find solutions (this is an academic example!). We choose a trajectory that is a straight line:

$$\begin{cases} q_1 = 0, & p_1 = 0, \\ q_2(t) = at - b, & p_2(t) = a \end{cases}$$

for some constants a and b. The variational equation along one of these solutions is the linear differential system

$$\begin{cases} \dot{Q}_1 = P_1, & \dot{Q}_2 = P_2, \\ \\ \dot{P}_1 = 2q_2(t)Q_1, & \dot{P}_2 = 0. \end{cases}$$

We look only at the solutions for which $Q_2 = P_2 = 0$. The linear system $\dot{Q}_1 = P_1$, $\dot{P}_1 = 2q_2(t)Q_1$ is equivalent to the differential equation

$$\ddot{Q} - 2(at - b)Q = 0.$$

This is an Airy equation, the solutions of which, the *Airy functions*, are analytic on the whole complex line, but no solution of which is a rational function or even an algebraic function. For those who like formulas, Airy functions can be written

$$Q(t) = \int_0^\infty \cos(x^3 \pm xt)dx.$$

Differential Galois theory – in about 195 words!

The situation of a linear differential equation with polynomial coefficients, whose solutions are not rational, is reminiscent of the situation of an algebraic equation with rational coefficients and irrational roots.

The base field is the field of meromorphic functions on our trajectory – this is the field $\mathbf{C}(t)$ in the example of Airy. With the linear differential equation is associated a smallest differential field which contains all the solutions of the linear equation (the Picard-Vessiot extension, the differential analogue of the splitting field of an algebraic equation). The differential Galois group is its group of automorphisms. The set of solutions of a linear differential equation is a vector space on which the Galois group acts as a subgroup of the corresponding linear group in the same way as the Galois group of an algebraic equation is a subgroup of the symmetric group, which acts by permutation of the roots. According to a theorem of Kolchin, the differential Galois group is an algebraic group.

In the Airy example, the solutions (and, more precisely, their behaviour at infinity) are intricate enough for the

Galois group to be really huge: it is the entire group $SL(2;\mathbf{C})$.

The Morales-Ramis theorem

The Galois group is the main character of a non-integrability theorem due to Morales and Ramis, in a tradition that goes back to Kowalevskaya, Poincaré, Painlevé and, more recently, Ziglin. This theorem can be considered as an analogue of the theorem on the solvability of equations by radicals. It asserts that *if a Hamiltonian system is integrable, then the Galois group of the variational equation along any trajectory must be almost Abelian* (in the sense that its neutral component is an Abelian group). Notice that, if we neglect finite groups, this is a stronger property than being solvable. Notice also that this theorem, although it gives a very powerful tool for proving non-integrability, is much easier to prove than the algebraic analogue: being an algebraic group, the Galois group can be attacked with infinitesimal tools – the statement is actually that its Lie algebra must be Abelian.

Conclusion

In concrete terms (if I dare say it): you choose a solution, you linearise the system along it, and you compute the Galois group. If it is not (almost) Abelian, your original system was not integrable. Notice that you should have found a solution, that is both simple enough so that you are able to compute the Galois group, and complicated enough so that the latter is not (almost) Abelian.

Applications

Nevertheless, this theorem does have numerous applications; for instance: In the simple case of the Hénon-Heiles example ($A = B = \lambda = 0$), we have seen that the Galois group is $SL(2;\mathbf{C})$. This group is *not* almost Abelian, and hence the system cannot be integrable. However the case $A = B = 0, \lambda = \frac{3}{2}$ illustrated in Figure 9 is still open. A non-symmetric spinning top cannot lead to an integrable system either.

Morales and Ramis have many applications, some of which can be found in Morales' book (cf. reference below).

The satellite

The main difficulty is not to find a particular solution to start with. The Galois group is an algebraic subgroup of the linear group $GL(2n;\mathbf{C})$, where n is the number of degrees of freedom of the system. This number is 2 in most of the examples considered here, which gives a subgroup of $GL(4;\mathbf{C})$. Using the fact that the Hamiltonian is a first integral, this can be reduced to a subgroup of $SL(2;\mathbf{C})$, which allows us to compute it.

However, the attitude of the satellite in a circular orbit is a system with 3 degrees of freedom, so that, after reduction, we still have a subgroup of $SL(4;\mathbf{C})$. This is too big: recall that the group needs only to be *almost Abelian*, so that it is not enough to find two elements that do not commute. With the help of computer algebra (resp. an additional geometric argument), Delphine Boucher (resp. the author of the present paper) were able to prove, in 2003, that the attitude is not integrable.

This does not prevent the satellite SPOT to take its beautiful pictures of the Earth (free advertisement!), since, as the orbits, the attitudes can be corrected.

The end

The first approach to non-integrability goes back to S. Kowalevskaya in 1889. She was investigating the integrability of the rigid body with a fixed point. She asked herself under which assumptions the solutions of the system would all be *meromorphic* functions of the time variable – this is called the *Painlevé test* – that is, their only singularities are poles (no ramification, no logarithm, etc).

She proved that this property is satisfied in only three cases: when the fixed point is the centre of gravity, when the rigid body has an axis of revolution (in these two cases, the system was known to be integrable), and in a new case (now called the *Kowalevskaya top*). She was in fact able to find an additional first integral in this last case too.

The relation between integrability (in the Liouville sense) and the softness of the singularities of the solutions is still not completely clear. The methods of differential algebra used here give precisely such a relation, up to order 1.

Acknowledgments

The spinning top in Figures 1 and 2 was originally drawn by Raymond Seroul. Figure 9 was given to me by Juan Morales. I thank them, together with Étienne Ghys who is responsible for the fact that I wrote the first version of this paper, with the anonymous referees he used to help me improving it, and with Martin Raussen and Robin Wilson for their help with the present version.

Michèle Audin [Michele.Audin@math.u-strabg.fr] studied mathematics in Paris and Orsay. She has been a professor at Université Louis Pasteur (Strasbourg, France) since 1987. Her research is in geometry and topology, especially on the geometry of integrable systems. She is the author of several research and student textbooks.

A few references

Details, information and references are given in:

- Juan Morales' book, *Differential Galois theory and non-integrability of Hamiltonian systems*, Progress in Math., Birkhäuser, 1999;
- the author's book, *Les systèmes hamiltoniens et leur intégrabilité*, Cours Spécialisés, 8, Société Mathématique de France & EDP Sciences, 2001;
- the references in these two books, and more recent references in other papers of the author are listed on the website: `http:www-irma.u-strasbg.fr/~maudin`.

Kolmogorov and Contemporary Mathematics

International Conference, Moscow 2003

Address at the Opening Ceremony

Beno Eckmann (ETH Zürich)

I heard the name *Kolmogorov* for the first time around 1936, when I was a beginning mathematics student. Here is the story. In a course by *George Polya* ('Aufgaben und Lehrsätze'), there were nice and amusing applications of probability, including his favourite topic 'random walks'. But we were unhappy with the so-called definitions of the probability concept. For Polya, intuition and application were more important.

Michel Plancherel ('Plancherel formula'), who was also one of our professors, told us to consult the 1933 *Ergebnisse* book by a certain Russian named Kolmogorov, where the concept of probability was put on a final rigorous axiomatic basis.

I still remember it like today: it was sensational, dramatic and enlightening. I am not certain that Plancherel really liked the new type of abstraction. He was more impressed by a very early construction from 1923 of Kolmogorov, a Lebesgue-Fourier series diverging almost everywhere; he did not tell us that the author was not even 20 when he wrote that paper! But we, the young ones, were happy, and the logical foundation of probability from 1933 was crystal-clear, abstract, and at the same time relating everything to the standard terminology and to concrete applications. We just liked the new trend of axiomatic abstraction. As for the name Kolmogorov, it also was quite abstract for us - just a name.

In 1939, I got in real contact with Kolmogorov when I began my Ph D. work in topology under *Heinz Hopf* ('Hopf algebras' and 'Hopf fiberings'); not in personal contact, of course, but Hopf told me about the famous topology conference in Moscow in 1935. At that conference, Kolmogorov had introduced a very important new concept (independently of J. W. Alexander) – namely, cohomology: homology is due to Poincaré (around 1900), and cohomology is its dual. Topologists had not expected a product structure for arbitrary complexes. They had been convinced that a ring structure is possible only for manifolds. Well, cohomology in very different appearances has been taken over by so many people, more and more in close connection with algebra, functional analysis, measure theory and so on: it is no longer known in general that the concept goes back to Kolmogorov. Although my thesis was about homotopy, cohomology became one of my favourite research topics and remains so.

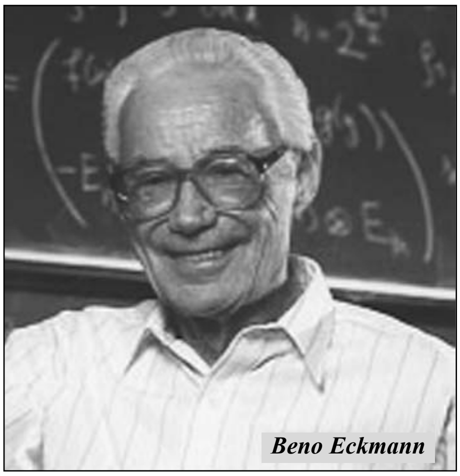
Could this be the same person as the probabilist? Believe it or not, Hopf said, it was! Not only that; he told me about a young man, remarkable in every respect, of unusual physical strength, climbing mountains of over 4,000 metres altitude, skiing enormous distances, swimming in ice-cold water - almost like Paul Aleksandrov. Aleksandrov was a very good friend of Heinz Hopf; their joint book on topology is well-known.

During these early years Kolmogorov made many other important contributions to algebraic topology, for various types of spaces. At that time few could anticipate the importance that topological ideas and all their ramifications would gain during the century – but Kolmogorov did! Thus we have to admire the really independent mind of this young man, independent of fashion. In that part of the century, it was fashionable to work on Hilbert's problems. Surely he did that too, in the axiomatisation of the applied field probability. In that context, let me remark that algebraic topology (homology, analysis situs) is not even mentioned in Hilbert's famous list of 1900: it was not considered to be a respectable field for a long time. I heard this much later from *Hermann Weyl,* who told me that he had published two papers on algebraic topology in Spanish around 1925 in a South American Journal, because he did not want his colleagues to read them!

Clearly I wanted to meet this man Kolmogorov. But there was World War II and then the Cold War. Communication by letter was slow if not impossible, and contacts were limited. Finally, I met Kolmogorov in 1954; he gave the famous plenary lecture at the International Congress in Amsterdam - about dynamical systems, the beginning of what would later become KAM theory. As for myself, surely enough, I lectured about the cohomology of groups.

Now things continue in much the same way: At the next International Congress 1958 in Edinburgh I heard Kolmogorov lecture, this time about functional analysis (just a short communication), at the 1962 Congress in Stockholm about optimal approximation of functions, and so on. No need to continue, you all know what I want to say: I was lucky to know Kolmogorov and to see him develop into one of the truly universal mathematicians of our time, covering all fields (with the exception of number theory, as far as I know), original, creative, deep and broad.

Contacts with Russia became easier during the years 1956-61 when I was secretary of the International Mathematical Union. It was the time when we succeeded in making the Union truly international, in spite of great political difficulties. All Eastern European countries and also China became members. Paul Aleksandrov was appointed as a new member of the Executive Committee of IMU. I would have preferred Kolmogorov, but I understood that he was apolitical in every respect. Of course we liked Paul Aleksandrov; he told us many stories about his friend Kolmogorov - for example, about



Beno Eckmann

their long voyage for several months on the Volga and beyond in 1929 – what impressed me tremendously was the fact that Andrei took with him on that long trip, apart from mathematics books, the Odyssey! The better I got to know Kolmogorov, the more I realised that his cultural universality went far beyond mathematics, into logic and foundations, into arts, poetry, history and education. His human and humanistic universality enabled him to be an extraordinary teacher.

His students are here, they can tell about that better than I can. He inspired them to do mathematics according to its true nature and unity: abstract, valid within its strict context, universal, and (precisely for that reason) eminently practical.

With the passing of each human being a mystery disappears from the world, a mystery that nobody else will be able to rediscover [Friedrich Hebbel]. Words, and certainly my words, are inadequate to describe the mystery of Andrei Kolmogorov. With regard to our common profession we learn from him that mathematics is a manifestation of the free creative power of the human mind and the organ for understanding the world through theoretical construction. And that it is part of the cultural tradition we have to transmit to the next generation.

To achieve more we dare not hope, to achieve less, we must not try. We are grateful to Andrei Kolmogorov for his outstanding contributions towards this goal.

The centenary of Andrei N. Kolmogorov's birth has already been commemorated in the Newsletter *with an article by N. H. Bingman and an address by EMS president Sir John Kingman in issue 49.*

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A.N. Kolmogorov *P Aleksandrov*

Proof on Broadway, Preuve à Bruxelles

Luc Lemaire, Bruxelles

In August 2001, I attended in New York a performance of ‘Proof’, by David Auburn, and also read the text of the play.

It was a huge success, got the author an avalanche of awards (including a Pulitzer prize) and ran for more than three years on Broadway. A film version is now in preparation.

Quite enthusiastic about it, I wrote a review for the EMS Newsletter (Issue 44, June 2002, p.22).

In June 2002, the theatre ‘Le Rideau de Bruxelles’ announced that they would translate and produce the play in French in September. On an impulse, I wrote to the directors of the theatre (whom I didn’t know at all), congratulating them on their initiative, adding some explanations about the obvious sources of inspiration of the author (Nash’s life, Wiles’s proof of Fermat’s last theorem...) and offering assistance in case they had any mathematical question.

I don’t know if I really expected an answer, but as it happened they invited me to a number of meetings with everyone involved in the play, asked me to check the translation of the (short, but absolutely correct) mathematical parts of the play, to contribute a four pages interview on mathematics and mathematicians for the programme, and even to produce some attractive cohomology sequences as background for the pages.

This was an extremely interesting and enjoyable interaction, for many reasons. One of the characters of the play, Robert, is inspired by the life of Nash: a genius who suffered a dramatic mental breakdown at 30, stopping short his remarkable development. His daughter Catherine (in the play) is the main character, and wonders if she might have inherited his mathematical power or maybe his mental fragility. The other two characters are Hal, a former student of Robert currently teaching in a mathematics department, and Claire, Catherine’s sister, a financial analyst meant to give a totally external vision of society on the group of academic mathematicians. The reference to Robert’s mental illness gave to the theatre people the idea that a mathematician was necessarily skating on a thin line between genius and madness.

During my first visit to the theatre, it was clear that each member of the staff present in the building on that day found a (weak) excuse to enter the room where I was to have a good look at me.

When I met the director of the play and the actors, they started the ball rolling by explaining candidly that having read the play they wanted “to see and possibly to touch a mathematician in the flesh”. Then to see how I would react, one actor asked me what the play was really about, “since everything to know is known in mathematics”. Although he did it very well (he is an actor!) the trick did not work and they passed to other questions.

After four hours of discussion, I like to believe that they concluded a mathematician could be pretty normal after all.

Their questions were interesting and could give us some idea of what we should explain when attempting to popularise mathematics.

Since part of the play is about a long proof, they wanted to understand what a proof is, how it looks like, in particular what the proof of Fermat’s last theorem could involve when the statement consists only of long multiplications and additions (not an easy question).

The play describes briefly the way mathematicians attack a problem - by different angles, by intuition, and not at that stage by logical deductions.

This is very well shown in Simon Singh’s television programme Fermat’s Last Theorem, Horizon, BBC, 1996, which gave a good insight to the actors and the director.

The image usually given of mathematics is the final presentation: definitions, statements and deductive proofs. We must realise that this hides the most attractive part of mathematical work - namely the non-deductive and non-logical search for the solution of a problem. After some time, the theatre people could talk ad lib on the common features of artistic and mathematical creation. Although it is clear they need not understand any of the mathematics to impersonate the characters, they wanted to - one of them came the first day with some pages of computations to understand which primes would be Germain numbers. But mostly they wanted to understand the characters of the play, and were genuinely interested in our lives, problems and motivations.

from ‘Preuve’ at Bruxelles

In September, I went back to the theatre to discover that the director Jonathan Fox, the actresses Valérie Marchant (Catherine), Isabelle Defossé (Claire) and actors Alexandre von Sivers (Robert) and Philippe Allard (Hal) had come up with tremendously good performance (which obtained the deserved success of having the room packed every night and going for a second season).

It was my turn to learn something new, about theatre. Indeed, having read the play and attended one performance already, I realised more than before the differences that can be made in a play by the direction, the scenography and the acting. Many ideas (different in Brussels and New York) were brought in (without adding any line to the text), and since I actually saw the play three more times, I could see it evolve as more ideas were introduced. It was of course a new experience for me to attend the same play a number of times over two years. Likewise, seeing successive versions of the excellent translation by Isabelle Anckaert showed me an approximation process, in which some ideas current in the US do not quite apply in Europe and have to be well presented through the translation.

But the story doesn’t stop there. Indeed, it was quickly agreed that before one performance of the play, the director Jonathan Fox and I would make a joint presentation, mostly to high school students, of aspects of the play from the point of view of theatre work and mathematics. We planned for one such presentation - but ended with more than ten over two seasons.

This gave me the opportunity to speak about Nash and Fermat - but more to the point about the existence of mathematical research, its enjoyment, the possible careers, to around 1500 high school students, a rare opportunity. And by the way, this generation of students who are now 17 years old mostly does not know about that old event - the proof of Fermat’s theorem way back in 1994. When we think of information and popularisation of mathematics to a young audience of potential mathematicians, we must remember they keep changing and information does not percolate through more than a couple of years.

To conclude, if you ever get an impulse of writing a letter about mathematics on such an occasion, do it, by all means, and you are liable to meet other people of unbounded enthusiasm.

Interview with Solomon Marcus

Interviewer: Madalina Berinde
(University of Cluj-Napoca, Romania)

Solomon Marcus

"The mathematical way of thinking is useful in any profession"

Beginning with your school years, one can see you have been in love with all kinds of human knowledge. Why then did you choose to enter the Faculty of Mathematics?

I discovered mathematics very late, just in the summer before going to University. I happened to read something about non-Euclidean geometry, and I was fascinated by the contrast between this and the intuitive perception of the world. I also became impressed by the infinity of the sequence of natural numbers, a fact that for me became an object of contemplation and continuous reflection. Philosophy was a possible choice to satisfy this curiosity, but I soon realized that only mathematics could give me the feeling of certainty I was looking for.

In the fall of 1944 I left the city of Bacau, where I had spent my first 19 years, and I came to Bucharest where I paid a visit to the Mathematics Section of the Faculty of Science. I was impressed by announcements including magic words such as 'infinitesimal calculus' and 'transfinite cardinal and ordinal numbers'. I took a provisional decision to try mathematics. The first class I attended was, fortunately, with a professor who decided not only my preference for mathematics, but also my way of life, to be devoted to mathematical research. His name was Miron Nicolescu. He was born exactly hundred years ago, in 1903, and meeting him was a great chance. But he was not the only one to have a decisive impact on me. Simion Stoilow, Gheorghe Vranceanu, Dan Barbilian, Octav Onicescu, Alexandru Froda, Grigore C. Moisil, Alexandru Ghika and other professors gave me many intellectual satisfactions and I often wrote about their personalities; see for instance my book 'From Romanian Mathematical Thinking' (in Romanian, 1975), 'Simion Stoilow' (in collaboration with Cabiria Andreian; in Romanian, 1982) and my articles in 'Academica', the journal of the Romanian Academy.

Trying to explain my option for mathematics, I think that my motivation in 1944 was that in mathematics the effort of memory is minimal, while the feeling of certainty is maximal. No other discipline can challenge mathematics in this respect. This was my thinking in 1944 and it is still so in 2003.

As anyone can see, the unnatural conflict between science, especially mathematics, and the humanities is something very common, at least at pre-university level education. Is there anything to be done in this respect?

When, as a university student, I began to discover the real face of mathematics and when I realized how high-school mathematics transforms mathematics into a caricature of itself, I decided that the fight for a fundamental change in mathematical education would be one of the aims of my life. I devoted several books and tens of articles to this topic, as can be seen in my C.V. (http://funinf.cs.unibuc.ro/~marcus).

The main shortcomings of school mathematical education are: the absence of ideas, replaced by procedures; the lack of motivation in the way notions are introduced, problems are selected and theorems are proved; insufficient attention paid to historical aspects; exclusive attention to formal correctness, lack of attention for understanding, for meaning, for 'why' questions; a very poor link to other disciplines taught in high school; curriculum and text books two or three times larger than what could be effectively assimilated by normal students; insufficient use of the ludic aspects of mathematics; insufficient correlation with computer science; insufficient attention to the mathematical way of thinking and to its relevance in the everyday life.

As a consequence of all the aspects above, mathematics is not attractive for most high school students. Moreover, it is not perceived as a cultural enterprise. Goethe's remark "Mathematicians are like French people. You tell them something, they translate it into their language and you no longer recognize what you told them." is still valid. Most intellectuals remember from school mathematics nothing more than the four fundamental operations with positive integers. On the other hand, the trend of school mathematics to exaggerate the use of symbols, at the expense of natural language, increases the gap between mathematical correctness and mathematical meaning. We need a complete change of school mathematical curriculum and school mathematical textbooks (which, in their present form, are used more by teachers and less by students, at least in Romania). But mathematical education should be revised not only with respect to school. All professions need a mathematical training related to their way of thinking and a mathematical background. Mathematics has a kind of universality and any form of education should exploit this fact. Combinatorial thinking, recursive thinking, algorithmic thinking, step-by-step thinking, deductive thinking, inductive thinking, thinking by analogies, probabilistic thinking are only a part of the many types of mathematical thinking. They are essential not only in mathematics, not only in science, but also in all aspects of life, even in the absence of mathematical jargon.

Tens of books, articles and delicious radio conferences prove your interest in making science accessible to everyone. The importance of popularising science, particularly mathematics, has been outlined often in the last years. Are the young generations of scientists aware of this? Are they prepared to face the difficulties of such a task?

My aim is neither 'making science accessible to everyone', nor 'popularising science, particularly mathematics'. Such slogans are misleading, they may suggest that mathematicians deliberately encode their message in a way that is not available for everyone, and then we need translators of mathematicians' messages into ordinary language. As a matter of fact, there is a trend of snobbery in some cases - of schizophrenia in other cases - pushing some authors to an excessive use of symbolism (Errett Bishop had an article entitled 'The schizophrenia of contemporary mathematics'). The exacerbation of the syntactic component of mathematical language at the expense of its semantic component is an important concern of mathematical education today – remember Goethe's remark that I have already mentioned.

My main interest in addressing people with respect to mathematics is to point out the cultural aspect of mathematics, its genuine link with other fields of culture, be they scientific, artistic or philosophical. It seems to me that one of the main reasons why mathematical education fails in fulfilling its task and makes of it, for most people, an unattractive topic, is the absence of a bridge to the universe of other disciplines and to human life as such. I will give some examples. Are we able to explain to high school students in what the mathematical way of thinking consists and how it is involved in everyday life? Can we show the relevance of mathematical thinking outside mathematics? This means, among other things, to be able to separate mathematical thinking from mathematical symbolism, although this separation is possible only within certain limits; to give examples of the use of mathematical symbolism devoid of mathematical thinking and examples of mathematical thinking in the absence of mathematical symbolism; to show, by relevant examples, how mathematical symbolism is born just from the need to develop the mathematical way of thinking.

This is exactly the direction in which mathematical education fails, and this fact explains why most intellectuals relate mathematics not to human thinking, but to formulas whose relevance, outside mathematics, is zero. Mathematics is a potential bridge between different disciplines; this means it can be such a bridge to the extent to which mathematical education succeeds to prove it, to make it effective. The logarithmic, the exponential and the polynomial functions cover a large variety of processes in physics, chemistry, geology, biology, psychology, linguistics and social sciences; do high school students have the chance and the pleasure to contemplate the way mathematics brings such heterogeneous phenomena into a unique framework? The answer is unfortunately negative.

Research takes a lot of effort and time, and scientists gifted in so many fields as you are still rare. Should popularising mathematics or the history of mathematics, for example, remain the complementary occupation of pure mathematicians, or should special attention be paid to forming young scientists willing to take on this job?

There are now, mainly in Western countries, scientific journalists, specialized in the popularisation of science. They have a special gift to transform the scientific enterprise into a story, a narrative structure that sometimes takes the form of a detective story. It happens that such journalists are sometimes (ex) successful researchers. I appreciate their work, but I don't think that this is the main way to approach the dichotomy proper mathematics - popularised mathematics. Irrespective of its level, good mathematics should include a cultural dimension, referring to the ideas, the motivation, its relevance to other fields, the aesthetic aspect, a philosophical aspect, and an historical aspect. But this cultural dimension should not be something added artificially, as a compensation of the aridity of mathematical formalism; it should be organically related to this formalism and essentially required by the text. Ideas, motivation, historical, cultural and philosophical context, relations to other fields, aesthetical dimensions should belong to the process of understanding, so much neglected. If things are separated, if real mathematicians are only those who make long calculations and manipulations of formulas, while popularisation mathematicians are those who learn how to package already existing mathematics, then people get a distorted image of mathematics.

Mathematical education will succeed as a cultural enterprise only when people discover in it something to enjoy, to play with, to contemplate, to relate to their way of seeing the world and of considering their life. Mathematics was traditionally taught by ignoring the evolutionary aspect and the historical context. The trend of contemporary mathematical textbooks is to reduce the proportion of ordinary language, by replacing it with formulas. The habit of leaving to the historian, to the populariser, the task of humanizing mathematics is the wrong strategy. In Romania, a typical example of a person who successfully transformed many mathematical enterprises into literary stories was Florica T. Campan. Authors of this type have a role that should not be underestimated. However, the general problem of mathematical education is to train teachers who are able not only to develop syntactic abilities, but also to bridge mathematics with understanding, with natural and social sciences, with philosophy and art, and to form the mathematical way of thinking as a tool occurring in any possible field.

Many years ago, a great mathematician, Alexander Grothendieck, published an article arguing for the need to separate the profession of the university researcher and that of the university teacher. One can understand that, to the extent to which we need more and more university teachers in mathematics, we are obliged to accept as teachers not only those with a real gift to perform research, but also persons who learned much mathematics and are able to transmit it to young generations. But good teaching is not equivalent to popularisation, except in the case when clear presentation is considered as popularisation. A good teacher is a kind of actor, he simulates that he is discovering spontaneously the things he is teaching, despite the fact that he has already taught them about hundred times before. Indeed, it may happen that some university teachers are not that successful in doing research. But, in order to succeed in teaching, it is obligatory to adopt a research attitude with respect to what you are teaching.

Last but not least: It is obvious for anybody seeing the lists of your publications that you are a kind of scientific monster. How was that possible? Are there other ways in which you express your delight towards the seen and unseen world, besides writing and lecturing?

I am far from being as productive as you suggest. My younger colleague Gheorghe Paun, who is also my former student and PhD student, is more productive and, what is very important, highly appreciated by the international community in the field of mathematical computer science, as a pioneer of several fields in this area, the most recent being membrane computing.

Before writing and lecturing, my first job and first source of pleasure and satisfaction is reading and studying. It often happens to me that I regret that I cannot leave aside writing when I am pressed to write something in order to conform to a deadline. I would rather spend all my time reading so many interesting things spread in books, journals, the internet etc. However, I always read with pen and paper in front of me, because I need to react to what I am reading and these reactions sometimes take the form of an article. So, reading and writing stimulate each other, they need each other, and each of them develops at the expense of the other. But reading does not refer only to the field of my research interests. I read not only mathematics; I also read philosophy, literature, social sciences, natural sciences, practically everything.

My belief is that apparently heterogeneous fields strongly interact, there is a unity of human knowledge and human creativity; if you don't take into consideration this fact, you risk getting a fragmentary representation of reality. I can illustrate this fact by some examples. For instance, it is interesting to observe how a mathematical object such as the Möbius strip in the last decades became a basic point of reference in anthropology (Claude Levi-Strauss), in art (M. C. Escher), in biology (Jesper Hoffmeyer) and in many other fields. It is also interesting to observe the spread of the metaphors related to Mandelbrot's fractal geometry in all directions. Gödel's incompleteness theorem is another universal paradigm characteristic for post-modern culture.

To be a mathematician today is a very demanding job and we should try to impart this feeling to the young generations. In particular, we are obliged to explain the way in which mathematical thinking is universal and, as a consequence, very useful for anybody, irrespective of their professional interests. Mathematics is a part of the cultural heritage of mankind.

SHORT BIOGRAPHICAL NOTE

Professor Solomon Marcus was born on the 1st of March 1925, in Bacau, Romania. Elementary school and high school in Bacau. Graduation (1949) and PhD (1956) in Mathematics, University of Bucharest, Romania. Assistant, lecturer, associate and full professor in Mathematics, University of Bucharest; emeritus professor 1991. Corresponding member (1993) and full member (2001) of the Romanian Academy. Research and teaching in mathematics, linguistics, computer science, semiotics, mathematical and computational linguistics and poetics, history and philosophy of science. One of the initiators of mathematical linguistics and poetics. Author of about 30 volumes and more than 400 research papers. Hundreds of invited lectures in universities of most of the European countries, in America, Asia and Oceania.

Notes

[1] Simion Stoilow (1887-1961), Romanian mathematician (analysis and function theory), Professor at the University of Bucharest; Member of the Romanian Academy

[2] Miron Nicolescu (1903-1975), Romanian mathematician (analysis and function theory), Professor at the University of Bucharest, Member of the Romanian Academy, President of the Romanian Academy (1966-1975), Director of the Institute of Mathematics of the Romanian Academy (1963-1973)

[3] Gheorghe Vranceanu (1900-1979), Romanian mathematician (differential geometry and topology), Professor at the University of Bucharest, Member of the Romanian Academy

[4] Dan Barbilian (1895-1961), Romanian mathematician (number theory and algebra), Professor at the University of Bucharest, also an appreciated Romanian poet by the name of Ion Barb

[5] Octav Onicescu (1892-1983), Romanian mathematician (probability theory, mechanics), Professor at the University of Bucharest, Member of the Romanian Academy

[6] Alexandru Froda (1894-1973), Romanian mathematician (real analysis), Professor at the University of Bucharest

[7] Grigore Moisil (1906-1973), Romanian mathematician (both pure and applied mathematics), Professor at the University of Bucharest, Member of the Romanian Academy, one of the promoters of computer science in Romania

[8] Alexandru Ghika (1902-1964), Romanian mathematician (analysis and function theory), Professor at the University of Bucharest, Member of the Romanian Academy

[9] Cabiria Andreian-Cazacu (1928-), Romanian mathematician (complex analysis), Professor at the University of Bucharest

Interviewer's note:

Interviewing an outstanding personality of the Romanian scientific scenery is an honour and a big challenge for anybody; in particular, when the personality in question is Prof. Solomon Marcus. It all becomes a great pleasure as well – for which I am very grateful. It remains to regret that a dialogue as the one above is too short to satisfy our curiosity.

Finally, I would like to join Professor Marcus when he confessed: "I hope to contaminate the readers of our dialogue with at least a part of the passion we invested in it."

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The Moscow Mathematical Society.

Part I

S.S. Demidov, V.M. Tikhomirov, T.A. Tokareva (Moscow)

This is the first part of an article on the history of the Moscow Mathematical Society. Part II will appear in the next issue of the Newsletter.

1. The birth of the Society

In the beginning of the 19th century, mathematical education at Kazan University attained a high level of standard, comparable to the best European Universities, due to primarily Lobatchevskii's efforts. During this period, the oldest Russian University, Moscow University, reached an equal standard only in the mid 1830s [1, ch. 12]. In 1834, N. E. Zernov (1804 – 1862), a student of Moscow University, and N. D. Brashman (1796-1899), a student of Vienna University and Vienna's Polytechnic Institute, who had previously worked at Kazan University, started to give lectures on pure and applied mathematics. These lectures were successful since both Zernov and Brashman were excellent teachers. Zernov's 'Reflexions on Integration of Partial Differential Equations' (1837) (the first doctoral dissertation in mathematics defended in Russia) was the first textbook on the integration of partial differential equations in Russian language, and for a very long period it was the manual for students of Moscow University. His treatise 'Differential Calculus and Application to Geometry' (1842) won a special prize of the Petersburg Academy of Sciences. Also Brashman's manuals 'Handbook on Analytical Geometry' (1836) and 'Stability Theory of Solid and Fluid Bodies' (1837) were awarded this prize in 1835 and in 1837 respectively. These two books were the standard manuals for the university students until the end of the century. Brashman was elected corresponding member of the Petersburgian Academy of Sciences [1, p. 220-222] for his research achievements.

Nevertheless, the most important result of Zernov's and Brashman's teaching was the raising of the standard of mathematical education at Moscow University.

Among their pupils we can mention the well known mathematicians O. I. Somov (1815-1876; graduation in 1835), P. L. Chebychev (1821-1894; graduation in 1841 - the most famous Russian mathematician of the second half of the 19th century), A. Yu. Davidov (1823-1886; graduation in 1849), and N. V. Bugaev (1837-1903; graduation in 1859).

As a consequence, an active mathematical centre was formed in Moscow in the 1860s. This was a period of exceptional evolution of the Russian social life. Tsar Alexander the second, crowned in 1855, implemented cardinal reforms that changed the profile of the country's life. The most radical reform was the abolition of the serfdom in 1861. He also introduced fundamental changes in the national educational system, in particular in university education. These changes were implemented in the new University Statute of 1863 that increased the representation of the mathematical sciences and recognized the educational importance of the scientific societies at the Universities.

N.D. Brashman

The activities of the mathematical community started to develop in this framework. The idea to found a mathematical society in Moscow was reconsidered. The first society of that kind had been created long before in 1810 [2]. But this society did not survive, as there did not exist at that time a sufficient number of active professional mathematicians in Moscow to support its function. A similar attempt was made in the 1860s, by a group of mathematicians who lived in Moscow, most of whom were affiliated with the university.

Such a Society was finally founded in 1864. The minutes of its first meeting are dated 15 (27) September of the same year. This date constitutes the starting point of the history of one of the oldest mathematical societies.

N. D. Brashman and A. Yu Davidov took the initiative for the foundation of this society. These two became its first president and vice president respectively, and V. Ya. Zinger (1836-1907) was elected as secretary. According to the Society's statute, a sine qua non condition for membership was a master or a doctorate in mathematical sciences or an important publication. The Society consisted of only 14 members in the first year. Among the members let us mention the professors of the university, the astronomer F. A. Bredikhin (1831-1904), the mathematician N.V. Bugaev, F.A. Sludskii (1841-1897), known for his research in mechanics, the physicist N. A. Lyubimov (1830-1898), as well as professor A. V. Letnikov (1830-1898) from the Moscow Technological School, and K. M. Peterson (1828-1881), a humble teacher of mathematics of the German gymnasium (the Peter – Pavel gymnasium in Moscow), who was in reality the most prominent mathematician in this time in Moscow. P. L. Chebyshev, who lived in St. Petersbourg, actively supported the Moscow mathematical society from the beginning of its existence.

At first, the founders of the Society proposed very modest goals. Thus, we can read in the minutes of its first meeting that "the goal of the Society is mutual cooperation in the study of mathematical sciences" [3, p. 239].

All mathematical disciplines were divided among the members of the society, who informed their colleagues about the latest findings in their respective branches. In addition, the members had to present the results of their own research during an obligatory monthly conference.[1]

However, the leaders of the Society quickly modified their goals in a more ambitious framework. So, when they invoked St. Petersbourg in January 1866 to secure the society, (which was 'established' a year later, under the name of 'Moscow Mathematical Society') officially, they proposed a new statute. In its first paragraph they declared the following: "The goal of the organization of the Society is to promote the development of the mathematical sciences in Russia" [3, p. 240].

At the fourth conference, on 15 December 1864, the leaders of the Society decided that the reports, which were presented in the meetings, merited publication. So in April 1865 they decided to start the publication of a journal, which could appear "twice a year in octavo" [4, c. 478]. The journal was named 'Mathematicheskii Sbornik' (Mathematical Collection). As the founders of the Society considered their main goal "to promote the development of Mathematical Sciences in Russia" it was natural to choose Russian as language. N. Brashman was in charge of the preparation of the first volume. The first volume appeared in October 1866 and was dedicated to his memory as the founder and the first president of the Society died in May 1866. This date marks the beginning of the publications of one of the most influential mathematical journals of the 20th century [3].

2. The adolescence of the Moscow Mathematical Society

In the beginning of the 20th century, the Moscow Mathematical Society, which started as a closed circle of professional mathematicians, expanded into a large and active scientific society. As we have already mentioned, the society consisted of 14 members only in 1867; 13 of them lived in Moscow and only one (P. Chebyshev) lived in another city (in St. Petersbourg). In 1913, on the eve of the First World War, the Society comprised 112 members. At this time, the geographical distribution of its membership was wider: 34 members lived in Moscow, 57 in various Russian cities, and 21 were foreign members.

The activity of the Society assumed a national character. Regarding its importance for the life of the Russian mathematical community, "the Society was number two after the Academy of Sciences", as A. P. Youshkevitch wrote [1, p. 317]. Conferences were organized regularly, and we can evaluate the evolution of mathematical studies in Moscow and the whole Empire from the presentations, which were made there (the proceedings of these conferences were published in 'Matematicheskii Sbornik').

Around this time, Moscow was transformed into a notable centre of mathematical studies in Europe, known first of all for the scientific schools in applied mathematics (N. E. Zhukovskii (1847-1921), S. A. Chaplygin), in differential geometry (K. M. Peterson, B. K. Mlodzeevskii (1858-1923), D. F. Egorov (1869-1931), and also in projective geometry (K. A. Andreev, A. K. Vlasov), in number theory (N. V. Bugaev) and in functions of complex variables (P. A. Nekrasov (1858-1924).

In the beginning of the 20th century, one of the most significant mathematical schools of the past century was born in Moscow – the school of the theory of functions of a real variable. D. F. Egorov and N. N. Luzin (1883-1950) were its founders and its first representatives.

The formation of the Moscow School took place in competition and in conflict with another school which at that time was much more famous in Europe, namely the Petersburgian school of P. L. Chebyshev, (A. A. Markov, A. M. Lyapunov etc).[2]

The reason for this conflict was first of all ideological disagreement, which to a certain extent determined the mathematical orientation of the two schools: on the one hand positivism, liberal democracy and antimonarchism, which were dominant among the Petersburgian mathematicians, on the other hand militant antipositivism, passion for idealistic and even religious philosophy, orthodox spirits and monarchism among the Muscovite.

This conflict marked the entire life of the Russian mathematical community until the 1930s. The conflict sometimes led to open clashes, as for example in the fights in 1887-1891 related to the works of academician V. G. Imshenetskii, who was supported by the Muscovites in his conflicts with A. A. Markov and A. N. Korkin, or in connection with S. Kovaleskaya's work on the problem concerning the motion of a rigid body around a fixed point, attacked by A. A. Markov; finally, in the fierce arguments of the latter with P. A. Nekrasov on the questions of probability theory and its teaching in schools. All these conflicts were discussed during the conferences of the Moscow Mathematical Society, which had to be an arbiter.

3. Period of the ordeals

The First World War, which began in 1914, became the starting point of the ordeals of the country. The Revolution of 1917, which broke out at the height of the war and the ensuing civil war (1918-1920) turned into a catastrophe for the entire scientific community. The cessation of the normal rhythm of the state, a disastrous situation due to the lack of provisions and fuel, brought the professors to the edge of survival. Soon the old, the weak and the sick began to perish: N.E. Zhukovoskii and K.A. Andreev died in 1921, and B.K. Mlodzeevskii died in 1923. For the younger and more active people, it was a period to search for ways to survive. N. N. Luzin and his disciples escaped to Ivanovo-Voznesensk where more tolerable conditions for the professors were organized in a new Polytechnical Institute.

The civil war ended in 1921, and the Bolsheviks started to restructure the country according to their ideology. The scientists began to return to Moscow, which had become the capital of the state in 1918. Luzin, returning in 1920, found an active department and an active mathematical society. D. F. Egorov, who had remained in Moscow, had tried hard to maintain the high level of mathematics. After B. K. Mlodzeevskii's death in 1923, D. F. Egorov who had been the vice president, became the president of the Moscow Mathematical Society. This custom, that the vice president was elected president after the president's death or resignation, was maintained until 1930.[3]

From the very beginning of his mandate as president of the society, D. F. Egorov actively began to ensure the normal function of the national Soviet mathematical community. The first step in this direction was to resume the 'Mathematicheskii Sbornik' which was interrupted in 1919. The 31st volume appeared in 1924. For many years Egorov corrected himself the printer's proofs.

D. F. Egorov also wished to put an end to the long-standing conflict between the principal mathematical schools. V. Steklov was invited to sit on the editorial board of the 32nd volume of the 'Mathematicheskii Sbornik', and therefore the mathematicians from Petrograd-Leningrad began more willingly to publish their papers in the revived journal: A. S. and Ya. S. Bezikovich G. M. Fikhtengoltc, and V. A. Fok (v.31) – I. M. Vinogradov (v.31, 42), N. M. Gyunter (v.32, 35) – I. A. Lappo – Danilevskii (v.34) – S. L. Sobolev (v.38, 40) - L. V. Kantorovich (v.41).

At the end of the 1920s, this review became the leading national journal publishing papers of mathematicians from various scientific centers of the U.S.S.R. for example from Kazan (N. G. Chebotariov), from Kiev (D. A. Grave, N. M. Krylov), from Tashkent (V. I. Ramanovskii), from Rostov-on-Don (D. D. Mordukhai – Boltovskoi) and from Odessa (M. G. Krein).

In the spring of 1927, a pân, a Russian Congress of Mathematicians, was organized in Moscow on the initiative of the Society and the Institute of Mathematics and Mechanics at Moscow University with the active participation of D. F. Egorov.

This Congress marked the beginning of the normal social mathematical life in the U.S.S.R at large. During the Congress it was decided to organize a national association of mathematical institutions, in order

МАТЕМАТИЧЕСКІЙ

СБОРНИКЪ.

Съ портретомъ Н. Д. Брашмана.

МОСКВА.
Въ Университетской Типографіи (Катковъ и Ко),
на Страстномъ бульварѣ.
1866.

Matematicheskii Sbornik, Vol 1

to assemble the mathematical congresses of the whole Union and to coordinate the activities of the mathematical communities between congresses.

It was paramount for the leaders of the Mathematical Society to normalize the country's destroyed mathematical life and to transform the national mathematical community into an international one. One of the means was to change the editorial policy of 'Mathematicheskii Sbornik'. Its editorial board, D. Egorov, editor on chief, and V. Kostitcyn, secretary, decided to publish papers not exclusively in Russian as they had done before, but also in the principal European languages – German, French, Italian and English. At that time, when Europe was not that rich in scientific periodicals, this attempt was successful. Among the collaborators of Mathematicheskii Sbornik in the second half of the 1920s we can mention: É. Cartan (v.34, 42), M. Fréchet (v.32) , J. Hadamard (v. 41), H. Hopf (v.37), S. Lefschetz (v.39), R. von Mises (v.41), E. Noether (v.36), R. Memke (v.36), W. Sierpinski (v.31,36), L. Tonnelli (v.33).

As a result of such initiatives and activities, the Moscow Mathematical Society headed by D. Egorov held the leading position in the country's mathematical life in the second half of the 1920s and gradually took over a great number of functions as the chief organizer in the national mathematical community.

Part II with

4. The Soviet Government and the mathematical community
5. The birth of the Soviet Mathematical School
6. The Moscow Mathematical Society after the end of the Second World War
7. Conclusion

will be published in the next issue.

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[1] Such a regulation existed until the mid 1920s when the conferences of the society took place twice a month. At the end of the 1940s such conferences took place weekly.

[2] This conflict which already existed during Chebychev's life (who maintained special relationships with the Muscovite) was manifested strongly after his death.

[3] Cf. the list of presidents before D. Egorov: N. D. Brashman (1864-1866), A. Yu. Davidov (1866-1886), V. Ya. Zinger (1886-1891), N. V. Bugaev (1891-1903), P. A. Nekrasov (1903-1905), N. E. Zhukovskii (1905-1921), B. K. Mlodzeevskii (1921-1923).

Can you spare books? Can you spare a little more?

Herbert Fleischner, Tsou Sheung Tsun

In issue 44 of this newsletter (June 2002), the Committee for Developing Countries (CDC) launched the book donation scheme under the title "Can you spare books?" and got a resounding response from our colleagues all over the world (see the CDC report in issue 46, December 2002).

We are of course continuing this scheme, with encouraging support from the President and the EC, and with substantial material help from the ICTP at Trieste, plus a small grant from the London Mathematical Society. Thus we are still interested in books (even on an undergraduate level) and journals from colleagues or institutions, who no longer need those items. However, in our book donation scheme we also want to assist departments and colleagues in developing countries in their research in specific areas. Therefore, we would now like to ask a little more from our colleagues in the "developed world".

From time to time we are asked by a scientific publisher to referee a book before they accept to publish it. As a "sweetening" incentive they may offer an honorarium, either in cash or in books. The sum in cash usually serves the purpose of complicating our tax forms and not much else, and the sum in books, although often larger, serves more often than not to increase the number of books we have to donate to the EMS-CDC scheme when we retire ...However, donated now to a library which cannot buy many expensive books it will serve a good purpose (deteriorating exchange rates are the daily nightmare in many developing countries). We are thinking of small groups, which are active in a specific research area, and whose libraries cannot afford specialized (and hence expensive) graduate texts or research monographs. Sometimes even half a dozen books will make a difference! Recently, we were able to persuade Princeton University Press to increase (by 30%) the honorarium paid to one of our colleagues, and we were thus able to send 8 classical and/or recently published books to a South American mathematics department. The important point here is that the recipient group can choose the books (from the publisher's catalogue) most useful to them.

So next time a publisher asks you to referee a book, please think of us. This may even help you to decide to do the refereeing in the first place, and thus serve the mathematics community twice at one go!

Herbert Fleischner [Herbert.Fleischner@ oeaw.ac.at] and Tsou Sheung-Tsun [tsou@maths.ox.ac.uk] are the Chair and the Vice-Chair of the EMS-committee on Developing Countries.

THE FOURTH EUROPEAN CONGRESS OF MATHEMATICS

Ari Laptev (Stockholm)

Every four years, the European Mathematical Society (EMS) organizes a European Congress of Mathematics. The purpose of this major event of European Mathematics is threefold: to present various new aspects of Pure and Applied Mathematics to a wide audience; to provide a forum for discussion of the relationship between mathematics and society in Europe; to enhance co-operation among mathematicians from all European countries.

So far, there have been three European Congresses of Mathematics:

1ECM in Paris, France, July 6-10, 1992.
2ECM in Budapest, Hungary, July 21-27, 1996.
3ECM in Barcelona, Spain, July 10-14, 2000. Theme: 'Shaping the 21st century'.

The Fourth Congress of Mathematics (4ECM) will take place in Stockholm, Sweden, June 27 to July 2, 2004. Without doubt it will be the major international mathematical event of the year 2004. The theme of the Congress is 'Mathematics in Science and Technology'.

The programme will be devoted to Pure and Applied Mathematics and highlight the importance of mathematics in scientific areas - themes like physics, biology, chemistry, information and computer science. The content will include interesting mathematical problems that arise from applications in various scientific fields.

The Organizing Committee, following philosophy and advice of the European Mathematical Society, aims at strengthening the training aspects of the conference for young researchers by facilitating the possibility of their attendance at the Conference.

4ECM Scientific Programme

The scientific programme of the 4ECM has been formed by the Scientific Committee consisting of 13 mathematicians of international recognition. This committee is chaired by Lennart Carleson (Stockholm). The other members are: Björn Engquist (Stockholm and Princeton, vice chairman), Noga Alon (Tel Aviv), Luigi Ambrosio (Pavia), Girard Ben Arous (Lausanne), Boris Dubrovin (Trieste, Moscow), Josi Luis Fernandez (Madrid), Ursula Hamenstädt (Bonn), Eduard J.N. Looijenga (Utrecht), Leonid Pastur (Kharkov, Paris), Benoit Perthame (Paris), Caroline Series (Warwick) and Andrzej Schinzel (Warsaw).

The committee has chosen 7 plenary lecturers: François Golse (France), Francesco Guerra (Italy), Johan Håstad (Sweden) Andrei Okounkov (USA, Russia), Oded Schramm (USA), Zoltán Szabó (USA), Claire Voisin (France) (http://www.math.kth.se/4ecm/program/plenary.lectures.html).

There will be 33 Invited Lectures in four parallel sessions covering innovative, multidisciplinary topics (http://www.math.kth.se/4ecm/program/invited.lectures.html).

One of the novelties of the 4ECM is the organization of 'Science Lectures' where the most relevant aspects of mathematics in science and technology will be discussed. So far, the following speakers have accepted our invitation: Richard R. Ernst (Switzerland, Nobel Prize in Chemistry 1991), Gerard 't Hooft (The Netherlands, Nobel Prize in Physics 1999), Walter Kohn (USA, Nobel Prize in Chemistry 1998), Martin Nowak (USA) and George Oster (USA).

Another novelty will be information on the work of the EU Research Training Networks in Mathematics and Information Sciences and Programmes from the European Science Foundation (ESF) in Physical and Engineering Sciences (PESC). Twelve EU Research Training Networks and PESC projects from Brussels and Strasbourg have been chosen by the Scientific Committee and have already nominated their speakers. (http://www.math.kth.se/4ecm/program/european.nw.lectures.html)

4ECM Prizes to young mathematicians and the Felix Klein Prize

There will be 10 EMS prizes of 5000 EURO each to young mathematicians who have made a particular contribution to the progress of Mathematics. The Prize Committee is chaired by N.N.Uraltseva (St.Petersburg). *I would like to remind readers that the deadline for 4ECM prize nominations is the 1st of February, 2004. (http://www.math.kth.se/4ecm/nomination.ecm.html).* The maximum age may be increased by up to three years in the case of an individual with a 'broken career pattern'. Mathematicians are defined to be 'European' if they are of European nationality or their normal place of work is within Europe. 'Europe' is defined to consist of all countries parts of which are geographically within Europe or that have a corporate member of the EMS based in that country. Prizes are to be awarded for the best work published before December 31, 2003. The Prize Committee shall interpret the word 'best' using its judgment: e.g., it may refer to innate quality or impressiveness, influence, etc. Nominations may be made by anyone, including members of the Prize Committee or by the candidates themselves. It is the responsibility of the nominator to provide all relevant information to the Prize Committee, including a résumé and documentation. The nomination for each award must be accompanied by a written justification and a citation of about 100 words that can be read at the award ceremony. The prizes cannot be shared.

The Felix Klein Prize, established in 1999 by the EMS and the endowing organization, the

Ari Laptev

Institute for Industrial Mathematics in Kaiserslautern, is awarded to a young scientist or a small group of young scientists (normally under the age of 38) for using sophisticated methods to give an outstanding solution, which is met with the complete satisfaction of industry, to a concrete and difficult industrial problem (http://www.math.kth.se/4ecm/felix.klein.html).

Grants

The budget of the 4ECM includes 100,000 EURO for covering the Congress expenses of young researchers. About 200 grants will be distributed. At least 20% of the participants should be early stage researchers. Since women are in minority in mathematics, some efforts will be made in order to encourage female researchers to attend.

Contributed Papers

About 20% of the participants should have poster presentations. The Organizers understand that some participants of the Congress might have the possibility of obtaining local funding if their posters are accepted. In order to speed up the process of acceptance, the organizers have decided on the following:

Abstracts submitted before February 15, 2004, will be considered by the committee and notification of its decision will be sent out before February 25, 2004. Alternatively, acceptance of abstracts submitted before April 20, 2004, will be notified before May 1, 2004.

Abstracts submitted after April 20, 2004, will not be considered (http://www.math.kth.se/4ecm/posters.html).

Satellite Conferences

There will be about 10-15 satellite conferences. Some of these will be a part of research activities of EU Research Training Networks and ESF PESC programmes (http://www.math.kth.se/4ecm/list.html).

Organization

The 4ECM will be hosted by the Royal Institute of Technology in Stockholm (KTH) in collaboration with Stockholm University (SU). KTH and SU are international institutions with established research and educational exchanges throughout the world, especially in Europe, USA and South America. Their Mathematics Departments have a number of excellent mathematicians and are among the leading Departments in Europe.

The Congress will take place at the University of Stockholm, which has all the required facilities. The plenary talks will be held at Aula Magna (1200 sits) which is equipped with the most modern facilities and has a number of smaller rooms available the 4ECM. There will also be some smaller rooms available at KTH and SU.

The 4ECM Organising Committee includes: Ari Laptev (KTH, Chairman), Torsten Ekedahl (SU), Christer Kiselman (Uppsala University), Anders Lindquist (KTH), Mikael Passare (SU), Ulf Persson (Chalmers University of Technology, Göteborg), Kjell-Ove Widman (Institute Mittag-Leffler), Jon Larsson (KTH) and Mikael Johansson (KTH).

The Stockholm Convention Bureau (SCB) will take care of the practical necessary arrangements such as hotel reservation, registration of the participants, etc. SCB has a long experience of more than 20 years in organizing large congresses in Stockholm.

Publicity

The Fourth European Congress of Mathematics has its home page at http://www.math.kth.se/4ecm/ updated regularly. It contains an electronic registration form, the programme of the congress, call for contributed papers, call for grants, call for prize nominations, etc.

The 4ECM Organizing Committee has published a poster, which has been sent to all Mathematical Departments in Europe and major Mathematical Departments in USA, Canada, Australia, Japan, China, and South America among others.

It has been agreed that the European Mathematical Society Publishing House will be responsible for publishing the 4ECM Proceedings.

The opening ceremony will take place at Aula Magna on the 28th of June, 2004. Stockholm's City Hall will be available for the Conference dinner on the 29th of June, 2004.

Registration

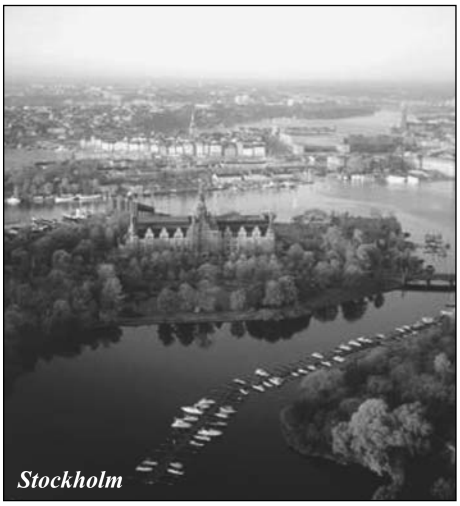
There is a possibility to have an advance registration. The registration form is available at http://www.math.kth.se/4ecm/registration.html

About Stockholm

Stockholm, the capital of Sweden, is a beautiful town with an excellent infrastructure. It is also a renowned conference city, and especially in the months of June-July (the time of the Congress) it provides many attractions for the participants. The Organizing Committee is planning to arrange a number of excursions around Stockholm.

Since 1901 Stockholm has been the venue of the Nobel Prize Ceremony - one of the most prestigious of all events and - indeed the city makes a fitting venue with a high standard of facilities and service. Public transport is extremely efficient and convenient, with a choice of buses, trains and an underground system.

Hotels, museums and restaurants in the city are generally within walking distance, which makes Stockholm an ideal city for pedestrians. It is easy to reach - Arlanda Airport handles some 225 international flights daily to and from thirty countries and four continents. Direct buses as well as the Arlanda Express Train connect Arlanda Airport with the City Terminal in central Stockholm.



Stockholm

Summary

The aim of this Congress is to highlight the importance of mathematics in different areas of technology and its place regarding other research subjects such as physics, chemistry, biology and medicine. We expect that the 4ECM will show the importance of mathematics in modern life and will inspire to further interaction between different scientific areas.

Conferences like 4ECM are vital to the progress of research in mathematics. Such a congress will stimulate young mathematicians to attract long-standing problems and also to solve new problems leading to many scientific and technological discoveries.

Ari Laptev [laptev@math.kth.se] is the chairman of the 4ECM Organizing Committee. He earned his PhD-degree in 1978 at Leningrad University. He is a specialist in the spectral theory of partial differential operators works as professor and vice-chairman at the Department of Mathematics, Royal Institute of Technology in Stockholm. He served as president of the Swedish Mathematical Society in the period 2001-2003.

ICME-10

I C M E
1 0
2 0 0 4

The 10th International Congress on Mathematical Education (ICME-10) will be held July 4-11, 2004 in Copenhagen, Denmark. More details on the programme, including lists of themes, topics, activities, etc., are available at http://www.icme-10.dk

The aim of the congress is to present the current states and trends in mathematics education and research at all levels of the educational system and to gather practioners and researchers from all over the world. A more general objective of the congress is to support the development of mathematics teaching in order to meet essential needs in society, such as securing the recruitment for mathematically based professional training and securing mathematics competences in general education in order to develop and maintain democracy.

The ICME congresses are held every fourth year under the auscpices ot the International Commission on Mathematical Instruction (ICMI). The first ICME was held in 1969 in Lyon, France.

ICME-10 in Copenhagen 2004 is expected to gather around 4000 researchers in mathematics education, mathematics teachers, and other interested parties from over 100 different countries. The congress will maintain and develop the ICME traditions but will also introduce a number of new elements to the scientific programme. The scientific programme is planned by the International Programme Committee (IPC) consisting of 21 members from all over the world.

The **main components** of the scientific programme will be:

§ Plenary Activities, including six lectures
§ ICME-10 Survey Teams
§ Regular Lectures
§ Topic Study Groups
§ Discussion Groups
§ Thematic Afternoon
§ Workshops and Sharing Experiences Groups
§ Posters and Round Tables
§ National Presentations.

Further details are available at http://www.icme-10.dk.

Deadline for early registration is February 28, 2004.

Amongst the characteristic features of the ICME-10 programme will be ample opportunities for the participants to discuss, develop, and share ideas and experiences in formal and informal settings, as well as the interaction between researchers and practitioners, and research and teaching practice.

Participation in ICME-10 will provide optimal opportunities for both formal and informal interaction with colleagues across the spectrum of mathematics education. In addition to the excursion on Thursday, July 8, the cultural and social events of ICME-10 will take place during the congress in connection with the lunch breaks and the happy hours. Further details of the social programme can be found at http://www.icme-10.dk.

Forthcoming conferences

compiled by Vasile Berinde (Baia Mare, Romania)

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

January 2004

19-28 : Advanced Course on Ramsey Methods in Analysis, Bellaterra (Barcelona)
Information:
http://www.crm.es/RamseyMethods
e-mail : RamseyMethods@crm.es
[For details, see EMS Newsletter 49]

February 2004

2-13 : Advanced Course on Contemporary Cryptology
Campus Nord, Universitat Politècnica de Catalunya
Information:
http://www.crm.es/ContemporaryCryptology
e-mail : Contemporary-Cryptology@crm.es
[For details, see EMS Newsletter 49]

23-28, 2004: C*algebras and Elliptic Theory, Bedlewo, Poland
Topics: K-theory of C*-algebras, index theory, algebras of pseudodifferential operators on singular manifolds, infinite Grassmannians and Fredholm pairs, deformation quantization
Organising Committee: B. Bojarski, G. Łysik and A. Weber (Warszawa); A. Mishchenko and E. Troitsky (Moscow)
Scientific Committee: M. Atiyah, P. Baum, D. Burghelea, R. Melrose, A. Mishchenko, V. Nistor, B.-W. Schulze, N. Teleman, E. Troitsky, S. L. Woronowicz
Fees: 220 Euros full board
Sponsors: International Mathematical Banach Center, Research Training Network "Geometric Analysis"
Grants: available for young participants (full board)
Deadline: 15 January
Information: contact A. Weber or G. Łysik, e-mail: calgebra@impan.gov.pl
Website: http://www.impan.gov.pl/~calgebra

March 2004

31-April 2: Quantitative Modelling in the Management of Healthcare IV, Salford, UK
Information: www.ima.org.uk/mathematics
[For details, see EMS Newsletter 49]

April 2004

5-7: 5th International Conference on Modelling in Industrial Maintenance and Reliability - Impacting on Practice, University of Salford, UK
Aim: To provide a forum for discussion of traditional and innovative modelling approaches to improve the performance of plant, products and processes
Topics: Maintenance (inspection, overhaul, preventive maintenance), fault diagnosis and condition based maintenance, reliability, risk analysis and risk management, reliability-centred-maintenance, warranty modelling, life-cycle costing and capital replacement, logistics in maintenance and reliability, human factors assessment languages (if other than English)
Organizers: The Institute of Mathematics and its Applications
Organising committee: Dr. P. Scarf (University of Salford), Dr. W. Wang (Salford), Prof. M. Newby (City University, London)
Proceedings: to be published
Location: University of Salford, Manchester, UK
Information:
e-mail: conferences@ima.org.uk
Website: www.ima.org.uk

19-24: CHT-04 International Symposium on Advances in Computational Heat Transfer; on cruise ship MS Midnatsol between Kirkenes and Bergen, Norway
Information:
e-mail: cht04@cfd.mech.unsw.edu.au
Website: http://cht04.mech.unsw.edu.au
[For details, see EMS Newsletter 49]

May 2004

30-June 5: Commutative rings and their modules, Incontro INdAM, Cortona, Italy
Aim & topics: The aim is to bring together researchers in the areas of commutative ring theory and module theory. The main emphasis of the workshop is on almost perfect rings and their modules; tilting torsion theories, tilting and cotilting modules on commutative rings; integer valued polynomials; multiplicative ideal and module systems, star and semistar operations, Gabriel-Popescu localizing systems; Krull and Mori domains; chain conditions and prime spectrum; Pruefer domains and their generalizations; factorization and divisibility properties, decomposition of ideals, class groups. Young researchers approaching these areas are welcome.
Programme Committee: M. Fontana (Università degli Studi Roma Tre), L. Fuchs (Tulane University, New Orleans), S. Gabelli (Università degli Studi Roma Tre), E. G. Houston (University of North-Carolina, Charlotte), L. Salce (Università degli Studi di Padova), P. Zanardo (Università degli Studi di Padova).
Organising Committee: F. Girolami, G. Picozza & F. Tartarone (Università degli Studi Roma Tre)
Sponsors: INdAM-Istituto Nazionale di Alta Matematica, with the contributions of the Mathematical Departments of the Universities of Padova and Roma Tre.
Main Speakers: Visit the web site for an updated list of speakers.
Information:
e-mail: cortona4@mat.uniroma3.it;
Website: http://www.mat.uniroma3.it/seminari/conferenze/cortona2004.htm

30 - June 6: SPT2004 - Symmetry and Perturbation Theory
Cala Gonone (Sardinia, Italy) (follows SPT96, SPT98, SPT2001 and SPT2002 conferences)
Information: Website http://www.sptspt.it
[For details, see EMS Newsletter 49]

June 2004

2-4: Mathematical problems in Engineering and Aerospace Sciences, The West University of Timisoara, Romania (ICNPAA2004)
Information: e-mail: SeenithI@aol.com;
Website: www.icnpaa.com
[For details, see EMS Newsletter 49]

7-11: Conference on Poisson Geometry, Luxembourg City, Grand-Duchy of Luxembourg
Information: http://www.cu.lu/Poisson2004
[For details, see EMS Newsletter 49]

16-23: **5th International Conference on Functional Analysis and Approximation Theory (FAAT 2004), Acquafredda di Maratea, Potenza, Italy**
Aim: The meeting is devoted to some significant aspects of contemporary mathematical research in functional analysis, operator theory and approximation theory, including the applications of these fields in other areas such as partial differential equations, integral equations, numerical analysis and stochastic analysis. One of the major aims of the conference is to bring together mathematicians working in the above topics in order to spur interdisciplinary collaborations and exchanges of results and techniques.
Main topics: Banach spaces, Banach lattices, function spaces, (positive) linear operators, semigroups of (positive) linear operators, evolution equations and stochastic analysis, approximate quadratures and integral equations, approximation processes in abstract spaces and in function spaces, approximation by (positive) operators, interpolation, polynomial approximation, constructive approximation, orthogonal polynomials.
Confirmed invited speakers: E. Behrends (Berlin), B. Bojanov (Sofia), A. L. Brown (London), N. Jacob (Swansea), N. Kalton (Columbia), A. Kroò (Budapest), W. Luxemburg (Pasadena), F. Marcellan (Madrid), G. Milovanovic (Nis), G. Monegato (Torino), B. Silbermann (Chemnitz), V. Totik (Szeged), G. Vinti (Perugia), L. Weis (Karlsruhe), Y. Xu (Eugene, U.S.A.).
Scientific Program: plenary lectures (50 min.), selected section lectures (30 min.) and short communications (15-20 min.).
Organizing Committee: F. Altomare, A.

Attalienti, M.Campiti, L. D'Ambrosio, S. Diomede, G. Mastroianni, D. Occorsio, M. G. Russo **Sponsors:** Center for Studies in Functional Analysis and Approximation Theory of the University of Basilicata (Potenza, Italy), the National Research Group 'Operator Theory, Semigroups and Applications to Evolution Equations and Approximation Problems' (PRIN – Cofin. 2003-05), the Departments of Mathematics of the University of Basilicata (Potenza, Italy), the University of Bari (Italy), and the University of Lecce (Italy), the Universities of Bari (Italy) and of Basilicata (Italy), the Department of Economics of the University of Bari (Italy), the National Group for Mathematical Analysis, Probability and their Applications (G.N.A.M.P.A.), the Basilicata Tourism Board.
Location: Hotel Villa del Mare, Acquafredda di Maratea, Potenza, Italy
Information: http://www.dm.uniba.it/faat2004; http://www.dm.unile.it/faat2004

18-23: Mathematical Foundations of Learning Theory, Universitat Pompeu Fabra, Barcelona
Aim: The scope of the meeting includes all aspects of the theoretical analysis of machine learning techniques for prediction and other data analysis problems. The main objective is to explore connections between learning theory and many other areas of theoretical computer science, mathematics and statistics. The program will include sessions on such topics as empirical processes and concentration inequalities, local theory of Banach spaces, approximation theory, game theory, nonparametric statistics, etc. The main goal of the meeting is to bring together (probably, for the first time) a diverse group of mathematicians and theoretical computer scientists working on these problems.
Coordinator: G. Lugosi (Universitat Pompeu Fabra)
Scientific Committee: P. Bartlett (University of California, Berkeley),
E. Giné (University of Connecticut), V. Koltchinskii (University of New Mexico, Albuquerque), G. Lugosi (Universitat Pompeu Fabra), S. Mendelson (Australian National University), V. Milman (University of Tel Aviv), S. Smale (University of California, Berkeley)
Main speakers: V. Milman (University of Tel Aviv), S. Smale (Toyota Technological Institute, Chicago and University of California, Berkeley)
Tutorial speakers: S. Boucheron (Université Paris-Sud, Orsay), N. Cesa-Bianchi (Université degli Studi di Milano), V. Kurková (Academy of Sciences of the Check Republic), P. Long (Genome Institute of Singapore), S. Mendelson (Australian National University)
Invited speakers: S. Ben-David (Cornell University), R. DeVore (University of South Carolina), L. Devroye (McGill University), R. Dudley (MIT), D. Foster (Wharton, University of Pennsylvania), Y. Freund (Columbia University), S. Hart (The Hebrew University of Jerusalem), M. Ledoux (Université Paul-Sabatier, Toulouse), N. Linial (The Hebrew University of Jerusalem), P. Massart (Université Paris-Sud), A. Naor (Microsoft Research), M. Opper (Aston University), A. Pajor (Université de Marne-la-Vallée), A. Pinkus (Technion, Israel), G. Schechtman (Weizmann Institute of Science), A. Tsybakov (Université Paris 6), R. Vershynin (University of California, Davis), V. Vovk (Royal Holloway), J. Wellner (University of Washington), D. Xuan Zhou (City University of Hong Kong), J. Zinn (Texas A&M University)
Grants: There will be a limited number of grants for registration and accommodation addressed to young researchers.
Deadlines: For applications for financial support, April 18, 2004; For registration and payment, May 15, 2004
Organiser: Centre de Recerca Matemàtica, Barcelona
Location: Universitat Pompeu Fabra, Barcelona
Information:
e-mail: MathematicalFoundations@crm.es
Website:
http://www.crm.es/MathematicalFoundations

26-July 1: 7th International Conference of The Mathematics Education into the 21st Century Project, Ciechocinek, Poland.
Theme: The Future of Mathematics Education
Aim: to provide an international overview of innovative ideas and materials for the teaching of mathematics in schools
Topics: Mathematical modelling, technology, equity, teacher training
Main speakers: I. Meznik (Czech Republic), A. Rogerson (Poland)
Format: Keynote lectures, round table plenary, paper presentations, workshops and an open forum of ideas
Languages: English and a parallel programme in Polish
Organizers: The Mathematics Education into the 21st Century Project
Programme committee chairpersons: A. Rogerson (Poland), F. Mina (Egypt)
Organising committee chairperson: Margaret Fryska (Poland)
Proceedings: to be published as hard copy and on our conference website
Grants: available for students, teachers and participants from countries in a difficult economic situation
Deadlines: to be advised in the First Announcement due on 30 October, 2003 from the e-mail address below
Information: please e-mail: arogerson@vsg.edu.au for all information
Website (of previous conferences only): http://math.unipa.it/~grim/21project.htm

July 2004

26-31: 6th World Congress of the Bernoulli Society and the 67th Annual Meeting of the Institute of Mathematical Statistics, Barcelona (Spain)
Information: e-mail: wc2004@imub.ub.es
Web site: http://www.imub.ub.es/events/wc2004/
[For details, see EMS Newsletter 49]

August 2004

18-21: The Thirteenth International Workshop on Matrices and Statistics, in Celebration of Ingram Olkin's 80th Birthday, Bedlewo, near Poznan, Poland
Theme: matrices and statistics
Aim: to stimulate research and to foster the interaction of researchers in the interface between statistics and matrix theory
Scope: to present methods of linear algebra with statistical origin or possible applications in statistics
Topics: Applications of linear algebra in statistics
Main speakers: I. Olkin (USA), T. W. Anderson (USA), J.K. Baksalary (Poland), R. Bru (Spain), C.M. Cuadras (Spain), P. Druilhet (France), L. Elsner (Germany), G.H. Golub (USA), J. Gro (Germany), C.R. Johnson (USA), J. Kunert (Germany), T. Ledwina (Poland), E. P. Liski (Finland), P. Major (Hungary), R.J. Martin (UK), V. Mehrmann (Germany), J. Tiago Mexia (Portugal), H. Monod (France), M.D. Perlman (USA), PSSNVP Rao (India), W. Ratajczak (Poland), D. von Rosen (Sweden), Bikas K. Sinha (India), G. Tusnady (Hungary), and H. Yanai (Japan)
Format: Invited talks and contributed presentations
Sessions: There will be plenary lectures and two parallel sessions.
Call for papers: If you wish to present a contributed presentation, please submit an extended abstract (up to two pages).
Organizers: Stefan Banach International Mathematical Center, Warsaw, Committee of Mathematics of the Polish Academy of Sciences, Warsaw, Faculty of Mathematics and Computer Science, Adam Mickiewicz University, Poznan, Institute of Socio-Economic Geography and Spatial Management, Faculty of Geography and Geology, Adam Mickiewicz University, Poznan, Department of Mathematical and Statistical Methods, Agricultural University, Poznan
Programme committee: R. William Farebrother (Shrewsbury, UK), S. Puntanen (Tampere, Finland; chair), G. P. H. Styan (Montreal, Canada; vice-chair), and H. Joachim Werner (Bonn, Germany)
Organising committee: J. Hauke, A. Markiewicz (chair), T. Szulc, and W. Wolynski - Poland
Proceedings: a special issue of Linear Algebra and Its Applications devoted to this workshop
Location: the Mathematical Research and Conference Center of the Polish Academy of Sciences, Bedlewo near Poznan
Grants: probably partial support for PhD students
Deadlines: for registration, 31 May 2004; for abstracts, 30 June 2004
Information:
e-mail: matrix04@main.amu.edu.pl
Website: http://matrix04.amu.edu.pl/

24-27: International Conference on Nonlinear Operators, Differential Equations and Applications (ICNODEA-2004), Cluj-Napoca, Romania
Information: e-mail: nodeacj@math.ubbcluj.ro
Website: http://www.math.ubbcluj.ro/~mserban/confan.htm
[For details, see EMS Newsletter 49]

September 2004

8-11: Dixièmes journees montoises d'informatique theorique, à Liège (Tenth Mons theoretical computer science days, in Liège)
Theme: Some aspects of theoretical computer science and discrete mathematics related to combinatorics on words (in the broad sense).
Scopes: This conference is widely open to young researchers. Notice that English and French are the two official languages of the meeting.
Topics: Combinatorics on words (including algebraic and algorithmic aspects), all aspects of formal languages theory, variable length codes, automata theory and verification.
Main Speakers: J. Cassaigne, D. Caucal, C. Frougny, T. Helleseth, S. Langerman, F. Neven, M.-F. Sagot.
Call for papers : Please check the webpage.
Organisers: J. Berstel, V. Bruyere, P. Lecomte, M. Rigo.

Location: Institute of Mathematics, University of Liege (Belgium).
Grants: Some financial support for young scientists is expected, see the conference website for updated information.
Deadline: 1st June for submission of a paper, 1st August for registration.
Information: e-mail : M.Rigo@ulg.ac.be; Website: www.jm2004.ulg.ac.be

20-24: 12th French-German-Spanish Conference on Optimization, Avignon, France
Aim: The French-German-Spanish Conference on Optimization in 2004 is organized by the 'Group of Nonlinear Analysis and Optimization' of the University of Avignon. It will be held in Avignon, France, in September 2004. This Conference is the 12th of the series of French-German meetings which started in Oberwolfach in 1980 and was continued in Confolant (1981), Luminy (1984), Irsee (1986), Varetz (1988), Lambrecht (1991), Dijon (1994), Trier (1996), Namur (1998), Montpellier (2000), and Cottbus (2002). Since 1998, the conference has been organized under the participation of a third European country. In 2004, the guest country will be Spain. The conference will in particular promote the contacts between researchers of the three involved countries and provide a forum for sharing recent results in theory and applications of optimization. However, scientists from other countries are also encouraged to participate.
Topics: Smooth and nonsmooth continuous optimization problems, numerical methods for mathematical programming, optimal control and calculus of variations, differential inclusions and set-valued analysis, stochastic optimization, multicriteria optimization, game theory and equilibrium concepts, optimization models in finance and mathematical economics, optimization techniques for industrial applications. Contributions on other issues related to optimization are also welcome.
Plenary speakers: A.Ben-Tal (Israel), E.Carrizosa (Spain), E.Casas (Spain), Lachand-Robert (France), J-B.Lasserre (France), Y.Nesterov (Belgium), U.Rieder (Germany), R.Tichatschke (Germany), S.Tijs (The Netherlands), F.Troeltzsch (Germany), E.Zuazua (Spain)
Scientific committee: F. Bonnans (France), J.-B. Hiriart-Urruty (France), F. Jarre (Germany), M. Lopez (Spain), J.E. Martinez-Legaz (Spain), H. Maurer (Germany), S. Pickenhain (Germany), A. Seeger (France), M. Thera (France)
Format: Contributions are solicited for presentation at the conference. Each accepted paper will be allotted a 30-minute talk (including discussion). The conference language is English. Besides the title of the proposed contribution, a short abstract (of at most 200 words) is also required.
Deadline to propose a contribution is March 25 , 2004. Acceptance or refusal notice to authors will be given by April 1, 2004.
Information:
e-mail: alberto.seeger@univ-avignon.fr;
Website: http://www.fgs2004.univ-avignon.fr

23-26: 4th International Conference on Applied Mathematics (ICAM-4), Baia Mare, Romania (previous editions in 1998, 2000 and 2002)
Information:
e-mail: marietag@ubm.ro; icam4@ubm.ro
Web site: http://www.ubm.ro/site-ro / facultati/departament/manifestari/icam4/index.html
[For details, see EMS Newsletter 49]

Personal column

Please send information on mathematical awards and deaths to the editor.

Awards

European Prize in Combinatorics awarded
A European Prize in Combinatorics has been established by the European Research and Training Network COMBSTRU and by the centre DIMATIA to recognise excellent contributions in Combinatorics by young researchers at most 35 years of age. The prize will be awarded biannually in conjunction with the meeting EUROCOMB. The award was funded with the contribution of private companies, DIMATIA and COMBSTRU.

The first prize was presented at the European Combinatorial Conference EUROCOMB'03 held in Prague last September. It is combined with a monetary award of 2500 Euros. The Prize Committee for the first edition consisted of Jaroslav Nesetril, Chair (Prague), Vera T. Sos (Budapest) and Alexander Schrijver (Amsterdam). The prize recipients can be found in the column below.

Hélène Exnault and **Eckart Viehweg** (Essen) have received a Gottfried Wilhelm-Leibniz-Prize 2003 of the German Research Foundation for their joint work on algebraic and arithmetic geometry.

Gerhard Huisken (Potsdam) has received a Gottfried Wilhelm-Leibniz-Prize 2003 of the German Research Foundation for his work on surface evolutions and on foliations.

Daniela Kühn (Berlin) and **Deryk Osthus** (Berlin) have been awarded the first European Prize in Combinatorics for an extensive collection of results in core graph theory devoted to the study of graph minors and random structures, particularly in their relation to Hadwiger's Conjecture.

Rupert Klein (Berlin) has received a Gottfried Wilhelm-Leibniz-Prize 2003 of the German Research Foundation for his work on turbulence phenomena.

Andrzej Komisarski (Łódz) has received the Prize of the Polish Mathematical Society for young mathematicians.

Rafal Latala and **Krzysztof Oleszkiewicz** (Warsaw) have been awarded the Banach Great Prize of the Polish Mathematical Society for their research papers.

Alain Plagne (Palaiseau) has received the first European Prize in Combinatorics for extensive work in combinatorial number theory and for the solution of several open problems employing techniques on the borderline between combinatorics and number theory.

Wiesław Pleśniak (Kraków) has been awarded an honorary doctorate at the Université de Toulon et du Var.

Hans-Peter Seidel (Saarbrücken) has received a Gottfried Wilhelm-Leibniz-Prize 2003 of the German Research Foundation for his work on computer graphics.

Piotr Sniady (Wrocław) has received the Kuratowski Prize.

Michael Szurek (Warsaw) has been awarded the first Marcinkiewicz Prize of the Polish Mathematical Society for students' research papers.

Paweł Wilczynski (Kraków) has received the Dickstein Great Prize of the Polish Mathematical Society for his achievements in popularizing mathematics.

Deaths

We regret to announce the deaths of:

Adam Bielecki (10 June 2003)

Stanisław Lojasiewicz (14 November 2002)

Recent books

edited by Ivan Netuka and Vladimír Souček (Prague)

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

I. Bajo, E. Sanmartín, Eds.: *Recent Advances in Lie Theory,* *Research and Exposition in Mathematics, vol. 25, Heldermann, Lemgo, 2002, 398 pp., 44 euros, ISBN 3-88538-225-3*
This volume contains updated versions of selected contributions at the First Colloquium on Lie Theory and Applications, held in Vigo, Spain in the year 2000. There are altogether 23 contributions on the theory of Lie groups and algebras. Three of them were related to series of lectures at the Colloquium. The first paper, written by D. V. Alexeevsky and A. F. Spiro, describes flag manifolds and homogeneous CR structures. The first part of the paper contains an introduction to the geometry of flag manifolds with a short description of the structure theory of semisimple Lie algebras and parabolic subalgebras. The second part describes the theory of compact, homogeneous Levi non-degenerate CR manifolds and their classification. The second paper by Yu. A. Brailov and A. T. Fomenko deals with Lie groups and Hamiltonian systems as. It consists again of two parts. The first part contains a review of integration methods for special classes of Hamiltonian systems on Lie groups, symmetric spaces and homogeneous Riemanniaan spaces. The second part contains new results in the singularity theory of integrable Hamiltonian systems. The third paper is written by M. Scheunert and contains an introduction to the cohomology of Lie superalgebras and some applications. The cohomology of colour Lie algebras is introduced, and some classical results on Lie algebra cohomology are generalized to this setting. There are also applications of the theory to the study of formal deformations of the enveloping algebra of a colour Lie algebra and to Hochschild cohomology. (jbu)

A. Baker: *Matrix Groups. An Introduction to Lie Group Theory*, *Springer Undergraduate Mathematics Series, Springer, London, 2002, 330 pp., 16 fig., 34,95 euros, ISBN 1-85233-470-3*
This book is designed as an introduction to the theory of Lie groups by means of matrix subgroups of the real or complex linear group. The main examples treated are the special linear groups, orthogonal and special orthogonal groups, unitary groups, symplectic groups and the Lorentz group. In particular, relations between complex matrix groups and real matrix groups are discussed. The author also treats various algebraic, analytic and topological properties (e.g., norms, metric, compactness and group actions). The second part contains a study of algebras, quaternions, quaternionic symplectic groups, Clifford algebras and spinor groups and their special properties. The third part can be considered as an introduction to the theory of Lie groups and homogeneous spaces. Classical examples are explained. The last part contains special topological and geometrical problems (connectivity of matrix groups, description of maximal tori in compact Lie groups, semi-simple factorisation, roots systems, Weyl groups and Dynkin diagrams). The book is a nice elementary introduction to the theory of Lie groups. (jbu)

V. C. Barbosa: *An Atlas of Edge-Reverse Dynamics,* *Research Notes in Mathematics 421, Chapman & Hall/CRC, Boca Raton, 2001, 372 pp., £56,99, ISBN 1-58488-209-3*
This book is a reference volume on the dynamics of scheduling by edge reversal (SER), i.e., on transformations of acyclic graphs by changing sinks (nodes with arcs oriented inward) to sources (nodes with arcs oriented outward). The author first introduces scheduling by edge reversal as a mechanism to rebuild communication routes in computer networks after topological changes. Other possible applications of this formalism are given. In particular, the author discusses a description of resource-sharing systems (like the well known dining philosophers problem) and networks of automata (e.g., Hopfield neural networks or Bayesian networks). The next topics are the basic properties of SER and an enumeration of the SER state space. The major part of the book consists of a repository of graphical representations of SER basins of attraction for some selected graphs. In particular, all graphs on six nodes, all trees on seven nodes, and all rings on three to eight nodes are covered. The book is easy to read and understand thanks to many examples. It is intended to be a repository of results and data. Thus, proofs for many results are omitted, but a comprehensive set of references where these proofs can be found is given. (rbar)

M. A. Bennett, B. C. Berndt, N. Boston, H. G. Diamond, A. J. Hildebrand, W. Philipp, Eds.: *Surveys in Number Theory,* *A K Peters, Natick, 2002, 63 pp., US$30, ISBN 1-56881-162-4*
The present collection of papers contains 14 of 72 papers published separately in three volumes under the title *Number theory for the Millennium* and presented at the Millennium Conference on Number Theory held at Urbana-Champaign. Thirteen of the papers are devoted to concrete mathematical topics related to the 'simple' or multiple Riemann zeta function (Huxley, Matsumoto), the Riemann hypothesis (Balazard), normal numbers (Harman), arithmetical aspects of the theory of curves (Poonen, Perrin-Riou), Diophantine approximation (Tijdeman), the Pell equation (H.Williams), expansion of a given function into a continued fraction (Lorentzen), Waring's problem (Vaughan and Wooley), pure and mixed exponential sums (Cochrane and Zheng), authomorphic forms (Winnie Li), or to primes in arithmetical progressions (Hooley). Exceptional in this aspect is the paper 'G. H. Hardy as I knew him' by R. A. Rankin. All papers certainly fulfil the editors' hope that a separate publication can help to stimulate the interest in the presented topics or related areas. All of them give the reader an up-to-date information on the development of basic ideas which paved the road to the described major achievements in the subject so that this collection give an integrated picture on main streams in contemporary number theory. As such, it can be recommended to active number theorists and also to a general mathematical audience. (spor)

E. R. Berlekamp, J. H. Conway, R. K. Guy: *Winning Ways for Your Mathematical Plays II,* *second edition, A K Peters, Natick, 2003, 277—473 pp., US$39, ISBN 1-56881-142-X*
The book under review is the second of four parts of the second edition of the book, which was successfully published a quarter of a century ago. However, the second edition contains some new parts. The book treats a lot of games with their winning strategies, and it is full of pictures and diagrams for reader's comfort. Although the topic belongs to recreational mathematics, all problems are studied in a very precise way. I am not quite sure, whether it was a good idea to divide the book into four parts. Volume II contains many references to Volume I. Hence it is difficult to read it, if the reader is not familiar with the first volume. (rc)

N. Berline, C. Sabbah, Eds.: *La fonction zéta,* *École Polytechnique, Palaiseau, 2003, 193 pp., 18 euros, ISBN 2-7302-1011-3*
This book contains three texts surveying properties of Riemann's zeta function from different viewpoints. J.-B. Bost explains a proof of the prime number theorem based on the theory of the Fourier transform for distributions. P. Colmez offers a panorama of arithmetic properties of the zeta function (and more general Dirichlet series), ranging from polylogarithms, transcendence results and polyzetas to modular forms, p-adic measures and the p-adic zeta function. Ph. Biane sketches the heuristic relationship between the distribution of zeroes of $\zeta(1/2+it)$, the statistical properties of eigenvalues of random unitary matrices , as well as a link between the zeta function and random walks and Brownian processes. (jnek)

N. L. Biggs: *Discrete Mathematics,* *second edition, Oxford University Press, Oxford, 2002, 425 pp., £26,50, ISBN 0-19-850718-6, ISBN 0-19-850717-8*
A well known definition says that a textbook is a book such that everybody thinks he can write a better one. Biggs' *Discrete Mathematics* is an exception – not only for its wide range of topics and its clear organization but notably for its excellent style of explanation. Many examples and exercises contribute to a better understanding. The book can be recommended to students and all those who are interested in this field of mathematics. N. L. Biggs wrote a wonderful textbook. (ec)

J.-M. Bismut, S. Goette: *Families Torsion and Morse Functions,* *Astérisque 275, Société Mathématique de France, Paris, 2001, 293 pp., FRF 350, ISBN 2-85629-109-0*

The relation between classical Ray-Singer torsion and Reidemeister torsion was studied by many mathematicians (including J. Cheeger, W. Müller, J. Lot, M. Rothenberg, J.-M. Bismut, W. Zhang and U. Bunke). In this book, the authors construct an equivariant version of the theory of analytic torsion, including a suitable normalization of analytic torsions forms. They show that equivariant torsion forms in higher degrees are essentially invariant under a deformation of the considered flat connection. They evaluate equivariant torsion forms (up to coboundaries) for fibrations satisfying suitable assumptions and they prove a formula for equivariant torsion forms in the case of unit sphere bundles. Tools and methods used in the book include superconnections and Chern-Simons theory, the (extended) de Rham map, the Witten deformation of the de Rham operator and instanton calculus, local families index techniques, the Berezin integration and localization of estimates using finite propagation speed. The book contains a full presentation of results announced earlier by the authors in Compt.Rend.Acad.Sci. (vs)

T. S. Blyth, E. F. Robertson: *Further Linear Algebra,* *Springer Undergraduate Mathematics Series, Springer, London, 2002, 230 pp., 34,95 euros, ISBN 1-85233-425-8*

The book is a continuation of the authors' *Basic Linear Algebra* published in the same series. After a summary of the contents of that volume, the authors proceed to inner product spaces and elements of direct sum decompositions of linear spaces. Then they come to the heart of the book, the primary decomposition theorem. This theorem is subsequently applied to prove the Jordan form theorem and various canonical forms for real and complex matrices. There is also a section on dual spaces and another one on bilinear and quadratic forms. The authors also included a section on the use of MAPLE in linear algebra calculations. Besides numerous well-chosen examples scattered throughout the text, the reader can also enjoy short biographical profiles of twenty one eminent mathematicians associated with the subject. (jtu)

M. B. Bridson, S. M. Salamon, Eds.: *Invitations to Geometry and Topology,* *Oxford Graduate Texts in Mathematics 7, Oxford University Press, Oxford, 2002, 327 pp., £37,50, ISBN 0-19-850772-0*

The purpose of the book is to present several topics in active areas of geometry and topology. Three papers are related to topology and discrete groups. The paper by A. J. Berrick contains a review of results and conjectures about perfect groups. In particular, acyclic groups are studied. The contribution by M. R. D. Bridson relates geometry and the word problem. It includes a discussion of the Filling theorem and the Dehn function. In the paper by M. C. Crabb and A. J. B. Potter, the reader can find a description of the Fuller index in the setting of equivariant fiberwise stable homotopy theory. The other five papers are related to contemporary problems in differential geometry. M. Eastwood and J. Sawon wrote an article describing the Borel-Weil construction of finite-dimensional holomorphic representations of *GL(n,C)* on spaces of holomorphic sections of certain vector bundles over $P_n(C)$. The paper by M. A. Guest is an overview over contemporary results and problems in finite-dimensional Morse theory, using Grassmannians as the main motivating examples. N. Hitchin wrote a paper on a key concept both for mathematics and theoretical physics – the Dirac operator on spin manifolds. Particular attention is devoted to the case of low dimensions; it includes a discussion of Higgs bundles and of magnetic monopoles. The contribution by S. M. Salamon on Hermitian geometry discusses several aspects of the theory of complex structures, depending on the existence of compatible Riemannian metric. It contains also a discussion of the Goldberg conjecture and the theory of connections on vector bundles related to these geometric structures. The paper by J. Seade is an expository paper on indices of vector fields and characteristic classes for singular varieties. This collection of eight articles is prepared by former students of Brian Steer, and it is dedicated to him. The list of research publications of B. F. Steer is presented in an appendix. The book contains rich and interesting material covering a broad part of geometry and topology which is explained in an accessible way. It is without any doubt an excellent book for graduate students as well as for mathematicians from other fields interested in these topics. (jbu)

B. J. Cantwell: *Introduction to Symmetry Analysis,* *Cambridge Texts in Applied Mathematics, Cambridge University Press, Cambridge, 2002, 612 pp., £35,95, ISBN 0-521-77183-8, ISBN 0-521-77740-2*

The book is an introductory text on symmetry analysis based on Lie group theory. After an interesting historical preface, the author introduces basic tools for symmetry analysis. He shows how dimensional analysis can be applied to deduce some laws of physics. Symmetry analysis is then applied to several special situations. The following two chapters contain a basic introduction to systems of ordinary differential equations, first order partial differential equations and to classical Hamiltonian mechanics. The next chapter contains a precise definition of one-parameter Lie groups; the author also describes basic tools needed later on: Lie series and Lie algebras. The following chapters show how Lie group techniques can be applied to a study of several problems: ordinary differential equations, partial differential equations as well as several special problems in fluid mechanics (boundary layer models, incompressible Navier-Stokes equations, compressible Euler equations and a certain model of turbulence). The calculation of the determining equations of the group is a tedious job. In order to help the reader, the author attached to the book a CD containing a Mathematica-based software for determining these equations as well as a limited tool for solving them. The last part of the book is devoted to Lie-Bäcklund transformations (and applications to conservation laws) and Bäcklund transformations (and applications to the Burgers potential equation and to the Korteweg-de Vries equation). The book contains a large number of solved problems and exercises, which help to understand the theory. It can be recommended as a very nice introductory text for graduate as well as undergraduate students interested in the subject. (mpok)

S.-Y. A. Chang, P. C. Yang, K. Grove, J. G. Wolfson: *Conformal, Riemannian and Lagrangian Geometry. The 2000 Barrett Lectures,* *University Lecture Series, vol. 27, American Mathematical Society, Providence, 2002, 84 pp., US$19, ISBN 0-8218-3210-7*

The book contains three survey articles based on lectures delivered at the University of Tennessee as J. H. Barrett Memorial Lectures. The first part (Partial Differential Equations related to the Gauss-Bonnet-Chern Integrand on 4-manifolds by S.-Y. A.Cheng and P. Yang) is devoted to four dimensional conformal geometry. Conformally invariant curvatures, invariant operators and partial differential equations on 4-dimensional manifolds are studied. In particular, the authors introduce the Weyl curvature tensor and Q-curvature and they study conformal compactification of a complete non-compact locally conformally flat four-manifold with integrable Q. It includes also a study of properties of the second elementary symmetric function $\sigma_2(A)$, where A is the conformal Ricci tensor. The second part by K. Grove (Geometry of, and via, Symmetries) is devoted to a study of properties of the isometry group of Riemannian manifolds and its geometry and topology. Several known examples are presented, the Alexandrov geometry of orbit spaces is described and studied using symmetries. In the last section open problems and conjectures are stated. The third part (The geometry of Lagrangian immersions into symplectic manifolds by J. G. Wolfson) is devoted to a study of Lagrangian immersions and their invariants and to the problem of minimizing volume among Lagrangian cycles inside a Lagrangian homology class. (jbu)

S. K. Chatterjee: *Statistical Thought: A Perspective and History,* *Oxford University Press, Oxford, 2003, 416 pp., £65, ISBN 0-19-852531-1*

It is not easy to describe the contents of this book in a few words. Generally speaking, the author describes the course of development of statistical concepts from the perspective of the present state of the subject. Some chapters of the book emphasize the philosophical context and the others are devoted to the history of selected statistical and probabilistic methods. Anyway, the reader is assumed to have a sufficient knowledge of mathematical statistics. The book is divided into two parts. Part I called *Perspective* is oriented to a philosophical background of statistical thought and an interpretation of probability. Part II called *History* describes the birth of probability theory, fundamental ideas (including the central limit theorem, maximum likelihood, information criteria, outliers, robustness, and many others), and the role of outstanding scientists like Pascal, Bernoulli, Bayes, Laplace, Gauss, Poisson, Galton, Pearson, Student, and Fisher. However, this volume is neither a book on the history nor on the philosophy of statistics. To illustrate the subject of the book, I would like to mention some details about sufficiency described in it. All statisticians know that this concept was introduced by R.A. Fisher in

1922. It is less known (see p. 255) that Fisher discovered the principle of sufficiency when he solved a problem raised by the astronomer and physicist Eddington in a 1914 book on astronomy (Which of the two given estimators of standard errors has a better performance?). But in fact, sufficiency was used already in 1860 by the American statistician Simon Newcomb (see p. 254), who observed that in a sample $X_1,\ldots,X_n$ with replacement from $\{1,\ldots,N\}$, the statistic max X_i in some sense summarizes information from the complete sample. The book can be recommended to teachers and students who are interested in philosophical principles of statistics and in the history of probability and statistics. (ja)

F. Collot: ***Construction of a Well-Ordering on the Continuum: Consequences for the Continuum Hypothesis,*** *Editions Européennes, Paris, 2001, 128 pp., ISBN 2-908082-16-0*

The subject of the book is characterized in the preface as an attempt, which "is perhaps a very particular point of the mathematical sciences, but it is simple and uses no elaborated notion". The author presents a proof of the continuum hypothesis (CH) from set theory. The framework is not usual Zermelo-Fraenkel set theory (ZFC). As informally indicated, a 'missing' axiom is added to ZFC, which makes it possible to present a proof of CH. The author discusses particular 'missing' axioms of set theory (e.g., the axiom of projective determinancy) and he adds various comments on the obtained results. (jmlc)

S.B. Cooper, S.S. Goncharov, Eds.: ***Computability and Models: Perspectives East and West,*** *The University Series in Mathematics, Kluwer Academic Publishers, New York, 2003, 375 pp., US$135, ISBN 0-306-47400-X*

The book contains 15 articles from the classical theory of computability, the computability of aspects of familiar mathematical structures and so called 'recursive model theory'. Some articles are surveys of work inadequately covered elsewhere, some bring important new results, with pointers to a wider context. The contributors, all internationally recognised experts in their fields, have been associated with the three-year Research Project 'Computability and Models'. This project has helped to transform the fragmented European scene into a lively community of researchers; it has helped to overcome an earlier splitting of recursion theory between schools in the East and West. (akuc)

M. A. de Gosson: ***The Principles of Newtonian and Quantum Mechanics: The Need for Planck's Constant, h,*** *Imperial College Press, London, 2001, 357 pp., £50, ISBN 1-86094-274-1*

This book is written for both physicists and mathematicians. The topics treated include Newtonian mechanics, semi-classical mechanics, (non-relativistic) quantum mechanics and its Bohmian interpretation. The main tool in the book is symplectic geometry. A study of symplectic rigidity leads to a semi-classical quantization scheme and to the Maslov index. A use of a general Leray index leads to a definition of a wave form on the phase space. The metaplectic group is a double cover of the symplectic group. A study of its representations is used in a treatment of the Schrödinger equation for a class of Hamiltonians and for a definition of certain Feynman path integrals. (vs)

E. DiBenedetto: ***Real Analysis,*** *Birkhäuser Advanced Texts, Birkhäuser, Boston, 2002, 485 pp., 99,81 euros, ISBN 0-8176-4231-5*

Every teacher of mathematical analysis has seen many books on real analysis, first as a student and later as a lecturer. I am not sure whether it would be completely fair to say that the book under review is the best book on real analysis I have ever seen, but it is certainly a good candidate for this position. I am sure I would like to have this book in my suitcase in case I would have to spend several years on a deserted island. The book covers virtually everything (in real analysis) that a teacher can dream of or that a gifted undergraduate or PhD. student might need for his/her studies and further research. The text is a deep self-contained exposition of all important features of real analysis involving just about the right amount of necessary abstraction and side-trips to various fields of application, such as functional analysis, harmonic analysis, function spaces, Sobolev embeddings, interpolation theory, PDEs, potential theory, etc. Moreover, it covers a number of topics, which appear rarely in introductory textbooks but which are absolutely indispensable in modern studies of mathematical analysis. To name just a few, let me mention covering theorems, the Hausdorff measure, the non-increasing rearrangement of a function, the Marcinkiewicz interpolation theorem, Radon measures, the Rademacher theorem, the Calderón-Zygmund decomposition, the Fefferman-Stein inequality, etc. The material is presented in a truly delightful way. Sufficient motivation for the investigation is given, and theorems are illustrated with a plenty of examples throughout the text. Each chapter is endowed with a `Problems and Complements' section, which give the reader plenty of further opportunities to exercise and to notice tiny links between different subjects. (lp)

S. K. Donaldson: Floer Homology Groups in Yang-Mills Theory, Cambridge Tracts in Mathematics 147, Cambridge University Press, Cambridge, 2002, 236 pp., £50, ISBN 0-521-80803-0

This book is based on a series of seminars on the topic held at Oxford University. It has two different goals. Firstly, it is an exposition of Floer's original work. Secondly, the author develops further aspects of the theory, which did not appear in the literature before. The Floer homology groups are new topological invariants of three-dimensional manifolds. They fit very nicely into a broader scheme inspired by topological quantum field theories. Intuitively speaking, they are middle dimensional holomogy groups of the infinite dimensional space of connections modulo gauges. There are very important relations of the Floer homology groups with invariants of four dimensional manifolds, instantons and Yang-Mills theory. The introduction describes motivations for the theory and its evolution. The first part of the book (Chapt. 2 - 5) contains a systematic treatment of the Floer homology groups of a homology 3-sphere. The second part of the book starts (Chapt. 6) with a description of the relation between the Floer homology groups and the invariants of 4-manifolds defined by Yang-Mills instantons. Chapt. 7 includes a description of a product structure on the Floer homology groups and a discussion showing how the Floer groups fit into topological field theory for a special class of 4-manifolds. In the last chapter, further possible research directions are described. The book gives a nice account of the theory of an interesting topic in contemporary geometry and topology. It can be strongly recommended to anybody interested in new ideas coming from recent important interactions between mathematics and modern theoretical physics. (jbu)

E. B. Dynkin: ***Diffusions, Superdiffusions and Partial Differential Equations,*** *AMS Colloquium Publications, vol. 50, American Mathematical Society, Providence, 2002, 236 pp., US$49, ISBN 0-8218-3147-7*

This is a book on the interplay between linear and semi-linear, elliptic and parabolic differential equations on one side, and the theory of diffusions and superdiffusions on the other side. Superdiffusion can be viewed as a diffusion of a 'cloud' of particles, obeying suitable rules of branching (i.e. birth and death of the particles). There are integral formulas resembling - and greatly generalizing - the classical Feynman-Kac path integrals. The author is a leading expert in the field; he played a key role in the development of probability theory since the fifties. The book gives a detailed treatment of the progress achieved by him and his collaborators in the last 12 years. An intuitive explanation of some of the main ideas is given in the introduction. Part 1 (Parabolic equations and branching exit Markov systems) contains chapters on linear PE and diffusions, BEM systems, superprocesses, semilinear parabolic equations and superdiffusions. Part 2 (Elliptic equations and diffusions) contains chapters on linear EE and diffusions, positive harmonic functions, moderate solutions of the equation $Lu=\psi(u)$, stochastic boundary values of solutions, rough trace, fine trace, the Martin capacity, null sets and polar sets. In the appendices, the reader can find facts on martingales and elliptic differential equations. The book combines both probabilistic and analytic tools with a very high skill; it summarizes the results achieved in an important area, which progressed significantly in recent years. (mzahr)

C.-A. Faure, A. Frölicher: ***Modern Projective Geometry,*** *Mathematics and its Applications, Kluwer Academic Publishers, Dordrecht, 2000, 363 pp., £89, ISBN 0-7923-6525-9*

Opening a book on projective geometry, we expect an investigation of objects occurring in projective space. We expect to meet subspaces, quadrics, algebraic subvarieties, differential submanifolds, and many other objects. The book under review is not of this type, and this explains perhaps, why it carries the title *Modern Projective Geometry*. The main aim of the book is to introduce the category of projective geometries. This means that the authors' goal is to look at projective geometries not only from inside, but also from outside. They adopt a synthetic definition of a projective geometry, and this definition has a fundamental influence on the style of the book. We find deep relations between projective geometries and other mathematical structures. First of all, a relation to lattice theory, i.e., the category of projective spaces is equivalent with the category of projective lattices. Secondly, a relation to closure spaces (and to matroids, in particular), i.e., an equivalence between the category of projective geometries and a category of certain closure spaces. The general approach leads us also to other geometries, e. g. affine geometries, hyperbolic geometries, and Möbius geometries. But this look at projective geometries from outside does not mean that we do not find information about these particular geometries. The book is written according to an excellent plan, and it surely represents a milestone in the development of projective geometry. The text is organized very carefully and each chapter is followed by many exercises. It is a great advantage of the book that it requires very modest prerequisites. Hence, it can be recommended already to undergraduate students in the first year of their study. On the other hand, I expect that also professional mathematicians will appreciate it. (jiva)

G. Halbout, Ed.: *Deformation Quantization,* *IRMA Lectures in Mathematics and Theoretical Physics 1, Walter de Gruyter, Berlin, 2002, 236 pp., 34,95 euros, ISBN 3-11-017247-X*
The contributions to this book are based on lectures presented at the joint meeting of mathematicians and theoretical physicists at Strasbourg on deformation quantization. A description of the contents can be found in a short introductory paper by G. Halbout. The survey paper by G. Dito and D. Sternheimer includes a treatment of the Kontsevich formality theorem and its description from the point of view of deformations of algebras over operads. A short note by G. Dito contains a discussion of deformation quantization of covariant fields. The paper by B. Fedosov considers deformation quantization on a symplectic manifold, a canonical trace on the algebra of quantum observables and a variation formula for the trace density. The quasi-Hopf algebras, the Drinfeld twist, quantum affine elliptic algebras, deformed double Yangians and their relations are topics treated in the contribution by D. Arnaudon, J. Avan, L. Frappat and E. Ragoucy. The paper by S. Waldmann describes recent results on the representation theory of the star product algebras arising in deformation quantization. The survey paper by C. Roger contains a discussion of properties of the Lie algebra of vector fields with vanishing divergencies and possibilities for its (generalized) deformations. Abelian deformations of ordinary algebras of functions on (possibly singular) manifolds and related Harrison cohomology are discussed in the paper by Ch. Frønsdal. The relation between Toeplitz algebras and star-product algebras is described in a paper by L. Boutet de Monvel. A construction of star-products on Poisson manifolds and a connection with the Fedosov construction in symplectic case are reviewed by A. S. Cattaneo, G. Felder and L. Tomassini. Finally, D. Tamarkin gives a proof of the Etingof-Kazhdan theorem on quantization of Lie bialgebras using the chain operad of little disks. (vs)

D. A. Harville: *Matrix Algebra: Exercises and Solutions,* *Springer, New York, 2001, 271 pp., 39,95 euros, ISBN 0-387-95318-3*
The author has collected well over 300 exercises from his earlier book *Matrix Algebra From a Statistician's Perspective* into a separate volume and he added solutions. The book also contains extensive and detailed summaries of the relevant terminology and notation. It is thus accessible to anyone familiar with basic concepts of matrix theory and linear algebra. It will be very useful for any teacher of a linear algebra course as a source of exercises of various levels of difficulty. Besides the standard topics covered in any course of linear algebra there are also sections on generalized inverses, matrix differentiation, Kronecker products, minimization of a second degree polynomial subject to linear constraints, and the Moore-Penrose inverse. The second to last section contains various applications of the spectral decomposition of symmetric matrices. (jtu)

W. Haussmann, K. Jetter, M. Reimer, Eds.: *Recent Progress in Multivariate Approximation: 4th International Conference,* *Witten-Bommerholz (Germany), 2000, International Series of Numerical Mathematics, vol. 137, Birkhäuser, Basel, 2001, 265 pp., 98 euros, ISBN 3-7643-6505-6*
This volume presents main results of the Fourth International Conference on Multivariate Approximation held at Witten-Bommerholz in 2000. The book starts with an article by M. Reimer and H. Schwetlick: *J. W. Schmidt in Memoriam*. Jochen W. Schmidt (1931 - 2000) was twice selected by the mathematical community as a leading mathematics reviewer of the German science foundation and participated in the preceding Bommerholz Conferences on Multivariate Approximation. The proceedings contains nineteen selected, peer-reviewed contributions covering the following main topics: interpolation and approximation on compact sets, Kergin interpolation; error asymptotics; radial basic functions; energy minimizing configurations on the sphere; quadrature and cubature formulae, harmonic functions near a zero; blending functions; frames and approximation of inverse frame operators. The list of publications and further data on J. W. Schmidt are enclosed in an appendix. (knaj)

S. Helgason: *Differential Geometry, Lie Groups, and Symmetric Spaces,* *Graduate Studies in Mathematics, vol. 34, American Mathematical Society, Providence, 2001, 641 pp., US$69, ISBN 0-8218-2848-7*
S. Helgason: *Groups and Geometric Analysis,* *Mathematics Surveys and Monographs 83, American Mathematical Society, Providence, 2000, 667 pp., US$56, ISBN 0-8218-2673-5 (reprint of the 1984 edition)*
S. Helgason: *Geometric Analysis on Symmetric Spaces,* *Mathematical Surveys and Monographs 39, American Mathematical Society, Providence, 1994, 611 pp., US$51, ISBN 0-8218-1538-5*
The first book is a new edition of a volume published by Academic Press under the same title in 1978. An appendix entitled *'Some Details'* (consisting of 13 pages of clarifying footnotes) has been added. We recall the content of the book for the younger generation: Elementary Differential Geometry, Lie Groups and Lie Algebras. Structure of Semisimple Lie Algebras, Symmetric Spaces, Decomposition of Symmetric Spaces, Symmetric Spaces of the Noncompact type, Symmetric Spaces of the Compact Type. Hermitian Symmetric Spaces, Structure of Semisimple Lie groups, The Classification of Simple Lie Algebras and Symmetric Spaces.

The second book starts with geometric Fourier analysis on spaces of constant curvature and then develops integral geometry and Radon transforms on Euclidean and two-point homogeneous spaces. The principal chapters deal with invariant differential operators and spherical function theory.

The third book is a continuation of the second book, presenting more recent material. It treats Radon transforms for various double fibrations, the main example being the sets of points and of horocycles in a symmetric space (p.145). Later chapters deal with a geometric Fourier transform on symmetric spaces (noncompact and compact) and range theorems for Radon and Fourier transforms with applications to differential equations. The final chapter deals with eigenspace representations associated with homogeneous spaces. The first book contains a complete table of contents. (ok)

C. W. Henson, J. Iovino, A. S. Kechris, E. Odell: *Analysis and Logic,* *London Mathematical Society Lecture Note Series 262, Cambridge University Press, Cambridge, 2003, 267 pp., £29,95, ISBN 0-521-64861-0*
This book contains three large articles, based on minicourses presented by the authors during the conference 'Analyse & Logique' at Mons, Belgium, in 1997. These papers are: Ultraproducts in Analysis, by C. W. Henson and I. Jovino, Actions of Polish Groups and Classifications Problems by A. S. Kechris and On Subspaces, Asymptotic Structure, and Distortion of Banach Spaces; Connection with Logic, by E. Odell. In each case, the title neatly describes the contents of the corresponding section. Every paper follows the standard pattern of a conference minicourse: It assumes a very low-level familiarity with the subject, explains basic notions and crucial examples, then takes a short path to quite recent deep theorems. Many times, proofs are omitted; instead, emphasis is given to the meaning of theorems and their interrelations. Each paper has its own extensive bibliography. One does not need to be a specialist in analysis to find this book a worthy item in the library. (psim)

H. Iwaniec: *Spectral Methods of Automorphic Forms,* *second edition, Graduate Studies in Mathematics, vol. 53, American Mathematical Society, Providence, 2002, 220 pp., US$49, ISBN 0-8218-3160-7*
The book under review is the second edition of the monograph 'Introduction to the spectral theory of automorphic forms' (the first edition

was published at Biblioteca de la Revista Matemática Iberoamericana, Madrid, 1995) by the same author. It reflects the fact that the book has grown out of lectures given by the author in Spain. Automorphic forms play a central role on the border between analytic number theory, algebra, analysis and geometry; hence it is not an easy task to write a comprehensive and readable introduction to this classical subject. The book under review demonstrates the author's mastery in both a conceptual and a pedagogical direction; it gives a very nice introduction to real analytic automorphic forms and their applications in number theory. Two introductory chapters deal with the hyperbolic metric and eigenfunctions of the Laplacian on the upper half plane, and with Fuchsian groups. The next five chapters form the core of the book. The reader is made familiar with the basic facts concerning cusp forms, Eisenstein series, and their meromorphic continuation based on the Selberg method, using the Fredholm theory of integral equations. Then the author devotes his attention to spectral theory, Kloosterman sums and trace formulas. The Selberg trace formula is applied to the problem of distribution of eigenvalues. The next chapter considers a geometric application, the lattice point problem in the hyperbolic upper half plane of complex numbers. The book provides a very readable textbook on the spectral theory of automorphic forms, not only for those willing to enter this fascinating subject but also for those who need some help to orient themselves in the theory. For the latter group of readers, two appendices provide some necessary background material from classical analysis and special functions. (spor)

G. J. O. Jameson: *The Prime Number Theorem,* *London Mathematical Society Student Texts 53, Cambridge University Press, Cambridge, 2003, 252 pp., £18,95, ISBN 0-521-89110-8*

This is a leisure introduction into basic analytic properties of Dirichlet series, which culminates in proofs of the prime number theorem and Dirichlet's theorem on primes in an arithmetic progression. The book is accessible even to undergraduate students - the prerequisites include standard courses in real and complex analysis but hardly any number theory. The first two chapters collect background material on Abel's summation and elementary properties of Dirichlet series. Chapter 3 treats (two version of) a Tauberian theorem relating the behaviour of Dirichlet's series $f(s) = \sum_{n\geq 1} a(n)n^{-s}$ and the function $A(x) = \sum_{n\geq 1} a(n)$. The prime number theorem is obtained as a special case for $f(s) = -\zeta'(s)/\zeta(s)$. These results are sharpened in Chapter 5 to include estimates for error terms and for zero-free regions of $\zeta(s)$. Chapter 4 is devoted to Dirichlet's theorem and Chapter 6 to an 'elementary' proof of the prime number theorem. Several appendices list background results from real analysis, others discuss numerical calculations of $\pi(x)$ and historical background. (jnek)

J. Jost: *Partial Differential Equations,* *Graduate Texts in Mathematics, vol. 214, Springer, New York, 2002, 325 pp., 59,95 euros, ISBN 0-387-95428-7*

The book is intended for students wishing to find an introduction to the theory of partial differential equations. The author focuses on elliptic equations and systematically develops the relevant existence schemes, always with a view toward nonlinear problems. It includes maximum principle methods (particularly important for numerical analysis schemes), parabolic equations, variational methods, and continuity methods. The book also develops the main methods for obtaining estimates for solutions of elliptic equations; Sobolev space theory, weak and strong solutions, Schauder estimates, and Moser iteration. Connections between elliptic, parabolic and hyperbolic equations are explored, as well as the connection with Brownian motion and semigroups. The book can be used for a one-year course on partial differential equations. Having some experience in teaching PDEs, I am always curious to see a new textbook in the field. I have found the book by J. Jost very well written. The concentration on elliptic equations creates a new possibility for an exposition of the main features of evolution equations. Both the 'Preface' and the 'Introduction' are rather helpful - it could be useful for the reader to come back to them from time to time to put the ideas together. I share the author's opinion that his book helps "in guiding the reader through an area of mathematics that does not allow a unified structural approach, but rather derives its fascination from the multitude and diversity of approaches and methods..." (oj)

J. Jost: *Compact Riemann Surfaces. An Introduction to Contemporary Mathematics,* *second edition, Universitext, Springer, Berlin, 2002, 278 pp., 24 fig., 39,95 euros, ISBN 3-540-43299-X*

The main topic of this book is the theory of compact Riemann surfaces and their connections to other areas of mathematics (two-dimensional differential geometry, algebraic topology, algebraic geometry, the calculus of variations and the theory of elliptic partial differential equations). The discussion includes three fundamental theorems: the Riemann-Roch theorem, the Teichmüller theorem and the uniformization theorem. One of the main tools used throughout the book is the theory of harmonic maps. The book can be also taken as a nice introduction to nonlinear analysis applied to geometry. The first chapter contains background material from topology (e.g., fundamental group and covering spaces). In the second chapter, Riemann surfaces are studied from the point of view of two-dimensional Riemannian geometry. It includes a discussion of curvature, the Gauss-Bonnet theorem, of special Riemann surfaces which are quotients of the Poincaré upper half plane with a hyperbolic metric, and of conformal structures on tori. The third chapter is devoted to the study of the Dirichlet principle and harmonic maps. Teichmüller theory is presented in the fourth chapter, the topological structure of Teichmüller spaces is described and the uniformization theorem for compact Riemann surfaces is proved. The last chapter contains an algebraic geometry approach to Riemann surfaces; homology and cohomology groups of Riemann surfaces are introduced and their relations to forms are given. The main topic is the Riemann-Roch theorem and the Abel theorem on elliptic functions. The book gives an excellent description of the contemporary theory of Riemann surfaces; it can be recommended to all mathematicians interested in the field. (jbu)

N. V. Krylov: *Introduction to the Theory of Random Processes,* *Graduate Studies in Mathematics, vol. 43, American Mathematical Society, Providence, 2002, 230 pp., US$35, ISBN 0-8218-2985-8*

The author, one of the leading researchers in the field of stochastic control, presents an introductory and, at the same time, advanced text aimed at undergraduate students majoring in probability and statistics. The theory of random processes, an extremely vast and complex part of mathematics, is laid out gradually and in a manner that respects the student's mathematical background; the presentation is rigorous and, importantly, allows him/her to appreciate the true probabilistic flavour of the formal theory. The main topics of the book are Wiener process, stationary processes, infinitely divisible processes and the Itô stochastic calculus that includes the strong theory of stochastic differential equations. There are some methodological novelties to be found in the text that deserve to be mentioned: The Itô stochastic integral which is introduced at a very early stage (Chapter 2) is viewed as a particular case of the integral with a random orthogonal measure as the integrator. Stochastic integration in this generality is extensively used. The spectral representation of trajectories of stationary processes and a representation of trajectories of infinitely divisible processes through jump measures are examples. About 130 exercises (hints available) accompany the bulk of mathematical reasoning, some of them being used in the main text. The reviewer's opinion is that the book meets the advertised purposes and may well serve as an introduction to the modern theory of stochastic processes. (jste)

H. W. Kuhn: *Lectures on the Theory of Games,* *Annals of Mathematics Studies, no. 7, Princeton University Press, Princeton, Oxford, 2003, 107 pp., £17,95, ISBN 0-691-02772-2, ISBN 0-691-02771-4*

This remarkable publication is based on Harold Kuhn's lectures on the theory of games held in 1952 at the Princeton University. It was supposed to appear in the Annals of Mathematical Studies in 1953 but the author decided to extend the contents substantially and to postpone the publication. However, the intended extension for games of more than two persons did not take place and finally, with the delay of 50 years, Princeton University Press published the original text. As a whole, the book provides interesting and valuable author's insights on the theory of games, a new mathematical discipline developing rapidly a half a century ago. Matrix games are presented in Section 2 along with necessary results from convex analysis and an interesting survey of alternative proofs of the minimax theorem. The next section is devoted to games in the extensive form and the last section deals with the games on unit square and includes also basic concepts of measure theory and probability. The book contains many illuminating and motivating examples. Numerous exercises appear at well chosen places of the text to support reader's understanding. (jdup)

S. Majid: ***A Quantum Groups Primer,*** *London Mathematical Society Lecture Note Series 292, Cambridge University Press, Cambridge, 2002, 169 pp., £24,95, ISBN 0-521-01041-1*
This book is based on lectures of the author on the subject and it keeps the style of oral lectures in a nice and pleasant manner. The book is divided into three parts. Basic notions (Hopf algebras, dual pairings, actions and coactions, the quantum plane, quasitriangular Hopf algebras and its ribbon version, the quantum double), together with a well chosen set of basic examples used throughout the book are presented in the first part. Representation theory and its famous applications in knot theory are treated in the second part using the point of view of braided categories (including (co)module categories, q-Hecke algebras, quantum dimension, algebras in monoidal categories, braided groups and braided differentiation). Applications of these methods to ordinary Hopf algebras are described in the last part of the book. The reader finds here a discussion of (double) bosonisation, Serre relations, *R*-matrix methods, Hopf algebra factorizations and Lie bialgebras, together with applications to Poisson geometry. Three problems sets can be found at the end of the book. The book is self-contained and supposes only a basic knowledge of algebra and linear algebra. Many intuitive comments and informal remarks, a well chosen set of main examples used systematically in the book and a clear and understandable style make the book very comfortable and useful for students as well as for mathematicians from other fields. (vs)

R. J. McEliece: ***Theory of Information and Coding,*** *Encyclopedia of Mathematics and its Applications 86, second edition, Cambridge University Press, Cambridge, 2002, 397 pp., £60, ISBN 0-521-00095-5*
This book is a self-contained introduction to basic results in the theory of information and coding. It has three parts. The introduction contains a short and elementary overview leading the reader to basic concepts of coding. The first part is devoted to the main results of Shannon's mathematical theory of communication. After a reference section collecting technical results about entropy, mutual information, etc., the author develops techniques that are necessary to prove Shannon's fundamental results, the channel and source coding theorems. The first part ends with a survey of advanced results. The second part is devoted to a study of specific codes, which can be used for channel and source coding. It deals with linear codes in general, with cyclic codes, BCH, Reed-Solomon, and related codes. There are also chapters on convolutional codes and on variable-length source coding. The second part ends with a survey of advanced topics, as well. Appendices contain basic information on probability theory, convex functions, Jensen's inequality, finite fields, and path enumeration in directed graphs. A prior knowledge of these areas is not a necessary prerequisite but it will certainly make it easier to follow the presentation. (jtu)

K. H. Parshall, A. C. Rice, Eds.: ***Mathematics Unbound: The Evolution of an International Mathematical Research Community, 1800-1945,*** *History of Mathematics, vol. 23, American Mathematical Society, Providence, 2002, 406 pp., US$85, ISBN 0-8218-2124-5*
The book is an excellent work on the history of national and international mathematical communities and on the process of its internationalization in the period between 1800 and 1945. The book is divided into 18 chapters written by 20 authors (T. Archibald, E. Ausejo, J. E. Barrow-Green, A. Brigaglia, J. W. Dauben, S. E. Despeaux, D. D. Fenster, H. Gispert, I. Grattan-Guinness, J. J. Gray, M. Hormigón, O. Lehto, J. Lützen, L. Martini, K. H. Parshall, A. C. Rice, Ch. Sasaki, S. L. Segal, R. Siegmund-Schultze and Y. Xu). Each chapter describes the evolution of mathematical communities, research and education trends in relation to the political and economical situation in Europe (France, Britain, German, Italy, Spain) and in America and Asia (China and Japan). Special attention is paid to the American, Chinese and Japanese mathematical communities as well as to the situation in German after 1933. The book describes the role of the most important European mathematicians (including Ch. Hermite, G. Mittag-Leffler, C. Arzelà, L. Dickson), the significance of the most important European mathematical journals (for example, Journal de mathématiques pures et appliquées, Acta Mathematica), the creation of national mathematical societies (e.g., Société mathématique de France, Circolo mathematico di Palermo), the development towards the creation of the international congress of mathematicians and the establishment of the International Mathematical Union. A lot of references to published as well as unpublished sources and many historical and bibliographical notes appear in each chapter; hence the book can influence future investigations of interesting historical questions connected with the internationalization of research-level mathematics. The book can be recommended not only to historians of mathematics but also to professional mathematicians, teachers and students who want to understand the creation of international mathematics. (mnem)

F. Pierrot: ***K-Théorie et Multiplicités dans $L^2(G/\Gamma)$,*** *Mémoires de la Sociéte Mathématique de France 89, Sociéte Mathématique de France, Paris, 2002, 85 pp., FRF 150, ISBN 2-85629-119-8*
The author proves a generalization of Atiyah's L^2-index theorem, from which he deduces a *K*-theoretical version of Langlands' theorem on the multiplicity of discrete series representations occuring in $L^2(G/\Gamma)$. Using recent results of V. Lafforgue, the author then deduces a generalization of Langlands' results to a larger class of groups. (jnek)

D. Pollard: ***A User's Guide to Measure Theoretic Probability,*** *Cambridge Series in Statistical and Probabilistic Mathematics, Cambridge University Press, Cambridge, 2002, 351 pp., £60, ISBN 0-521-80243-3, ISBN 0-521-00289-3*
Which parts of measure theory should a student of mathematics (statistics, finance, etc.) know in order not to be frustrated by an advanced and rigorous course on probability theory? An obvious answer is that the standards on abstract integration and construction of a measure are not enough when nowadays, even at the undergraduate level, topics such as martingales and Brownian motion are often included. The text is written in an economic way, but space is left also for heuristics and history with the aim to introduce the reader to probabilistic inventiveness and thinking. Integration is developed first via extended linear functionals on spaces of measurable functions (in Appendix A); then follow basic probabilistic topics like independence, conditioning, martingales and Fourier transforms. The central limit theorems, convergence to Brownian motion, strong representations, couplings and the law of iterated logarithm receive a deep and detailed treatment to provide the reader with a solid information on more recent developments in the Gaussian branch of probability. The text includes also sections that may be considered really advanced (the martingale characterization of Brownian motion, option pricing via equivalent martingale measures and the disintegration procedures being a sample of them). The formal mathematical material is accompanied by solved exercises and by a collection of frequently challenging problems. A really useful book for everybody who faces students interested in modern probability without a preliminary knowledge of measure and integration theory. (jste)

I. R. Porteous: ***Geometric Differentiation. For the Intelligence of Curves and Surfaces,*** *second edition, Cambridge University Press, Cambridge, 2001, 333 pp., £24,95, ISBN 0-521-81040-X, ISBN 0-521-00264-8*
This book presents an introduction to the local differential geometry of curves and surfaces in Euclidean space. All standard parts of the theory (plane curves, curves in three-dimensional space studied by Frenet frame methods and surfaces in three-dimensional space) are included but there are also some additional topics. Both the style of the book and its content are inspired by ideas and the work of R. Thom and V. I. Arnold on singularity theory. Several topics related to singularities such as umbilics, cusps, probes and ridges and ribs for surfaces are presented in details. Topics discussed in the book include moreover plane kinematics, curves on the unit sphere, multilinear forms and their applications in geometry, probes and contacts. In surface theory, ridge and rib points as well as umbilics are studied very intensively. The discussion of parabolic and subparabolic lines on a regular surface is interesting. Some concepts and results of V. I. Arnol'd regarding curves on S^2 and its extension to curves and surfaces on S^3 can be found in the last chapter. There are many historical notes and comments throughout the book as well as some curiosities. It is a very good and interesting introduction to differential geometry of curves and surfaces, which can be recommended to anybody interested in the subject. (jbu)

A. Pressley, Ed.: ***Quantum Groups and Lie Theory,*** *London Mathematical Society*

Lecture Note Series 290, Cambridge University Press, Cambridge, 2002, 234 pp., £27,95, ISBN 0-521-01040-3
This book is based on the LMS Symposium on quantum groups held at Durham in 1999; it contains papers based on lectures presented there. There are two surveys papers presenting the content of two lecture series. The first one (written by S. Ariki) contains an introduction to cyclotomic Hecke algebras using the language of Fock spaces and their relation to the study of solvable lattice models in statistical mechanics. The second one (by P. Etinghof and O. Schiffmann) contains a description of the classical and quantum dynamical Yang-Baxter equation and its applications to the theory of integrable systems and to representation theory. The book contains moreover 11 papers on various topics in the field. They are written by E. Beggs (group doublecross products), R. Carter and R. Marsh (canonical bases), V. Chari and A. Pressley (modules of quantum affine sl_2), B. Drabant (balanced categories and Hopf algebras), K. R. Goodearl (quantized primitive ideal spaces), I. Gordon (quantum groups at roots of unity), J. Ding and T. J. Hodges (YB equation for operators on function fields), S. Majid (twisting of quantum groups), I. M. Musson (finite quantum groups and pointed Hopf algebras), D. Parashar and R. J. McDermott (quantum and Jordanian deformations) and H. Wenzl (tensor category and braid representations). This is an interesting collection of papers in the field. (vs)

B. Rustem, M. Howe: ***Algorithms for Worst-Case Design and Applications to Risk Management,*** *Princeton University Press, Princeton, 2002, 389 pp., £52, ISBN 0-691-09154-4*
Risk management topics are treated in this book in a way that is different from what the reader might think of first. World-wide experience during the last decade shows, that it is perhaps more realistic to consider worst possible scenarios in the financial world than just to perform inference based on more optimistic criteria. The roots of the presented ideas and methods arise in part from the theory of games, in particular from the minimax principle. This seems to be the leitmotif. The title of the book does not really describe the content of the book and may be misleading. There is much more in the book than just algorithms. Most of the key concepts of financial mathematics are clearly explained and discussed in the text. Nevertheless, the fundamental idea of 'worst-case' is thoroughly kept through the whole text. Let us describe just a sample from a broad area of topics covered in the book's eleven chapters: computing of saddle points, numerical experiments with minimax algorithms, strategies for securities' hedging, simulation studies, asset allocation problems, asset-liability management including immunization, and currency management. In the bonanza of books on mathematical finance and/or financial mathematics, the book under review is surely an exception. The presented ideas may be exploited both in theory and practice. Strongly recommended to anyone with interest in financial mathematics and keen to acquire non-standard pieces of knowledge of standard and other financial problems. The book is also recommended to practitioners. (jh)

M. Schatzman*: Numerical Analysis: A Mathematical Introduction,* *Clarendon Press, Oxford, 2002, 496 pp., £24,95, ISBN 0-19-850852-2, ISBN 0-19-850279-6*
This book provides an elegant mathematical introduction to numerical analysis summarizing some of the required knowledge from linear algebra, Fourier analysis, functional analysis and partial differential equations. It covers many basic ideas of modern numerical computing, with an emphasis on methods and algorithms. The book is divided into four parts. Part I starts with a guided tour on floating number systems and machine arithmetic. The exponential and logarithms are constructed from scratch to present a new point of view on well-known questions. Part II consists of 5 chapters. It starts with polynomial approximation (polynomial interpolation, mean-square approximation, splines). It deals moreover with Fourier series, providing the trigonometric version of least-square approximations, and with one of the most important numerical algorithms, the fast Fourier transform. Part III (Chapters 9-12) relates to numerical linear algebra. This part is important because operation counts are the limiting factor for any serious computation. Chapters 9-11 deal with direct and iterative methods for the solution of linear systems of equations, with an emphasis on operation counts. Chapter 12 presents orthogonality methods for the solution of linear systems and introduces the *QR* decomposition. Part IV (Chapters 13-18) treats a selection of non-linear complex problems: the numerical computation of eigenvalues and eigenvectors of a square matrix (the power method, the *QR* method), solution of nonlinear equations and systems, ordinary differential equations (single-step and linear multistep schemes), and the numerical analysis of some partial differential equations. Each chapter contains several exercises. The examples are carefully selected and illustrate many important ideas in the field. The book does not assume any previous knowledge of numerical methods and is written for advanced undergraduate students in mathematics. It will also be useful for scientists and engineers wishing to learn whether mathematics can explain why their numerical methods work - or fail. (knaj)

J. Sjöstrand: ***Complete Asymptotics for Correlations of Laplace Integrals in the Semi-classical Limit,*** *Mémoires de la Société Mathématique de France 83, Société Mathématique de France, Paris, 2000, 104 pp., FRF 150, ISBN 2-85629-097-3*
The book summarizes progress achieved by the author and others (V. Bach, T. Jecko) in the study of the correlation decay for Laplace integrals of the type $\int exp\{- \phi(x)/h\}dx$ in the low temperature regime, i.e., for small values of h. The variable x is taken from R^{Λ}, where Λ is either a d-dimensional torus, or a finite subset of an infinite lattice. The function $\phi(x)$ is assumed to satisfy a certain condition of positive definiteness for its second derivative near its (unique) minimum point. The case of 'one potential well', with 'nearly quadratic' behaviour around the minimum point is thus considered. The main result of the book is the following: A detailed formula for the pair correlation function $<x_i\, x_j>$ is given as an expansion in the variable h, (the expectation $< >$ is given in the above mentioned Gibbs measure). The result is rather general and greatly improves earlier results, due to the author and others. The essential tool used in the proof, introduced already in the previous works by Helffer and Sjöstrand, is the formula expressing the pair correlation function in terms of the 'Witten Laplace' operator (defined as the Hodge Laplacian with the help of the corresponding creation/ annihilation operators). The problem is then translated to the study of spectral properties (bottom of the spectrum) of such an operator, more precisely of its zeroth and first part, applying a method called the 'Grushin (Feshbach) approach' by the author. The book is divided into twelve short chapters and two appendices. Chapter 0 and 1 introduce the problem and formulate the main result (and its generalization); the remainder develops the details of various steps of the proof (reshuffling of the creation/ annihilation operators, investigation of higher order Grushin problems, asymptotics of the correlations, etc.). The method developed in the presented book is an important contribution to a subject which has great importance in statistical physis and quantum field theory and which was up to now treated in the literature by quite different methods, like cluster expansions. (mzahr)

E. M. Stein, R. Shakarchi: ***Complex Analysis,*** *Princeton Lectures in Analysis II, Princeton University Press, Princeton, 2003, 379 pp., £35, ISBN 0-691-11385-8*
The book is the second volume of a 'miniseries' of four books forming a course of analysis. While the first three volumes contain introductory Fourier analysis, complex analysis and measure and integration theory (with Hilbert space theory), the last one covers some parts of functional analysis, probability theory, etc. The main idea behind the series is to explain these parts in a unified way accenting their mutual interplay. The book under review contains (together with traditional parts, like the Cauchy theorem and its consequences, meromorphic functions, entire functions or conformal mapping) also chapters on zeta functions and the prime number theorem, elliptic functions, and on applications of theta functions. Two appendices deal with asymptotics and simple connectivity and with the Jordan curve theorem. The style of exposition is similar to the classical book by Rudin. The book contains numerous exercises (165) and problems (50) with hints (some of the problems are rather demanding). The authors hope that the book(s) will be accessible to students interested in diverse disciplines (mathematics, physics, engineering, finance), at both the undergraduate and graduate levels. (jive)

G. Tourlakis: ***Lectures in Logic and Set Theory, vol. I: Mathematical Logic,*** *Cambridge Studies in Advanced Mathematics 82, Cambridge University Press, Cambridge, 2003, 238 pp., £47,50, ISBN 0-521-75373-2*
G. Tourlakis: ***Lectures in Logic and set Theory, vol. II: Set Theory,*** *Cambridge Studies in Advanced Mathematics 83, Cambridge University Press, Cambridge,*

2003, 575 pp., £65, ISBN 0-521-75374-0
These two volumes present a basic course on mathematical logic and set theory. The contents are standard, including first order languages, axioms and rules of inference, basic metatheorems, the Löwenheim-Skolem theorems, Gödel's completeness theorem, the compactness theorem, and full proofs of both Gödel's incompleteness theorems in the first volume; the axioms of Zermelo-Fraenkel set theory, the axiom of choice, the natural numbers, partially ordered sets, ordinal and cardinal numbers with their elementary arithmetic, the constructible universe and elements of forcing in the second volume. Extreme care paid to details; most of the material is explained twice, first at an informal level and then formally; plenty of footnotes are added to sharpen the reader's understanding. This approach (together with a verbatim repetition of 57 pages from Volume 1 in Volume 2) may be appreciated by a student, who wishes to find every dot on every *i*. But it consumes a lot of space and consequently makes it impossible to include more advanced chapters: the rationals and the reals are not constructed, except for the Δ-system lemma, infinitary combinatorics is not introduced, the basics of Borel and of projective sets is missing and widely used principles, like MA, are never mentioned. (psim)

R. A. Wilson: *Graphs, Colourings and the Four-colour Theorem*, *Oxford Science Publications, Oxford University Press, Oxford, 2002, 141 pp., £19,50, ISBN 0-19-851062-4, ISBN 0-19-851061-6*

The theory of graph colouring has flourished over decades (in fact, already for one and a half centuries) with the planar map colouring problem having been its corner stone. Considered first as a riddle, the Four Colour Conjecture had soon turned into a nightmare for discrete mathematicians and graph theorists. But it was a nightmare with a very positive influence on the development of graph theory. Through numerous attempts and false proofs, it has motivated new notions, new theorems and new theories. And finally its solution, the proof that turned the Four Colour Conjecture into the Four Colour Theorem, is one of the strong concrete links between discrete mathematics and computer science. The proof depends heavily on computers, and no human being can check all details and cases, which is a blessing in the eyes of (most) computer scientists and rather a weird feature in the eyes of (some) mathematicians. The book under review presents a concise monograph on graph colouring results connected to the Four Colour Theorem. It describes ideas of early attempts, points out mistakes in published false proofs and gives a quite legible outline of ideas behind the computer-aided proofs. On the way to concluding sections, several classical results are presented, including the Euler formula for plane graphs, and theorems of Heawood, Brooks and Vizing. The last section contains a detailed and useful exposition of the discharging method. A certain drawback of the book is the lack of presentation of recent new results and directions in graph colouring - an area, which is very rich both in applications and theoretical results. Many classical results on colourings not directly related to the Four Colour Theorem are left out as well. Anybody seriously interested in graph colourings would thus need to look for other sources for further reading. On the other hand, the book provides a neatly wrapped up history of the Four Colour Conjecture; it is moreover published in the year of its 150th anniversary. As such it will please every reader. And last but not least, it is a thin book, which will not eat much space in your library; the contents to weight ratio is well above the average. (jk)

R. Wilson*: Four Colours Suffice,* *Penguin, London, 2002, 262 pp., £12,99, ISBN 0-713-99670-6*
The Four Colour Problem was one of the most famous problems of mathematics of the 20th century. The problem even attracted the attention of the general public. Even the solution of the problem was accompanied by doubts, and it was the starting point for a discussion about the nature of mathematical proofs. The present book accurately describes the origin and the colourful history of the problem and various proof attempts. The book is written for a general public; the recent development (such as work of Robertson, Seymour and Thomas) is only briefly mentioned. It is a very good popular book. Its lively and accessible form will pave the way also to non-experts and to a non-mathematical audience. (jnes)

B. H. Yandell: *The Honors Class. Hilbert's Problems and Their Solvers,* *A K Peters, Natick, 2002, 486 pp., US$39, ISBN 1-56881-141-1*
This book is devoted to the history of Hilbert's problems and their solutions. The collection of 23 mathematical problems presented by David Hilbert at the ICM in Paris in 1900 became soon a guiding inspiration for mathematicians in the 20th century. The book under review starts with a description of Hilbert's biography and the background of his work and his problems. Then the author describes the achievements and success of people who devoted their lives to solve Hilbert's problem. The first part is about problems 1, 2 and 10 (set theory and real numbers), the second part explains problems 3, 4, 5 and 6 (geometry, specific areas), the third part describes problems 7, 8, 9, 11 and 12 (number theory), the fourth part is devoted to problems 14, 15, 16, 17 and 18 (modern algebra, geometry and graph theory) and the last part discusses problems 13, 19, 20, 21, 22 and 23 (analysis). In all cases, the mathematical substance of these problems, their solutions or the attempts to solve them, short biographical information on mathematicians involved and interesting historical aspects are described. This part of the book can also be appreciated by readers who are not mathematicians. An appendix contains Hilbert's lecture delivered at the Second International Congress of Mathematicians in 1900 (in English) and reprinted from the Bulletin of the American Mathematical Society 8(1902). Ample notes, an extensive selected bibliography and an alphabetical index are included. The book can be recommended to everybody who wants to know more about the birth of modern mathematics in the first half of the 20th century. (mnem)

V. V. Yaschenko, Ed.: *Cryptography: An Introduction,* *Student Mathematical Library, vol. 18, American Mathematical Society, Providence, 2002, 229 pp., US$39, ISBN 0-8218-2986-6*
A very clearly written introduction to cryptography. The presented material is illustrated with many examples and notes, so that the text can be recommended to every novice in the subject. The reader finds information on all useful basic topics and results as well as comments outlining research topics. The book consists of 6 chapters (the English edition does not contain Chapter 6 of the Russian original, entitled 'Computer and Cryptography'), which are written by different authors and which can be read independently of each other to a certain extent. For instance, the last Chapter 6 is based on problems offered at the Russian 'Cryptography Olympiads for High School Students' since 1991. Its understanding requires almost no knowledge beyond standard high school mathematics. The previous five chapters of the booklet provide the reader with the most basic notions and techniques used in the contemporary symmetric and asymmetric cryptosystems. All notions like one-way functions, one-way trapdoor functions, key exchange protocols, or zero-knowledge protocols are discussed in a highly lucid way. Attractive themes like coin flipping over the phone, basic algorithmic number theory (including RSA, factorisation and primality), complexity questions for some number-theoretical algorithms or threshold secret sharing schemes are not missing. The book is well-motivated and can be recommended as first reading to everybody interested in cryptography. (spor)

List of reviewers for 2003
The Editors would like to thank the following for their reviews this year.
J. Andel, A. Barkhudarjan, R. Barták, R. Bashir, M. Becvárová-Nemcová, M. Beneš, L. Beran, B. Maslowski, L. Bocek, J. Bureš, E. Calda, R. Cerný, M. Cihák, T. Cipro, J. Dupacová, J. Drahoš, A. Drápal, M. Engliš, M. Ernestová, E. Fašangová, M. Feistauer, J. Fiala, S. Hencl, D. Hlubinka, J. Hurt, M. Hušek, J. Jelínek, O. John, P. Kaplický, M. Klazar, P. Knobloch, O. Kowalski, D. Král, J. Král, A. Kucera, P. Kurka, J. Lukeš , J. Málek, J. Malý, J. Milota, J. Mlcek, K. Najzar, J. Nekovár, J. Nešetril, B. Novák, L. Pick, M. Plátek, A. Pultr, P. Pyrih, Š. Porubský, L. Poul, D. Pražák, Z. Prášková, M. Pokorný, T. Roubícek, P. Ševera, P. Simon, P. Somberg, V. Soucek, J. Spurný, J. Stará, J. Štepán, J. Trlifaj, J. Tuma, P. Valtr, J. Vanžura, J. Veselý, M. Zahradník, K. Zvára, J. Žemlicka.

All of the above are on the staff of the Charles University, Faculty of Mathematics and Physics, Prague, except:
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