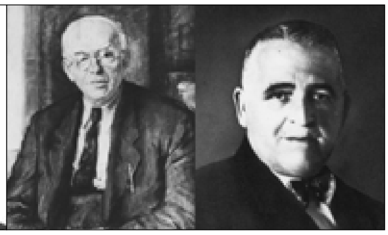
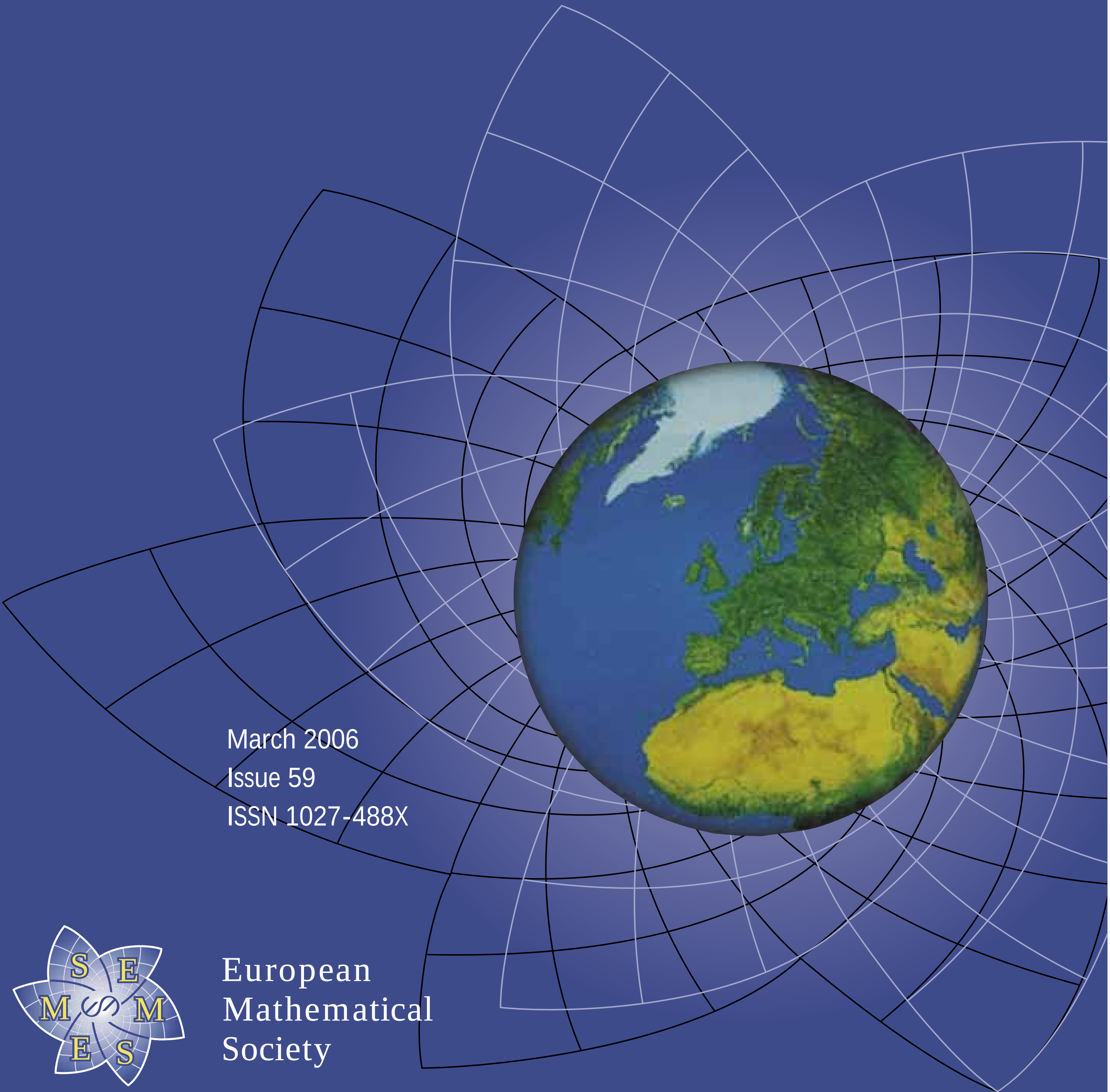
NEWSLETTER

OF THE EUROPEAN MATHEMATICAL SOCIETY





March 2006
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European
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January 2006 | 312 pages | Hardback | £55.00
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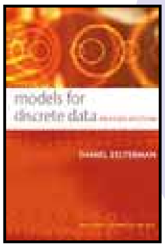
REVISED EDITION

Models for Discrete Data



Daniel Zelterman

This revised edition illustrates the statistical analysis of data using computer programs in SAS, a widely used software package in the health sciences. Many numerical examples are provided to illustrate the methods and these are discussed along with the corresponding computer output.

February 2006 | 352 pages
0-19-856701-4 |978-0-19-856701-1 | Hardback | £50.00

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Stephen Simon

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February 2006 | 208 pages
0-19-856760-X| 978-0-19-856760-8 | Hardback | £65.00
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Mathematical Geophysics

An introduction to rotating fluids and the Navier-Stokes equations

Jean-Yves Chemin, Benoit Desjardins, Isabelle Gallagher, and Emmanuel Grenier

Aimed at graduate students, researchers and academics in mathematics, engineering, oceanography, meteorology and mechanics, this text provides a detailed introduction to the physical theory of rotating fluids, a significant part of geophysical fluid dynamics.

Oxford Lecture Series in Mathematics and Its Applications 32

March 2006 | 256 pages | 0-19-857133-X | Hardback £45.00

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Edited by J. Ferreirós and J. J. Gray

This edited volume, aimed at both students and researchers in philosophy, mathematics and history of science, highlights leading developments in the overlapping areas of philosophy and the history of modern mathematics.

March 2006 | 440 pages
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Category Theory

Steve Awodey

This text provides a comprehensive reference to category theory, containing exercises, for researchers and graduates in philosophy, mathematics, computer science, logic and cognitive science. The basic definitions, theorems, and proofs are made accessible by assuming few mathematical pre-requisites but without compromising mathematical rigour.

Oxford Logic Guides No. 49 | May 2006 | 272 pages
0-19-856861-4 | 978-0-19-856861-2 | Hardback |£65.00

Fourier-Mukai Transforms in Algebraic Geometry

Daniel Huybrechts

This seminal text by a leading researcher is based on a course given at the Institut de Mathematiques de Jussieu. Aimed at students with a basic knowledge of algebraic geometry, the key aspect of this book is the derived category of coherent sheaves on a smooth projective variety. Full proofs are given and exercises aid the reader throughout.

Oxford Mathematical Monographs.| May 2006 | 280 pages
0-19-929686-3 |978-0-19-929686-6 | Hardback | £50.00

Hilbert Modular Forms and Iwasawa Theory

Haruzo Hida

The 1995 work of Wiles and Taylor-Wiles opened up a whole new technique in algebraic number theory and, a decade on, the waves caused by this incredibly important work are still being felt. This book, by a leading researcher, covers both this general area and that of Iwasawa Theory, which is currently enjoying a resurgence in popularity

Oxford Mathematical Monographs.| June 2006 | 400 pages
0-19-857102-X |978-0-19-857102-5| Hardback | £65.00

The Structure of Models of Peano Arithmetic

Roman Kossak and James Schmerl

Aimed at graduate students, research logicians and mathematicians, this much-awaited text covers over 40 years of work on relative classification theory for nonstandard models of arithmetic. The book covers basic isomorphism invariants: families of type realized in a model, lattices of elementary substructures and automorphism groups.

Oxford Logic Guides No. 50 | June 2006 | 304 pages
0-19-856827-4 | 978-0-19-856827-8| Hardback | £50.00

Threading Homology through Algebra

Selected patterns

Giandomenico Boffi and David Buchsbaum

Aimed at graduate students and researchers in mathematics, this book takes homological themes, such as Koszul complexes and their generalizations, and shows how these can be used to clarify certain problems in selected parts of algebra, as well as their success in solving a number of them.

Oxford Mathematical Monographs | June 2006 | 264 pages
0-19-852499-4 | 978-0-19-852499-1| Hardback | £60.00

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EMS Calendar

2006

1 May Deadline for submission of material for the June issue of the EMS Newsletter
Contact: Martin Raussen: raussen@math.aau.dk

15–12 May EMS Summer School at the SIMULA laboratory, Longyearbyen (Norway)
Mathematical model of the heart
Web site: http://home.simula.no/ems2006/, contact: sundnes@simula.no

8–19 May EMS Summer School at Liège (Belgium)
Combinatorics, automata and number theory
Web site: http://www.cant2006.ulg.ac.be, contact: M.Rigo@ulg.ac.be

5–15 June EMS Summer School at Istanbul (Turkey)
Arithmetic and geometry around quantisation
Web site: http://guests.mpim-bonn.mpg.de/agaq, contact: agaq@mpim-bonn.mpg.de

16–18 June Joint EMS–SMAI–SMF Mathematical Weekend in Pays de Loire, Nantes (France)
Web site: www.math.sciences.univ-nantes.fr/WEM2006

30 June EMS Executive Committee Meeting, Torino (Italy)
Contact: Helge Holden: holden@math.ntnu.no

1–2 July EMS Council Meeting, Torino (Italy)
Web site: www.math.ntnu.no/ems/council06/

3–7 July EMS Conference at CRM Barcelona (Catalunya, Spain)
Recent developments in the arithmetic of Shimura varieties and Arakelov geometry
Web site: http://www.crm.es/svag, contact: svag@crm.es

10–15 July *Mathematics and its Applications*: First joint meeting of EMS, SIMAI, SMF, SMAI, and UMI, Torino (Italy)
Web site: www.dm.unito.it/convegniseminari/mathsandapps

10–22 July EMS Summer School at the Renyi Institute in Budapest and at Lake Balaton (Hungary)
Horizon of combinatorics
Web site: http://www.renyi.hu/conferences/horizon/, contact: ervin@renyi.hu or veve@renyi.hu

10–31 July EMS-SMI Cortona Summer School (Italy)
A geometric approach to free boundary problems
Contact: dipartimento@matapp.unimib.it

22–30 August International Congress of Mathematicians, Madrid (Spain)
Web site: www.icm2006.org/

23 August Panel discussion at ICM2006 organised by the EMS.
Should mathematicians care about communicating to broad audiences? Theory and Practice.
Web site: http://www.icm2006.org/scientificprogram/specialactivities/#panel

10–23 September EMS Summer School at Linz (Austria)
Mathematics in molecular cell biology
Website: http://www.ricam.oeaw.ac.at/emsschool ; contact: Vincenzo.Capasso@mat.unimi.it or christian.schmeiser@oeaw.ac.at

A complete list with plans for EMS summer schools (2006–2008) appeared on page 11 of issue 58.

Editorial

John Ball (Oxford, UK)

The ICM returns to Europe

This summer the International Congress of Mathematicians returns to Europe, and will be held for the first time in Spain.

If you have been to an ICM before you will no doubt already be making plans for Madrid. But in case you have never attended one and are fearful of being lost in such a large gathering, let me make some propaganda. ICM 2006 will be my sixth ICM, and I have vivid mathematical and human memories of them all. For many the event begins outside the host city at one of the many satellite meetings. The ICM itself traditionally begins with an impressive Opening Ceremony, at which the winners of the Fields Medals and Nevanlinna Prize are announced and presented with their awards – this year for the first time the Carl Friedrich Gauss Prize, for mathematics that has had an impact in the outside world, will be awarded. The conference itself presents an unrivalled opportunity to choose from more than 180 plenary and sectional lectures on the latest developments from many of the world's leading mathematicians, selected through a careful procedure involving some 150 mathematicians. With such an embarrassment of choice it can be difficult to make an optimal selection, and it is inevitable that you hear later of something terrific that you missed. Then there are the public events, a splendid book and software exhibition, and a varied social programme featuring the special characteristics of the host country. In the end, though, it is the many personal encounters with colleagues from all over the world that contribute most to the experience that is an International Congress.

The Special Development Fund

Of course, to get to the ICM is not just a question of taking a plane. You need the necessary funding, and this may prove difficult to find, especially if you are young and from a developing or economically disadvantaged country. This is where IMU's Special Development Fund (SDF) comes in, which pays for travel for young mathematicians from such countries to attend the ICM. As for previous Congresses the Spanish organizers are generously funding the local costs for travel grant recipients. Unfortunately the money available can only support a small proportion of those that apply. The Special Development Fund is supported entirely by donations from Mathematical Societies. The largest contributor has been the American Mathematical Society, which allows its members to make a donation to the SDF when paying their membership fees, a mechanism that if adopted by more Societies would significantly increase the number of travel grants available. Other countries that have contributed since 2002 are Italy, Japan, the Netherlands and the UK.

IMU and the ICM

While the ICM is the responsibility of the International Mathematical Union, of course the main burden of organization lies with the host country, and our Spanish colleagues have been making tremendous efforts to ensure that the Madrid ICM will be a marvellous occasion. But still the role of IMU is a crucial one, as IMU sets the parameters for the ICM and chooses where it will be held as well as appointing the Program and Prize Committees. Of course this is not all that IMU does, and it is involved in other central issues for the world mathematical community such as electronic information and publishing, mathematical education and how to advance mathematics in developing countries. The supreme body of IMU is the General Assembly, traditionally held just prior to the ICM in a different location to the Congress. The General Assembly is a kind of United Nations of Mathematics, where delegates representing their countries meet to elect the new officers and committee members, to admit new member countries, and to debate and vote on changes to the functioning of IMU. This year the General Assembly will be held in the historic pilgrimage city of Santiago de Compostela, and there will be an exceptionally full agenda involving proposals for improvements to the electoral process for IMU and its Commissions, and to the way IMU supports mathematics in developing countries, as well as discussions on future guidelines for the ICM and on electronic issues.

Finding out more

Should you be interested in finding out more about the ICM and IMU, please visit the IMU webpages at http://www.mathunion.org. Whilst roaming these pages you can subscribe to the new IMU electronic newsletter IMU-Net, past issues of which contain much useful information. I encourage you also to join, if you have not already done so, the Electronic World Directory of Mathematicians, and to learn about the new Federated World Directory of Mathematicians.

I look forward to seeing you in Madrid. Don't miss it!

John Ball is Sedleian Professor of Natural Philosophy at the University of Oxford, and is President of the International Mathematical Union.

Introducing the editorial team: part V

Frédéric Paugam has been maître de conference at University Pierre and Marie Curie (Paris VI) since 2005. He is a member of the operator algebra team at the Mathematical Institute at Jussieu.

He obtained his PhD in 2002 on arithmetic geometry at the University of Rennes with a thesis on abelian varieties and Galois representations. He learned about operator algebras during a two-year Postdoc period (at the University of Regensburg, at the Max-Planck-Institute Bonn and at the IHES) and he did some work on the newly emerging subject of non-commutative arithmetic geometry. Now he continues to study arithmetic geometry, operator algebras and their interactions. Frédéric joined the editorial board of the Newsletter at the beginning of 2006.

His current interests besides mathematics are the sea, piano, dancing and sports. He is engaged to a teacher.

Report on the 3rd EMS-SCM Joint Mathematical Weekend

Barcelona, September 16th–18th, 2005

Marta Sanz-Solé (Barcelona, Chair of the Organising Committee)

Back from holidays

After the summer break, the academic activities of the Catalan Mathematical Society began with the celebration of the third EMS-SCM Joint Mathematical Weekend (JMW), announced in Issue 55 of this Newsletter.

On September 16th–18th, 167 mathematicians from 21 different countries of the five continents came to Barcelona to attend this meeting, including 93 from Spanish universities and 64 from other European countries.

The scientific activities of the JMW took place in the historical building of the Barcelona University where the Faculty of Mathematics is located. The venue was chosen because of the cultural and architectural value of the building and especially its central location.

The opening

The meeting opened at the Aula Magna, the name corresponding to its style rather than its size. The room has been cleverly renovated, keeping an ancient flavour with voluptuous neo-classical pictures on the walls whilst still being equipped with good technical facilities for academic activities.

The Vice President for Research of the hosting institution, Marçal Pastor, chaired the short opening ceremony. He welcomed the participants, expressing his deep respect for mathematicians who are able to work hard, even during weekends.

Carles Casacuberta, President of the Catalan Mathematical Society, addressed the participants, mentioning the admiration the Society has for the tasks that the EMS is doing and stressing its enthusiastic collaboration with its projects. He also appreciated the large response of the participants and the work done by everybody involved in preparation for the meeting.

Sir John Kingman, the EMS President, emphasized the significance of this type of joint mathematical activity and the important role of the EMS in its promotion. He warmly thanked the Catalan Mathematical Society and the Catalan Universities for organising the weekend.

A review of the scientific programme

The scientific topics of the weekend were: Combinatorics and Graph Theory, Dynamical Systems, Evolution Partial Differential Equations and Calculus of Variations, Module Theory and Representations of Algebras and Non-commutative Geometry. The programme built around these fields of mathematics consisted of five plenary lectures and five minisymposia, with about six invited lectures in each one. Readers interested in the exact titles and abstracts of the talks are invited to download the programme booklet at the home page of the meeting: http://www.scm.iecat.net/emsweekend.

Participants could enjoy general overviews about the trends and most recent results on the different areas by attending the plenary lectures by Jean-Christophe Yoccoz, Henning Krause, Henri Berestycki, Alexei Bondal and the closing lecture by Béla Bollobás. They could also learn about more specialized advances in each of the minisymposia.

Participants in the 3rd Joint Mathematical Weekend, Barcelona 2005

Topics addressed in the meeting included arithmetical conditions in dynamical systems problems, Schrödinger equations, celestial mechanics, quantum mechanics, analysis of qualitative properties of layer solutions, self-similar solutions and their stability, analysis of the spectrum, asymptotic behaviour of reaction-diffusion equations, nonlinear diffusions, graph theory, matroids, enumeration, combinatorial number theory, representation dimension and derived categories. Participants could also appreciate important connections between different mathematical fields; for instance, Combinatorics and Probability Theory, Geometry and Evolution Problems.

Conference dinner and the day after

On Saturday evening, the participants met for a pleasant, informal dinner at a restaurant in a leisure complex at the seaside, with wonderful views of the water-front and an excellent Mediterranean cuisine.

It was certainly a little hard to go back to lectures on Sunday morning, especially for those who were not used to the evening summer timing in Barcelona. Nevertheless, mathematicians proved once again to be serious people and the lecture hall on Sunday had a very good attendance. Outside the building, the city was showing a sleepy face, except for one early activity: the popular yearly marathon that for a couple of hours invaded its main streets.

The closing

After Bollobás' plenary lecture, the mathematical weekend closed formally. Sir John Kingman addressed the

Courtyard in Barcelona

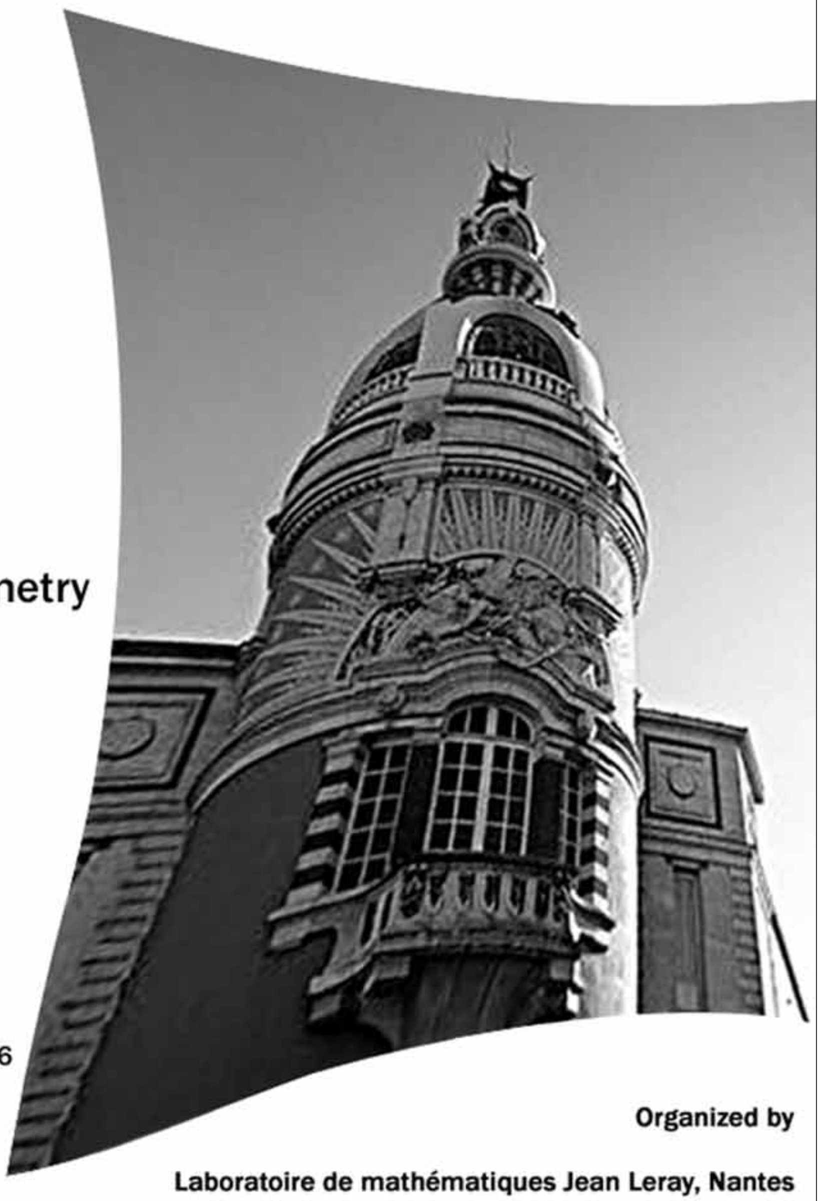
participants, expressing the satisfacti on of the EMS on the development of the event, thanking once more the Catalan Mathematical Society for their organisation and the participants for their presence, and finally announcing the site of the next Joint Mathematical Weekend. It will be in Nantes (France) next June 16th–18th, with a promising choice of topics.

The local organisation, seeing a general impression of happiness among participants, addressed a proud goodbye to everybody. A lovely bunch of roses and orchids appeared miraculously as the curtain went down.

Participants spread out around the town, except the members and invitees of the EMS Executive Committee, who were invited by the Catalan Mathematical Society to start their second meeting of the year shortly after.

Mathematical week-end Nantes - France

June 16-18, 2006



Topics

- Inverse problems
- Large scale stochastics
- Complex algebraic geometry
- Global analysis
- Real algebraic varieties

Speakers, registration, schedule and practical informations

www.math.sciences.univ-nantes.fr/wem2006

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Torino 2006

XX Olympic Winter Games **February 10–26**

Biannual EMS Council Meeting **July 1–2**

Announcement in issue 58 of this Newsletter. Further information: http://www.math.ntnu.no/ems/council06/

Mathematics and its Applications **July 3–7**

A Joint Meeting of
Società Italiana di Matematica Applicata e Industriale, Société de Mathématiques Appliquées et Industrielles, Société Mathématique de France, Unione Matematica Italiana.
Under the Auspices of the European Mathematical Society.

Plenary speakers:

Luigi Ambrosio (SNS, Pisa), Yves André (CNRS, ENS Ulm, Paris), Paolo Baldi (Università di Roma Tor Vergata), Gerard Besson (CNRS, Institut Fourier, Grenoble), Franco Brezzi (Università di Pavia), José Antonio Carrillo (ICREA, Universitat Autònoma de Barcelona), Carlo Cercignani (Politecnico di Milano), Albert Cohen (Universitè Paris 6), Gianni Dal Maso (SISSA, Trieste), Jean-Marc Delort (Université Paris 13), Maria Esteban (CNRS, Université Paris 9), Barbara Fantechi (SISSA, Trieste), Kenneth H.Karlsen (University of Oslo), Cedric Villani (ENS Lyon).

Venue:

Centro congressi unione industriale Torino, Via Fanti, 17, 10128 Torino
Dipartimento di Matematica del Politecnico di Torino, Corso Duca degli Abruzzi, 24, 10129 Torino
Dipartimento di Matematica dell'Università degli Studi di Torino, Via Carlo Alberto, 10, 10123 Torino

Registration:

Through the web site below. Registration includes: badge, conference materials, nine coffee breaks, reception, social dinner, concert.
Registration fee (until April 15/June 15/on site):
150/200/230 for members of UMI-SIMAI-SMF-SMAI-EMS; 190/240/270 for non-members.

Further information:

http://www.dm.unito.it/convegniseminari/mathsandapps/

EMS Committee for Developing Countries

Tsou Sheung Tsun (Oxford, Vice-chair)

A large number of authors for the forthcoming *Encyclopaedia of Mathematical Physics*, edited by Jean-Pierre Francoise, Greg Naber and myself, to be published by Elsevier in May 2006, have donated their honorariums to our committee for our work with developing countries.

So far, one week after the launch of the appeal, we have more than £10,000 (roughly 15,000 euros) pledged. We are most grateful to these colleagues and find it most wonderful that mathematicians are so willing to help their less fortunate colleagues.

Poster Competition at the ICM 2006

www.icm2006.org/scientificprogram/postersessions

Are you interested in participating actively at the next ICM2006? If yes, do not miss the opportunity to submit a poster and to take part in the poster competition.

Remember

- Posters do not evaporate as quickly as short communications.
- They remain on display for several hours and are therefore more visible than oral communications.
- They promote discussion between authors and small groups of researchers in a relaxed and informal atmosphere, often leading to multiple à la carte presentations.

Take part in the poster competition

- You might be awarded one of the first or second prizes in one of the twenty scientific sections of the ICM.
- You might win either 200 or 100 euros and receive a diploma for credit.

And, what is perhaps more important, you will contribute in improving the quality of scientific communication as one of the ingredients for the success of the ICM.

Procedure

1. The author(s) of the *poster* must state whether they intend to take part in the competition by submitting their abstracts for inclusion on the congress website. This statement of intent must be followed up by sending the electronic version of the *poster* in question before June 30th, 2006.
2. The Local Program Committee will be the jury presiding over the competition.
3. Only those *posters* accepted for presentation and whose authors have stated their intention to participate in the competition will be considered eligible by the jury.
4. The jury will base its decisions on the following criteria:
   a) Visual attractiveness and originality of the presentation
   b) Clarity of exposition of scientific data
   c) Quality of mathematical content and suitability of presentation in this form
5. A list of the prize winners in each section will be made public during the congress. Diplomas will be awarded in a ceremony. Further details will appear in due time.
6. The jury reserves the right to declare prizes vacant.

The Ramanujan Prize for Young Mathematicians from Developing Countries

Srinivasa Ramanujan (1887–1920)

The Abdus Salam International Centre for Theoretical Physics (ICTP) is pleased to invite nominations for the 2006 Ramanujan Prize for young mathematicians from developing countries. The Prize is funded by the Niels Henrik Abel Memorial Fund. The Prize carries a $10,000 cash award and an allowance to visit ICTP for a meeting where the Prize winner will be required to deliver a lecture.

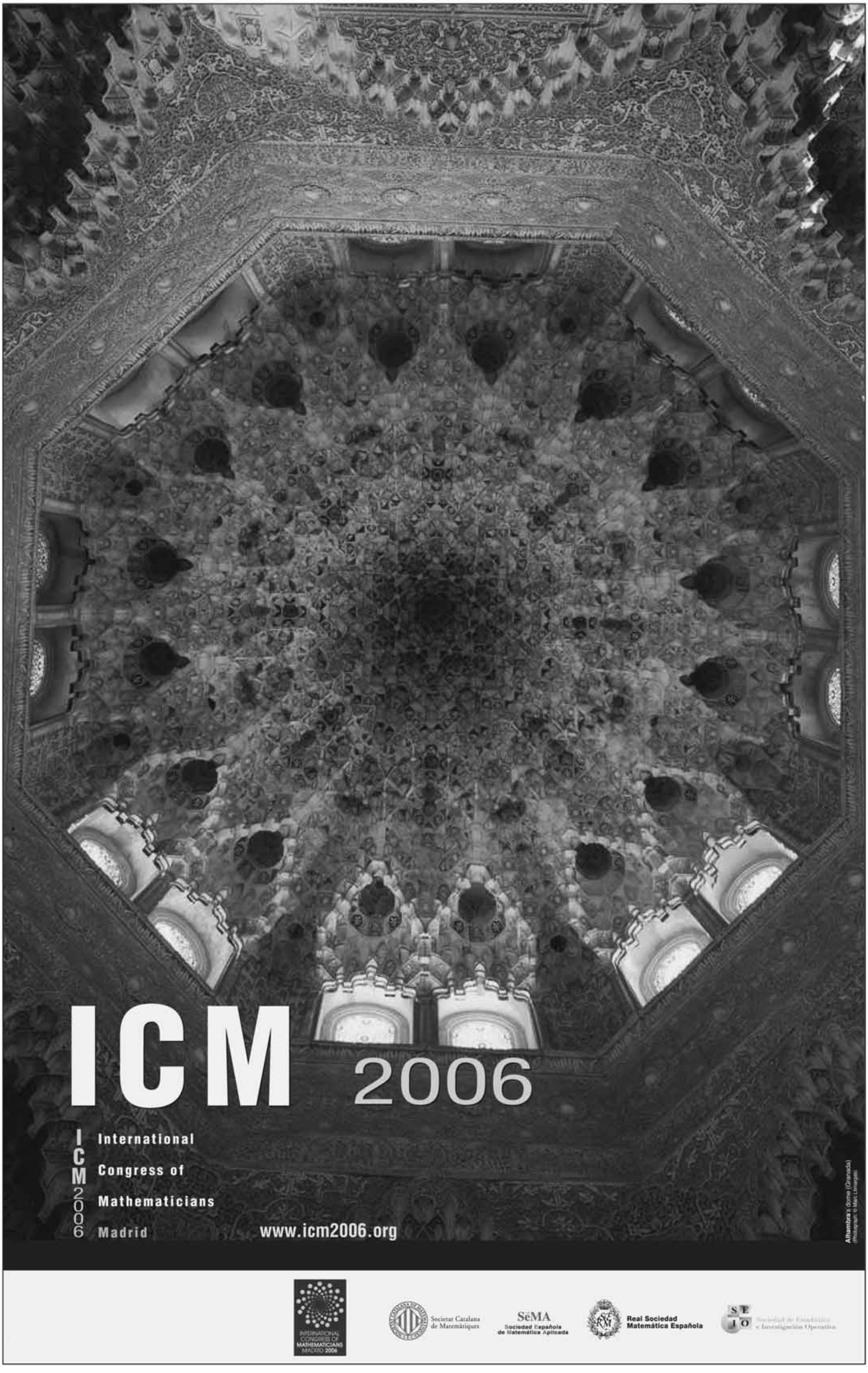
The Prize will be awarded annually to a researcher from a developing country less than 45 years of age on 31 December of the year of the award, who has conducted outstanding research in a developing country. Researchers working in any branch of the mathematical sciences are eligible. The Prize will be awarded usually to one person, but may be shared equally among recipients who have contributed to the same body of work.

The Prize winner will be selected by ICTP through a committee of five eminent mathematicians appointed in conjunction with the International Mathematical Union (IMU). The deadline for receipt of nominations is July 31, 2006.

The first winner of the Prize for 2005 is Professor Marcelo A. Viana from IMPA, Brazil, and the award Ceremony was held at ICTP on December 15, 2005.

Please send nominations to director@ictp.trieste.it describing the work of the nominee in adequate detail. Two supporting letters should also be arranged.


Marcelo Viana, the fist winner of the Ramanujan Prize. (Foto: ICTP Photo Archives, Massimo Silvano)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Poincaré conjecture and Ricci flow An outline of the work of R. Hamilton and G. Perelman

L. Bessières (Grenoble, France)

During the years 2002/2003, the Russian mathematician G. Perelman posted three papers on the Arxiv mathematical server that, if correct, have completed a program begun in the 1980's by R. Hamilton to solve the Poincaré and geometrization conjectures. The key tool of this program is the Ricci flow, a differential equation on the space of Riemannian metrics. The aim of this text is to present this theory, explaining parts of Hamilton and Perelman's work deeply enough to hopefully make the proof of the Poincaré conjecture clear to the reader.

The final part of this article will appear in the next issue of the Newsletter. An extended version (in French) appeared in Gazette des mathématiciens ***106*** *(2005), pp. 7–35.*

Introduction

In this chapter, we give a short presentation of the Ricci flow approach to the Poincaré conjecture. The Poincaré conjecture, the origins of which go back to 1904, can be stated as follows. Noting that a manifold M is simply connected if any continuous map $S^1 \to M$ can be continously deformed to a point,

Conjecture 1 (Poincaré [Po]). *Let M be a 3-dimensional compact simply connected manifold. Then M is homeomorphic to the sphere S^3.*

This question, in the beginning purely topological, has stimulated intensive efforts to understand relationships between topology and geometry. In the geometric approach, one tries to endow M with a Riemannian metric of constant positive sectional curvature.

Richard Hamilton

If M has a differentiable structure, a Riemannian metric g is the smooth data at each point x of M of a scalar product g_x on the tangent space T_xM. The sectional curvature of g assigns to each plane $P \subset T_xM$ a real number $K(P)$. It can be expressed as an infinitesimal deviation of circles tangent to P to have Euclidian length. This generalizes the notion of Gaussian curvature of a surface embedded in $\mathbb{R}^3$. If a Riemannian manifold (M,g) has constant sectional curvature, by a classical result, it is isometric to a quotient of some model space. Up to homothety, there are only three models: the hyperbolic space $\mathbb{H}^3$ ($K=-1$), the Euclidian space $\mathbb{R}^3$ ($K=0$), and the round sphere $\mathbb{S}^3$ ($K=1$). Thus the Poincaré conjecture is a consequence of:

Conjecture 2. *Let M be a 3-dimensional compact simply connected manifold. Then M has a Riemannian metric of constant strictly positive sectional curvature.*

It is a particular case of Thurston's geometrization conjecture, which asserts that every 3-manifold has a canonical topological decomposition into pieces that can be endowed with one of eight model geometries.

The Ricci flow of Hamilton

To put a nice metric on a given manifold M, a natural idea, which seems naïve at first glance, is to take an arbitrary metric g_0 and to deform it by some regularizing process. Following this idea, in 1982, Richard Hamilton introduced the so-called Ricci flow equation [Ha82].

A one-parameter family $g(t)$ of Riemannian metrics on M is called a Ricci flow if

$$\frac{\partial g}{\partial t} = -2\,\mathrm{Ric}_{g(t)}, \qquad (1)$$

where $\mathrm{Ric}_{g(t)}$ is the Ricci curvature of the metric $g(t)$.

This curvature tensor gives a symmetric bilinear form for each tangent plane T_xM. Thus equation (1) makes sense. For the moment, think of it as an average of the sectional curvature that contains less information in general. However, if the Ricci curvature is constant, i.e. $Ric_g = \lambda.g$ for some $\lambda \in \mathbb{R}$, the sectional curvature is constant. Moreover, in dimension 3 the two curvatures are equivalent. If $Ric_{g(0)} = \lambda.g_0$, one can easily check that $g(t) = (1-2\lambda.t)g(0)$ is a solution of (1), for $t \in [0, 1/2\lambda)$ if $\lambda > 0$ and for any $t \geq 0$ otherwise. For example, the Ricci flow on a sphere of constant curvature is a homothety that shrinks the sphere to a point in finite time. On a product $S^2 \times \mathbb{R}$, the Ricci flow shrinks S^2 as above and leaves the $\mathbb{R}$ factor invariant. In general, writing (1) in coordinates, one can view it as a kind of heat equation.

In his seminal paper, R. Hamilton shows short-term existence, for any initial data (M, g_0), of a solution to (1) with $g(0) = g_0$ [Ha82]. To understand the long-term evolution of the flow, one controls the curvature with its evolution equation and makes use of some maximum principles developed for such purposes.

The most striking result of [Ha82] says that if (M^3, g_0) is compact with strictly positive Ricci curvature, then the Ricci flow $g(t)$ with initial data (M, g_0) gets arbitrarily rounder and rounder under the flow, that is the pinching of the eigenvalues of the Ricci curvature improves up to 1. Moreover, a rescaled flow with constant volume converges to a Riemannian manifold of constant strictly positive Ricci (and thus sectional) curvature. The film of the (unscaled) flow would be as in Figure 1.

In the general case, the Ricci flow behaves more wildly. The sectional curvature can explode toward $+\infty$ in some places and remain bounded elsewere, as shown on S^3 in Figure 2.

In this case, the idea of Hamilton was to do surgery on the manifold and start the Ricci flow again on the new manifold. The hope was to find a Ricci flow with controlled geometry after a finite number of operations. The first step is to classify the singularities. The technique developed by Hamilton is to rescale the flow in space and time, obtain Ricci flows with bounded curvature and try to take a limit of these rescaled flows. Then, one would classify the limits and deduce a description of $g(t)$ near points of high curvature. An important problem in this strategy is the existence of limits. A key point was to control the injectivity radius of the metric.

The Ricci flow with surgery of Perelman

The problem above was completely solved by Perelman with the so-called No Local Collapsing Theorem (4.1 in [PeI]). Moreover, Perelman gives the full classification (in dimension 3) of these limits, called κ-solutions. Finally, the Canonical Neighborhood Theorem (12.1 in [PeI]) shows that points with large curvature have neighborhoods close to κ-solutions, thus with canonical geometry. This result is the main achievement of the first paper.

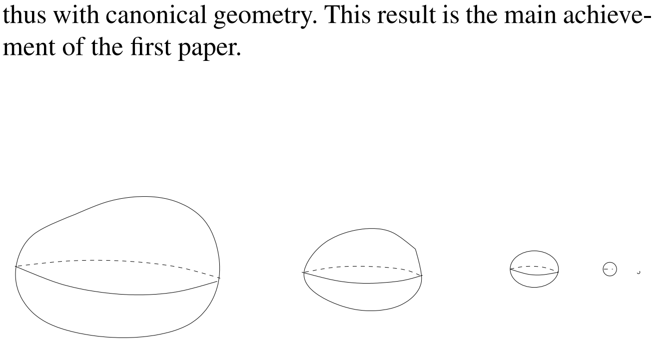

Figure 1. The flow gets rounder

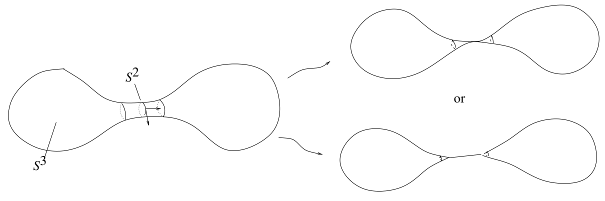

Figure 2. Examples of neckpinches

With this accomplished, Perelman then defines and proves the existence of a Ricci flow with surgery, which was the main goal of Hamilton. In each surgery, one cuts the manifold near points where the curvature explodes, throws away components with large curvature, pastes balls on the other components and runs the Ricci flow again. The deleted components, which are called extinct, have canonical geometry and thus the topological decomposition is controlled.

In a *tour de force*, Perelman shows that this procedure can be repeated indefinitely, unless all components become extinct. Now the proof of the Poincaré conjecture is straightforward, especially if one assumes that the manifold is irreducible. All the extinct components are spheres S^3, thus it suffices to prove that the Ricci flow with surgery becomes extinct in finite time. This is done in [PeIII].

In this issue of the text, we explain the main results of Hamilton and the No Local Collapsing Theorem (NLCT) of Perelman. In the next issue, we'll detail the Canonical Neighbourhood Theorem (CNT), the Ricci flow with surgery and the proof of the Poincaré conjecture.

The Ricci flow equation

Let M denote a 3-dimensional compact connected orientable manifold. One wants to round a Riemannian metric with a heat equation. Ideally, one would minimize some function on the space $\mathcal{M}$ of all Riemannian metrics of M. Then the equation would be given by the opposite of the gradient flow. A natural function on $\mathcal{M}$ is the so-called Einstein-Hilbert functional, that is the integral of the scalar curvature $\int_M R$. Its critical points (on the subspace of Riemannian metrics of volume 1) are exactly those metrics with constant Ricci curvature, i.e. $Ric_g = \lambda g$, which are called Einstein metrics.

Unfortunately, the equation associated to this gradient has no solutions in general. Hamilton proposed (1) as a modification of this equation. This is not a gradient flow but one does have existence and uniqueness of its solutions. This was first proved in [Ha82] using non-trivial analytic machinery and was simplified soon after by a trick of D. DeTurck [DeT], which allows one to use classical results on parabolic equations. Moreover, the solution exists as far as the curvature is bounded. More precisely (see 14.1 in [Ha82] and 8.1 in [Ha95a]),

Theorem 3. *For any smooth initial metric on a compact manifold there is a maximal time T on which there is a unique smooth solution to the Ricci flow for $0 \leq t < T$. Either $T = \infty$ or else the sectional curvature is unbounded as $t \to T$.*

Curvature evolution equations and the positive curvature case

To understand the evolution of the metric, one can consider the curvature evolution equations. Given a Ricci flow $g(t)$ on M, the scalar curvature of $g(t)$ follows the parabolic equation

$$\frac{\partial R}{\partial t} = \Delta R + 2\,|\,\mathrm{Ric}\,|^2, \qquad (2)$$

where all quantities depend on $g(t)$ and the Laplacian is $+tr(D^2)$. This equation implies that the minimum $R_{min}(t)$ of the scalar curvature of $g(t)$ is increasing. Indeed, one has $\Delta R(x,t) \geq 0$ at a minimum x of the scalar curvature of $g(t)$, We summarize some facts about curvatures of 3-dimensional manifolds for the convenience of the reader: The scalar curvature mentioned above is the trace of the Ricci curvature with respect to the metric g; let λ_1, λ_2, λ_3 be the eigenvalues of Ric_g with respect to g_x, then the scalar curvature at x is $R(x) = \lambda_1 + \lambda_2 + \lambda_3$. The Ricci curvature is the trace of the sectional curvature; let (e_1, e_2, e_3) be an orthonormal basis of T_xM and P_{ij}, $(i \neq j)$ be the plane spanned by e_i, e_j, then $\mathrm{Ric}(e_1, e_1) = K(P_{12}) + K(P_{13})$. Only in dimension 3, there is a reverse relation $K(P_{12}) = \frac{1}{2}(\lambda_1 + \lambda_2 - \lambda_3)$, where e_i are eigenvectors of Ric. Thus $R = 2(K(P_{12}) + K(P_{13}) + K(P_{23}))$. Under dilation, the curvatures behave as follows: if $\lambda > 0$, $K_{\lambda g} = \frac{1}{\lambda} K_g$, $\mathrm{Ric}_{\lambda g} = \mathrm{Ric}_g$, $R_{\lambda g} = \frac{1}{\lambda} R_g$.

thus $\frac{\partial R}{\partial t}(x,t) \geq 0$ and, heuristically, the minimum increases. One can make this argument rigorous with a maximum principle. Moreover, if $R_{min}(0) > 0$, one can show that

$$R_{min}(t) \geq \frac{1}{R_{min}(0)^{-1} - \frac{2}{3}t}$$

as far as the flow exists. Thus the maximal time T is finite in this case.

We get more information from the evolution equation of the Ricci curvature, which in dimension 3 has the form

$$\frac{\partial \mathrm{Ric}}{\partial t} = \Delta \mathrm{Ric} + Q(\mathrm{Ric}), \tag{3}$$

where Q is a quadratic expression. With a maximum principle for tensors, Hamilton shows that if $\mathrm{Ric}_{g_0} \geq 0$ then $\mathrm{Ric}_{g(t)} \geq 0$. Moreover if $\mathrm{Ric}_{g_0} > 0$, it holds for any t and we have the pinching

$$\frac{|\mathrm{Ric} - \frac{R}{3}g|}{R} \leq \frac{\alpha}{R^{\beta}}, \tag{4}$$

for some constants $\alpha, \beta > 0$. This means that if $R(x,t) \to +\infty$, $\mathrm{Ric}_{g(t)}$ gets closer to its average $\frac{R}{3}g(t)$ and the pinching of the eigenvalues improves.

Together with a control of the scalar curvature gradient, Hamilton proves that the scalar curvature explodes to $+\infty$ at each point at the same time T and with the same speed. Then he shows that the family of metrics $\tilde{g}(t) = \mathrm{vol}(g(t))^{-2/3} g(t)$, a normalization that makes the volume constant, converges to a metric of constant sectional curvature. This is the main result of [Ha82]:

Theorem 4. *Let M be a 3-dimensional compact manifold with a Riemannian metric of strictly positive Ricci curvature. Then M has a Riemannian metric of constant strictly positive sectional curvature.*

Remark 5. *By a classical result, M is then isometric to a finite quotient of the round S^3. One says that M is a spherical manifold. If M is simply connected, M is diffeomorphic to S^3. This is the first step on the way to the Poincaré conjecture.*

Formation of singularities and the zoom technique

In this section, we consider the more general situation of when the curvature diverges on only a part of the manifold, as in the figure on page 7. One then says that the Ricci flow has a singularity. We consider only 3-dimensional manifolds.

Hamilton-Ivey pinching

First note that the sectional curvature may diverge at a point $x \in M$ for some plane $P \subset T_xM$ only. Think of the round cyclindrical flow $g(t)$ that shrinks $S^2 \times \mathbb{R}$ to a line. If $K(P,t)$ is the sectional curvature of $g(t)$ at $P \subset T_xM$, then $K(P,t) \to +\infty$ if P is tangent to S^2 and $K(P,t) = 0$ if P is normal. This example is representative of the preference of the Ricci flow for positive curvature. The most striking result in this direction is the so-called Hamilton-Ivey pinching ([Ha86],[Iv]): *There exists a positive increasing function $\phi : [-1, +\infty) \to [1, +\infty)$, such that $\frac{\phi(s)}{s} \to 0$ as $s \to \infty$, with the following property. Let $g(t)$ be a Ricci flow on $M \times [0,T)$ such that $R_{min}(0) \geq -1$ and $K_x(\cdot, 0) \geq -\phi(R(x,0))$ for any $x \in M$. Then*

$$\frac{R}{2} + 2\Phi(R) \geq K \geq -\Phi(R). \tag{5}$$

for any $0 \leq t < T$. Up to a homothety of $g(0)$, the initial condition is always fulfilled. On the other hand, recall that $R_{min}(t)$ is increasing. This pinching implies that $R \to +\infty$ as $|K|$ diverges. Thus, for any $\varepsilon > 0$, $\frac{K}{R} > -\varepsilon$ if $|K|$ is sufficiently large. That is, the negative part of the curvature is arbitrary small compared to the positive part.

Parabolic rescaling

Now we study the formation of singularities with more geometric tools. One of them is the zoom, or parabolic rescaling, used by Hamilton in [Ha95a] and [Ha95b]. The idea is to dilate the metric and the time in order to have a new solution of the flow with uniformly bounded curvature (in past times). More precisely, let $g(t)$ be a Ricci flow on $M \times [0,T)$, $x_0 \in M$, $t_0 \in [0,T)$ such that $R(x,t) \leq Q_0 \equiv R(x_0,t_0)$ for all $x \in M$ and $t \leq t_0$. Then

$$g_0(t) = Q_0 g\left(t_0 + \frac{t}{Q_0}\right)$$

is a Ricci flow on $[-t_0Q_0, (T-t_0)Q_0)$ and $R_0(x,t) \leq 1$ for any $x \in M$ and $t \leq 0$. This is called a parabolic rescaling of $g(t)$ at (x_0,t_0). Now suppose $T < \infty$ and is maximal and therefore $\sup|K(t)| \to +\infty$ as $t \to T$. We can pick a sequence of points (x_k,t_k) such that $t_k \to T$ and $Q_k \equiv R(x_k,t_k) \geq R(x,t)$ for any $x \in M$ and $t \leq t_k$. Now consider the sequence $g_k(t)$ of parabolic rescaling at (x_k,t_k).

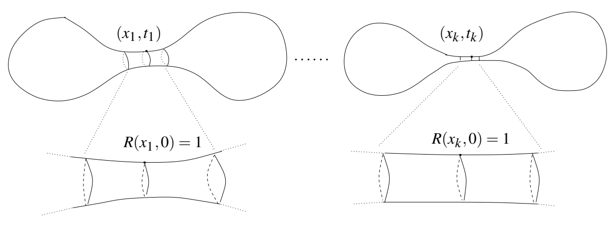

Figure 3: A sequence of parabolic rescalings

It is defined at least on intervals $[-t_kQ_k, 0]$, where, thanks to the Hamilton-Ivey pinching, we have uniform bounds on the sectional curvatures. Note that $-t_kQ_k \to -\infty$. A very natural question is whether we can take a limit and get a Ricci flow defined on $(-\infty, 0]$. The answer is yes but with some additional hypotheses.

Convergence of Riemannian manifolds

We recall some facts relating to the convergence of Riemannian manifolds, a theory developed by M. Gromov [Gr-La-Pa]. Consider a sequence (M_k, g_k) of Riemannian manifolds with $x_k \in M_k$. *One says that (M_k, g_k, x_k) converges in the pointed C^p-topology to a pointed Riemannian manifold (M, g, x) if, for any $k > 0$, there exist embeddings F_k from $B(x,k)$ to M_k, such that $F_k(x) = x_k$ and $F_k^* g_k$ converge to g on each compact of M uniformly in the C^p topology.* The topology of M_k and M can be very different, as shown in the figure below.

We have the following compactness theorem.

Theorem 6. *(8.28,[Gr-La-Pa]) Suppose there exist constants $V > 0$ and for any $r > 0$, $K(r) > 0$ such that for any k,*
1) The sectional curvatures of g_k are bounded, in absolute value, by $K(r)$ on the ball $B(x_k, r)$.
2) The injectivity radius of g_k at x_k is bounded below by V.
Then there exists a subsequence of (M_k, g_k, x_k) that converges in the pointed C^2-topology to a pointed Riemannian manifold (M, g, x), g of class C^1.

Note that the injectivity radius at $x \in M$ of a metric g is the supremum of the radius $r > 0$ such that the exponential map $exp_x : B(0,r) \subset T_x M \to B(x,r) \subset M$ is a diffeomorphism. Due to Cheeger's theorem [Ch], if the sectional curvature is bounded, bounding the injectivity radius below at $x \in M$ is equivalent to bounding the volume of the unit ball $B(x,1)$ below. The shrinking of a sphere to a point or a (flat) torus to a circle gives a good idea of what happens without a bound on the curvature or injectivity radius. The regularity of the limit can be improved if we have bounds on the curvature's derivatives.

Now we can define pointed convergence of the Ricci flow. Consider $B(x,t,r)$, the geodesic ball with centre $x \in M$ and radius $r > 0$ with respect to a metric $g(t)$.
Let (a,b) be an interval such that $-\infty \le a < 0 \le b \le \infty$. Let $(M_k, g_k(t), x_k)$ be a sequence of pointed Ricci flows on (a,b) with $x_k \in M_k$. One says that the sequence converges in the pointed topology to the pointed Ricci flow $(M, g(t), x)$ if there exist, for any k, embeddings F_k from $B(x,0,k)$ into M_k, taking x to x_k, such that the pull-back metrics $F_k^* g_k(t)$ converge to $g(t)$ in the C^∞-topology uniformly on any compact set of $M \times (a,b)$. In particular, curvatures converge at all orders. The relevant compactness theorem is (Hamilton [Ha95b]):

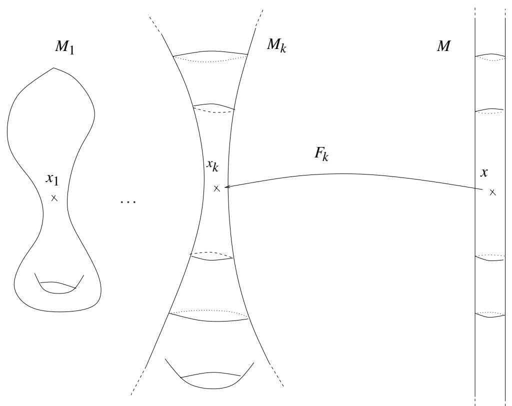

Figure 4: Pointed Riemannian convergence

Theorem 7. *If a sequence of pointed Ricci flow $(M_k, g_k(t), x_k)$ satisfies the two conditions:*
1) For any $r > 0$ and $t \in (a,b)$, the absolute value of the sectional curvatures of $g_k(t)$ are bounded on $B(x_k, t, r)$ by a constant $K(r,t)$
2) Injectivity Radius Estimate: the injectivity radius at x_k for $g_k(0)$ is bounded below by a constant $V > 0$.
Then there exists a subsequence, which converges to a pointed Ricci flow $(M, g(t), x)$ defined on (a,b).

Of course, we can consider flows defined on intervals (a_k, b_k), with $0 \in (a_k, b_k)$, and obtain convergence to a flow defined on (a,b), with $a = \lim a_k$ and $b = \lim b_k$. Now we come back to the sequence of parabolic rescaling of the previous paragraph. The choice of (x_k, t_k) and the Hamilton-Ivey pinching imply a uniform bound for the sectional curvature on $M_k \times [-t_k Q_k, 0]$.

Unfortunately, Hamilton was not able to obtain the Injectivity Radius Estimate in full generality. Suppose for a moment that this problem has been solved. Then, by the compactness theorem, we could extract a subsequence of $(M_k, g_k(t), x_k)$ that converges to a Ricci flow on $M \times (-\infty, 0]$. Moreover, it has bounded and (taking a limit in the Hamilton-Ivey pinching) positive curvature. These conditions impose severe restrictions on the topology of the limit. The majority of the classification is done by Hamilton in [Ha95a], modulo the Injectivity Radius Estimate.

The first strike of G. Perelman in [PeI] is to obtain the Injectivity Radius Estimate for any Ricci flow of a compact manifold on a finite time interval. This result, from the "No Local Collapsing Theorem", is detailed in the next chapter. Another problem in Hamilton's program was to understand explosions of curvature at different speeds. If the centres (x_k, t_k) are far from being maximum of curvature, the curvature of their parabolic rescaling are not uniformly bounded in this case. This question is solved by Perelman with the "Canonical Neighborhood theorem", which is also in the first paper (th. 12.1 in [PeI]). We will detail this point in the next issue.

No Local Collapsing Theorem (NLCT)

Usually, one says that a family (g_ε) of Riemannian metrics on a manifold M collapses (with bounded curvature) if the injectivity radius of g_ε goes to zero at each point, whereas the sectional curvature remains bounded, say by 1. Intuitively, the Riemannian manifolds (M, g_ε) become closer and closer to a space of lower dimension, as for example a family of cylinders shrinking to a line. The condition on the curvature is to prevent the trivial contraction of the manifold to a point. Instead of the injectivity radius, one can consider the volume of unit balls. Given a Riemannian manifold (M, g), one speaks of local collapsing at a given scale. Intuitively, a big ball in a cylinder is close to a segment but a very small ball looks like a Euclidian ball.

More precisely, fix $\rho > 0$ (the scale) and consider all radii $0 < r \le \rho$. One says that a ball $B = B(x,r)$ is admissible if $|K| \le r^{-2}$ on $B(x,r)$. To understand this condition, consider the metric $\tilde{g} = r^{-2} g$. Thus $(B, \tilde{g}) = \tilde{B}(x,1)$ has radius 1 and curvature satisfying $|\tilde{K}| = r^2 |K| \le 1$. It is easy to see that λg

is κ-collapsed at scale $\sqrt{\lambda}\rho$. Now, given $\kappa > 0$, *one says that g is* κ*-collapsed at scale* ρ *if there exists an admissible ball* $B(x,r)$ *with* $r \leq \rho$*, such that*

$$r^{-n} vol(B(x,r)) < \kappa.$$

This is equivalent to having $vol(\tilde{B}) < \kappa$ or the injectivity radius of $\tilde{g}$ smaller than some function of κ. Now, one says that *g is* κ*-non collapsed at scale* ρ *if for any admissible ball* $B = B(x,r)$*, with* $0 < r \leq \rho$*, one has* $r^{-n} vol(B(x,r)) \geq \kappa$*.* Note that the constant κ is smaller than the Euclidian ratio $r^{-n} vol(B_{\mathbb{R}^n}(x,r))$ because for an arbitrary metric, the limit as $r \to 0$ of this ratio is the Euclidian one. For such a $\kappa > 0$, the flat cylinder is κ-collapsed at large scale but κ-non collapsed at small scale. The round sphere and the round cylinder $\mathbb{S}^2 \times \mathbb{R}$ are κ-non collapsed at any scale, even if the sphere is very small. Now, the NLCT of Perelman can be stated as follows:

Theorem 8. *Let M be a compact manifold with* $g(t)$ *a Ricci flow defined on* $[0,T)$*,* $T < \infty$*. Then there exists a constant* $\kappa > 0$ *such that* $g(t)$ *is* κ*-non collapsed at scale* $\sqrt{T}$ *for any* $t < T$*.*

In particular, any sequence of parabolic rescaling will satisfy the Injectivity Radius Estimate. We describe some techniques used in the proof and very roughly the proof itself. We have said before that the Ricci flow is not a gradient flow. The first trick of Perelman is to prove that it is, up to diffeomorphism.

More precisely, for each metric g and each smooth function f on M, define

$$\mathcal{F}(g,f) = \int_M (R + |\nabla f|^2) e^{-f} \mathrm{d}vol. \qquad (6)$$

Restrict this function to the subspace of $\mathcal{M} \times C^\infty(M)$ given by (g,f) such that the volume form $e^{-f}\mathrm{d}vol$ is constant, equal to a fixed one denoted by $\mathrm{d}m$. The gradient flow equation for $\mathcal{F}$ is then:

$$\frac{\partial g}{\partial t} = -2(\mathrm{Ric} + D^2 f), \qquad \frac{\partial f}{\partial t} = -\Delta f - R, \qquad (7)$$

where all quantities depend on $g(t)$.

Now, the idea is to deform a solution $(g(t), f(t))$ of (7) to kill the term $D^2 f$ and obtain a solution $\tilde{g}(t)$ of the Ricci flow. A classical result of Riemannian geometry says that if ϕ_s is a family of diffeomorphisms such that $\frac{d}{ds}\phi_s = \nabla_g f$, then $\frac{d}{ds}(\phi_s^* g) = 2D^2 f$. Given a solution of (7), one can define diffeomorphisms ϕ_t such that $\frac{d}{dt}\phi = \nabla f$ at time t. Then $\tilde{g}(t) = \phi_t^* g(t)$ and $\tilde{f}(t) = f(t) \circ \phi_t$ solve the system:

$$\frac{\partial \tilde{g}}{\partial t} = -2\,\mathrm{Ric}, \qquad \frac{\partial \tilde{f}}{\partial t} = -\Delta \tilde{f} - R + |\nabla \tilde{f}|^2, \qquad (8)$$

where all quantities depend on $\tilde{g}(t)$. The first equation gives a solution to the Ricci flow. Moreover, $\mathcal{F}(g(t), f(t)) = \mathcal{F}(\tilde{g}(t), \tilde{f}(t))$. The reverse operation is possible, that is a deformation of a solution to (8) gives a solution to (7).

A suspicious reader may ask how to use these facts, as the second equation is a backward heat equation with no solutions in general. Here is the trick: given a Ricci flow $\tilde{g}(t)$ on $[0,T]$, one solves the second equation of (8) in the backward direction, from initial data $\tilde{f}(T)$. Now $(\tilde{g}(t), \tilde{f}(t))$ is a solution to (8) on $[0,T]$, thus $\mathcal{F}(\tilde{g}(t), \tilde{f}(t))$ is increasing with t.

The plan is to prove the NLCT and Perelman uses the trick above with a more complicated function, called the entropy function. His formula is

$$\mathcal{W}(g,f,\tau) = \int [\tau(R + |\nabla f|^2 + f - n](4\pi\tau)^{-\frac{n}{2}} e^{-f} \mathrm{d}vol,$$

where $\tau > 0$. If at time $t < \infty$ the function f is close to the indicatrix function of an admissible ball $B(x,r)$, then the quantity $W(g,f,r^2)$ controls the ratio $r^{-n} vol(B)$. Then the growth of the function $W(g(t), f(t), \tau(t))$ along the flow allows one to control the ratio at time t relative to $g(0)$ and t. Of course, the proof is quite technical.

Conclusion

Given a sequence of parabolic rescaling as above, the NLCT and the compactness theorem imply convergence of a subsequence to a Ricci flow $(M_\infty, g_\infty(t), x_\infty)$ defined on $(-\infty, 0]$ at least. It is non flat and has positive bounded curvature. Moreover, for some $\kappa > 0$, it is κ-non collapsed at any scale. Perelman calls those solutions of the Ricci flow κ-solutions. They are models for singularities. In the next issue, we give the classification of κ-solutions and its application in the CNT. Next, we'll define the Ricci flow with surgery and explain how Perelman uses it to solve the Poincaré conjecture.

Bibliography

[Ch] J. Cheeger *Finiteness theorem for Riemannian manifolds*, Amer. J. Math. 92 (1970), 61–74.

[DeT] D. DeTurck, Deforming metrics in the direction of their Ricci tensor, *J. Differential Geom.*, 18 (1983), 157–162.

[Gr-La-Pa] M. Gromov, J. Lafontaine et P. Pansu, Structures métriques pour les variétés riemanniennes, CEDIC (1981)

[Ha82] R. Hamilton, Three-manifolds with positive Ricci curvature, *J. Differential Geom.* 17 (1982), no 2, 255–306.

[Ha86] R. Hamilton, Four-manifolds with positive curvature operator, *J. Differential Geom.* 24 (1986), 153–179.

[Ha95a] R. Hamilton, The formations of the singularities of the Ricci flow, *In Surveys in Differential Geometry*, volume II, 7-136, International press, Cambridge MA,1995

[Ha95b] R. Hamilton, A compactness property for solutions of the Ricci flow, *Amer. Jour. Math.* 117 (1995), 545–572.

[Iv] T. Ivey, Ricci solitons on compact three-manifolds. *Diff. Geom. Appl.*, 301–307, 1993.

[PeI] G. Perelman, The entropy formula for the Ricci flow and its geometric applications. *ArXiv: math.DG/0211159*.

[PeII] G. Perelman, Ricci flow with surgery on three-manifolds. *ArXiv: math.DG/0303109*.

[PeIII] G. Perelman, Finite extinction time for the solutions to the Ricci flow on certain three-manifolds. *ArXiv: math.DG/0307245*.

[Po] Henri Poincaré, Œuvres Tome VI, *Gauthier-Villard*, Paris 1953.

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Ljudmila Vsevolodovna Keldysh (To Her Centenary, Part II)

A. V. Chernavsky (Moscow, Russia)

The Keldysh–Novikov family

The children's education was the most important part of the family life of L. V. Keldysh and P. S. Novikov, just as it had been in L. V.'s paternal family; colleagues at the Steklov Institute once asked her to give a talk on education and later recalled that it was a memorable lecture. The children were constantly being educated, not through moralizing speeches but by their parents' personal example and the whole family life-style. The dominance of spiritual values over material ones was implicit. She insisted that the children should be neatly clothed and have good food but without excess. ("Cheap chic!" was her characteristic observation when she encountered pretentiousness.)

Another important trait of their lives was a love of the outdoors, of fresh air and of spending as much time as possible out of town. Even during the war years, when all her drive was directed to the survival of the family, she would always find and rent a room in some village a few dozen kilometres from Moscow and take the children there for the whole summer. She loved the beauty of nature and country houses. Even in later life, she did not care for the comforts of vacation resorts but preferred a tent in a forest on some river-bank. She considered her husband's smoking to be a serious flaw but she was unable to overcome it.

There were no rigid schemes in the intellectual education of the children. The only things that L. V. Keldysh regarded as an obligatory supplement to school education were learning foreign languages and reading. Books were ordinarily, but not exclusively, given as presents and she tried to diversify their choice of reading material as much as possible. Their reading gave occasions for conversation at the table about history, art, science and life. This was precisely what constituted the children's family education. As they grew up, the role of father in these conversations became more significant. If some ethical question was touched upon, one of the parents would speak about "what is good and what is bad", usually rather categorically, but only in passing, without discussing details, as if assuming that there was nothing to discuss. But in other cases, the conversation would run as a discussion or even as a contest, never as a homily from the parents to the children.

The parents would frequently mention that choice of profession should be based only on one's vocation and capabilities. In that sense, they were themselves excellent examples, since both came from families comprising no mathematicians, in fact no scientists at all. Nevertheless, all three sons chose the physical and mathematical sciences as their professions. The eldest, Leonid, is a physicist and a full member of the Academy of Sciences. For a certain period he was Academician-Secretary in the Section of General Physics and Astronomy of the Russian Academy of Sciences. The youngest, Sergey, is an academician and a Fields medalist whose name is known to the entire international mathematics community. The third son, Andrey, was also a very gifted mathematician in the opinion of I. R. Shafarevich, his research advisor, but he perished tragically before realizing his potential. Only the youngest sister, Elena, is an exception to the scientific trend; she is a philologist and translator, who teaches French and Portuguese at the Institute of International Relations. The elder sister, Nina, died after a long illness.

Ljudmila Keldysh and Petr S. Novikov at the ICM, Moscow 1966

The choice made by the three sons was possibly due to the fact that discussions of scientific problems between their parents (who had related scientific interests) were often emotional and this was a part of home life. Moreover, many of the closest friends of the parents from their student years, such as the physicists A. A. Andronov and M. A. Leontovich, and the astronomer N. N. Pariisky, were not only outstanding scientists but also had wide ranges of interests and very impressive personalities. Another reason was that in the period in which they were growing up, the physical and mathematical sciences were flourishing and had become popular throughout the world.

The range of interests of the family extended far beyond the limits of science itself and touched upon practically the entire cultural sphere; one may say that culture was a lifeform for this family. In the post-war years, the two artists O. A. and V. V. Domogatski became close family friends. She was a sculptor and he was a graphic artist with extensive knowledge of the arts, sculpture, art history and history in general and a large circle of acquaintances in the Moscow intelligentsia. Other people from the art world came to the house and original works of such remarkable Russian painters as Fonvisin, Falk, Kuznetsov, Meshcherin, and Krymov adorned the walls of the house. Another family friend was the well-known actor and stage director I. I. Solov'ev, who would provide information about new shows and the theatre world in general.

L. V. Keldysh was a "natural object" of curiosity for journalists, especially around March 8th (the so-called International Woman's Day, an important day in Soviet Russia). She would react to this with respectful annoyance. In particular, talk about "feminine mathematics" made her smile. At the end of the 1940's, a journalist was appointed to write about this exceptional woman who was a professor of mathematics and a mother of five, about her work, her family and her social activity. He spent much time and effort, conversed with L. V. herself and with many people around her, all this only to telephone and say with chagrin, "our editor has said that my write-up is not fit to print because education in your family is too individualistic and, as a result, your eldest son even is not in the Young Communist's League!"

In day-to-day life, L. V. followed strict ethical rules, quite rigorous but without any element of hypocrisy or bigotry. Her demands were particularly strict when applied to herself. As to others, she was much more indulgent; she was well-disposed and always ready to help. However, decency and culture were to her the highest merits of a human being and these two qualities were inseparable in her eyes.

In the same vein, she invariably sought to help those who were in trouble or victims of injustice, although she was never an active fighter against abstract evil because of the innate absence of aggressiveness in her character and her constant preoccupation with family and science.

Here is a characteristic example: in the postwar excesses of Stalinism, commissions for purging workers' collectives were organized and such a commission appeared at the Steklov Institute. At the time, V. A. Rokhlin (still a young mathematician and not yet as famous as he would become) was employed by the institute as an assistant to L. S. Pontryagin. When Rokhlin obtained his doctorate degree, knowing that as a former war prisoner of the Germans he had no chance of getting a research position at the institute, he handed in his resignation before the commission began functioning. However, the commission destroyed his letter of resignation and organized a meeting of the institute's staff, which decided that Rokhlin should be fired as an "anti-Soviet element". Only seven people voted against this motion, P. S. Novikov and L. V. Keldysh among them. (The other five were B. N. Delonay, A. O. Gelfond, A. A. Markov, L. S. Pontryagin and I. R. Shafarevich).

Another stand of L. V. Keldysh against injustice was her signature of the "Letter of the 99", written in defense of the mathematical logician A. S. Essenin-Volpin, who, in 1968, was forcibly placed in a mental institution by the KGB.

It is hard to imagine today how much courage was needed then to display such high moral conduct. Throughout her life, she never wavered from it.

Scientific work of L. V. after the war

The work of L. V. in descriptive set theory was completed just before the war. A report on these results, which composed her thesis, was published in a note "On the structure of B-sets" in Doklady (1941) [3] but the full exposition appeared (for an obvious reason) only toward the end of the war. It was a paper in French, with the same title, in Mathematical Sbornik [4]. In a 1945 volume of Trudy MIAN, she summed up a decade of her work in this domain [5] and then began to work on topological themes.

The note in 1945 Doklady [7], dedicated to open mappings of A-sets, lies between her work on descriptive set theory and topology. Its basic result states that every A-set in Baire space is the image under an open mapping of a set that is an intersection of a F_σ-set and a G_δ-set. But it had been shown by Hausdorff that the class G_δ is invariant relative to open mappings.[1] L. V. obtained her result, unexpected in view of this classical theorem of Hausdorff, by an original geometric construction.

Raising of dimension. Light mappings.

Toward the end of this period, the topological theme in L. V.'s work came to the fore and she turned naturally to the investigation of continuous mappings of compact spaces. This work occupied the second decade of her mathematical activity (1947–1957). The distinctive feature of her topological work was again its concrete geometric character and, as in B-set theory, her aim to structure the clarification of mappings of a general kind and construct decisive examples. She was especially interested in problems posed by P. S. Alexandrov, her elder comrade in Lusitania and chief of the Moscow topological school. These problems concerned the mechanism of dimension raising. Here, three classes of mappings play the main role: light (or null-dimensional, having null-dimensional preimages of points), monotone (with connected preimages of points) and open. Any mapping is a composition of monotone and light mappings, which suggests the importance of studying them. As for open mappings, one long-term expectation was that they are sufficiently close to topological properties of spaces to conserve dimension. It is easy to show that an open mapping cannot raise dimension of the line segment and a monotone open mapping cannot raise dimension of the square. It is somewhat more difficult to show that one cannot raise dimension of surfaces by monotone and light open mappings (see [8]).

Almost ten years of study of the raising dimension mechanism led L. V. Keldysh to results that remain significant achievements. She has written complicated geometric constructions of examples, which have shown, in the domain of elemental-geometric objects, that the condition of openness doesn't prevent the possibility of dimension raising in both the light case and in the monotone (even for manifolds) case. Alexandrov's conjecture, stating that for a compact space any continuous mapping that finitely raises dimension is a composition of a finite-to-one mapping and a mapping that does not raise dimension, was rejected in the general case rather quickly. L. V. Keldysh showed in [9] how one must change the conjecture. She began with a study of the structure of light irreducible mappings of the segment onto the cube (the well-known Peano curves).[2] Her result states that every irreducible mapping f of the segment I onto the k-dimensional cube I^k factorizes into a composition of $2(k-1)$ continuous mappings:

$$f = \varphi_{k-1}\psi_{k-1}\dots\varphi_1\psi_1 \quad (1)$$

where all ψ_p are light mappings that don't raise dimension and all φ_p are two-to-one mappings, each of which raises dimension by one. As a two-to-one mapping cannot raise dimension more than one, L. V. Keldysh's result is conclusive and gives the complete clarification to the picture of irreducible Peano mappings.

She also indicated property of a mapping that allows it to be represented in the form (1).

The technique that she worked out in this study allowed her to understand the structure of light mappings of any finite dimensional compact space, especially light open mappings. Amongst open mappings, only homeomorphisms are irreducible. But L. V. Keldysh indicated a curious class of mappings that contains both irreducible and open mappings, i.e. *piecewise* mappings that send pieces onto pieces, where one calls the closure of an open set a *piece*. (She asked if any light mapping of a compact space satisfies this property; it seems the answer is not known so far.) She showed that any light piecewise mapping is a composition of an irreducible and an open mapping, where the second uniformly (that is on open subsets) does not raise dimension. Then she showed that in the case of an open light mapping, one can choose the irreducible component so that it has the property mentioned above providing it can be presented in the form (1). In conclusion, a light open mapping of a compact space that raises dimension by k can be written as a composition of $2k+1$ mappings, where the odd mappings do not uniformly raise dimension and the even mappings are two-to-one and each raises dimension by one. So, the dimension increase is due to two-to-one irreducible gluings [10, 11].

The rather complicated technique of proofs of these results are evidently rooted in various techniques of descriptive set theory, especially the sieve operation. This is definitely true for the result that has crowned this series of works by L. V. Keldysh, her example of a light open mapping of the Menger curve onto the square [12].

It was A. N. Kolmogorov who constructed the first unexpected example of dimension raising by light open mappings [13]: the 2-adic group acts on the Menger curve and the orbit space of the action is the Pontrjagin two-dimensional surface (which breaks the sum theorem in dimension theory). The dimensional insufficiency of this continuum left doubts but there were new examples of open mappings of a one-dimensional continuum, whose range was the square. In these examples, mappings had the form of compositions of a monotone but not light open mapping and a light open mapping that does not raise dimension. So, the dimension raising was not due to a light open mapping.

Keldysh's example from [12], one of the classics of geometric topology, shows visually the dimension raising mechanism accompanied by openness in the concrete case of the mapping of a one-dimensional continuum (identified with the Menger curve by R. D. Anderson's criterium [17]) onto the square. Once, A. N. Kolmogorov said to A. B. Sossinsky that he had given up on the topic when he realized that he was unable to compete with L. V. Keldysh. Later B. A. Pasynkov developed a nice technique, with the help of which it became possible, using Keldysh's example as a starting point, to build a light open mapping of the Menger curve even onto the Hilbert cube [14].

Other people later built simpler examples, however these examples seem to reveal to a lesser degree the dimension raising mechanism [15, 16]. D. J. Wilson shows in [19] that for every locally connected continuum one can build an open mapping of the Menger curve onto it in such a way that every point preimage is homeomorphic to the Cantor set.

The study of light open mappings has significance, from the point of view of an open classical Hilbert–Smith problem, to the possibility of an effective action of a p-adic group on manifolds. Such an action would give a light open mapping onto orbit space that necessarily raises the dimension by two or more, as was shown by Yang [18]. It would be rather exotic; for example, if this action is free and its factor-space is locally simply connected the mapping is a locally trivial fibering and its space certainly cannot be any manifold. Light open mappings of *manifolds* with dimension three and more that are not finite-to-one were built by D. Wilson [19] and J. Walsh [21] in 1972–76. The technique used by them is very similar to the technique of the next series of Keldysh's works, which concern monotone open mappings.

Dimension raising. Monotone mappings.

It was well-known that monotone mappings do not raise dimension of surfaces. R. D. Anderson in 1952 gave an example of a monotone-open mapping of a one-dimensional continuum onto the Hilbert cube.

It was much more difficult to build a monotone mapping of *a cube onto a cube of higher dimension*. L. V. Keldysh constructed in 1955 [22] such a mapping of the 3-cube onto the 4-cube that easily generalises to a monotone mapping of any cube of dimension more than 2 onto any other one, including the Hilbert cube. It was essential in her examples that the mapping was irreducible (in this case, the set E of one-point preimages of points is an everywhere dense G_δ and the mapping is homeomorphic on it).

The next year, she showed [23] that if the set E just mentioned is arcwise connected for a given mapping $f: K \to M$ of continuum K onto manifold M of dimension more than 2, then one can transform f into a *monotone open* mapping $K \to M$ with the help of an arbitrary small shift of M onto itself (by a pseudoisotopy, see below). So, she obtained the basic result: it is possible to map openly and monotonically the 3-cube onto a cube of any dimension.

She made the following remark, which emphasizes the geometric core in her construction of a monotone mapping of 3-cubes onto 4-cubes: it turns out that it may be obtained as a limit of ε-dense embeddings with the property that any path in the 4-cube may be δ-shifted into the image of the 3-cube (and $\delta \to 0$ as $\varepsilon \to 0$).

Departing from this remark, A. V. Chernavsky built mappings of cubes onto cubes of higher dimension [24], which generalizes Keldysh's example in the following way. For every k and for p such that $2p+3 \leq k$, there exists a mapping of the k-dimensional cube onto cubes of any higher dimension including the Hilbert cube, with point preimages acyclic up to dimension p. This mapping is the limit of embeddings of the k-cube with conditions that generalize the conditions of Keldysh's example. Keldysh's method transforms this mapping by a pseudoisotopy into a monotone open one. This result is exact because of R. L. Frum-Ketkov's theorem that when a mapping of a k-cube onto polyhedrons of higher dimension has preimages of points acyclic up to dimension p then $k \geq 2p+3$ [25].

Geometric topology of manifolds. L. V. Keldysh's seminar

This seminar began in 1956–57 as a spin-off of the seminar at MSU headed by P. S. Alexandrov. The assiduous participants of it were (in order of participation) A. V. Chernavsky, M. A. Stan'ko, A. B. Sossinsky and E. V. Sandrakova. But there were also doctoral students from other cities (M. S. Farber from Bacu, V. P. Kompaniec from Kiev, S. V. Matveev from Cheljabinsk, Van ny Kyong from Viet-Nam, etc.) and distinguished visitors from abroad (M. H.A. Newman, E. C. Zeeman, O. G. Harrold, J. Kister, D. Henderson, etc.). Especially influential was a visit by R. H. Bing.

The term "geometric topology", coined by M. H.A. Newman at the 1954 Congress, refers to topology in which algebraic or analytic tools play a secondary role or in which topological properties of manifolds are the central issue. In the 1963 list of the most important problems of geometric topology, J. W. Milnor included: the Poincaré conjecture in dimensions three and four, triangulability and Hauptvermutung for manifolds, the topological invariance of Pontrjagin classes and of simple homotopy type, the annulus conjecture and, finally, the double suspension conjecture. Today they are all to a large extent solved, but at the time they held centre-stage both in L. V. Keldysh's seminar and worldwide. For some of these conjectures, ideas introduced by participants of L. V. Keldysh's seminar exerted an essential influence. She gave to this seminar all her energy, meticulously checking the results of her disciples and lending them support of any kind. [30]

The work of L. V. from this period is connected, in one way or another, with the notion *pseudoisotopy*, that is a one-parameter family of mappings $g_t\colon \mathbb{R}^n \to \mathbb{R}^n$ with g_t homeomorphisms for $t < 1$. In her last articles, she developed an approach to study topological embeddings through constructions of pseudoisotopies which transform standard embeddings into the given ones (see [29]). M. A. Stan'ko happily inverted this idea; he introduced the notion *embedding dimension* as the minimal dimension of a polyhedron onto which one may shift the given compact space by a small pseudoisotopy. This notion turned out to be central in the future development of geometric topology.

The seminar of L. V. Keldysh ceased in 1974. At the close of the 60's, events in Russian political life had impinged on normal scientific life; as already mentioned, P. S. Novikov and L. V. Keldysh had supported dissidents such as Essenin-Volpin. This led to conflicts, which considerably shortened the lives of these two remarkable people. In 1973, L. V. took

Disciples of L. V. Keldysh, from left to right: V. P. Kompaniets, M. A. Stan'ko, A. V. Chernavsky, E. V. Sandrakova, A. B. Sossinsky

her retirement in protest against the dismissal of her collaborator, which she took to be unjust. Then Petr Sergeevich Novikov died in 1974. In February 1976, Ljudmila Vsevolodovna Keldysh also passed away. Just one week before her death, freshly returned from hospital after major surgery, she came to the Steklov Institute for the traditional meeting with her students.

The author is very grateful to members of L. V. Keldysh's family for acquaintance with their family history and permission to use it in this outline. Also used with thanks are recollections of L. V. Keldysh's students L. V. Sandrakova, A. B. Sossinsky and M. A. Stanko. Many thanks again go to A. B. Sossinsky and L. C. Siebenmann for their efforts to adapt this text, written by a Russian author, for the understanding of European readers.

Notes

1. An open mapping is a mapping that sends open subsets onto open subsets
2. An irreducible mapping takes no proper closed subspace onto the whole image (or, in another way: the subset of unicity points $\{x = f^{-1}fx\}$ is everywhere dense).

References

[1] Келдыш В. В. Семья Келдышей // В: М. В. Келдыш. Творческий портрет по воспоминаниям современников. Москва. Наука. 2001, стр.121–132

[2] Лузин Н.Н. Лекции об аналитических множествах и их приложениях М: ГТИТТЛ, 1953, 359 с.

[3] Келдыш Л.В. Структура В-множеств // Докл. АН СССР, 1941. 31, $n^\circ 7$, с.651–653.

[4] Keldych Ludmila V. Sur la structure des ensembles mésurables B // Матем. Сб. 1944, т.15, $n^\circ 1$, с.71–98.

[5] Келдыш Л.В. Структура В-множеств // М.: Наука, 1945. 76 с. (Труды МИАН; т.17).

[6] Островский А.В. К вопросу Л.В. Келдыш о структуре борелевских множеств // Матем.Сб., 1986. 131,$n^\circ 3$, с.323–346.

[7] Келдыш Л.В. Об открытых отображениях А-множеств. Докл. АН СССР, 1945, 49, $n°$9, 646–648.

[8] Whyburn G. T. Analytic Topology // Amer.Math.Sos. Colloq.Publ. XXVIII, 1942.

[9] Келдыш Людмила. Непрерывные отображения сегмента на n-мерный куб // Докл. АН СССР, 1949, 66, $n°$3, 327–330.

[10] Келдыш Людмила. Нульмерные отображения конечномерного компакта // Докл. АН СССР, 1949, 68, $n°$6, 989–992.

[11] Келдыш Людмила. Нульмерные отображения, повышающие размерность // Матем.сб., 1951, 28, $n°$3, 537–566.

[12] Келдыш Людмила. Нульмерные открытые отображения // Изв.АН СССР Сер.матем. 1959, 23, $n°$2, 165–184.

[13] Kolmogorov A. N. Über offene Abbildungen. Ann. of Math., 1937, 38, n.1, 36–38.

[14] Пасынков Б.А. Нульмерные открытые отображения, повышающие размерность // УМН, 1963, 18, $n°$5, 183–190.

[15] Williams R. C. A useful functor and three famous examples in topology // Trans.Amer.Math.Soc., 1963, 106, 319–329.

[16] Козловский И.М. Повышающие размерность открытые отображения компактов на полиэдры как спектральные пределы несущественных отображений полиэдров // Докл. АН СССР, 1986, 286, $n°$3, 535–538.

[17] Anderson R. D. One-dimensional continuous curves and a homogeneity theorem // Ann. of Math. 1958, 68, $n°$1, 1–16.

[18] Yang Chung Tao. p-adic transformation groups // Michigan Math.J., 1960, 7, $n°$3, 201–218

[19] Wilson David C. Open mappings of the universal curve onto continuous curves // Trans. AMS, 1972, 168, 497–515.

[20] Wilson David C. Open mappings on manifolds and a counterexample to the Whyburn conjecture // Duke Math.J., 1973, 40, $n°$3, 705–716.

[21] Walsh J. J. Light open and open mappings on manifolds I, II // Trans.AMS, 1975, 209, 410–432; 1976, 217, 271–284.

[22] Келдыш Людмила. Пример монотонного неприводимого отображения трехмерного куба на четырехмерный // Докл. АН СССР, 1955, 103, $n°$6, 957–960.

[23] Келдыш Людмила. Преобразование монотонного неприводимого отображения в монотонно-окрытое и монотонно-окрытые отображения куба, повышающие размерность // Матем.сб., 1957, 43, $n°$2, 187–226.

[24] Чернавский А.В. Обобщение построения Л.В. Келдыш монотонного отображения куба на куб большей размерности // УМН, 1985, 40, $n°$4, 209–211.

[25] Фрум-Кетков Р.Л. О поведении циклов при непрерывных отображениях компактов // Докл. АН СССР, 1957, 115, $n°$2, 249–252.

[26] Lashof R. S. (ed.) Problems in differential and algebraic topology. Seattle Conference of 1963 // Ann. of Math. 1965, 81, 565–591.

[27] Келдыш Людмила. Топологические вложения в евклидово пространство // М.: Наука, 1966 184 с. (Труды МИАН СССР; т. 81).

[28] Келдыш Людмила. Вложение нульмерных компактов в E^n // Докл. АН СССР, 1962, 147, $n°$4, 772–775.

[29] Келдыш Людмила. Топологические вложения в многообразие и псевдоизотопия // Матем.сб. 1966, 71, $n°$4, 433–453.

[30] А.В. Чернавский. О работах Л.В. Келдыш и ее семинара. УМН. 2005, 60(4), стр. 11–36.

[31] Список публикаций Л.В. Келдыш. Труды МИАН. 2006, том 252.

[32] L. Graham, J.-M. Kantor, A comparison of two cultural approaches to mathematics: France and Russia, 1890–1930, to appear in ISIS, 2006.

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Interview with Professor Viorel Barbu

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Short Biographical Note

Professor Viorel Barbu was born on 14th June 1941 in Deleni, Vaslui County, Romania. He graduated from Al. I. Cuza University of Iași, Faculty of Mathematics, in 1964 and after doctoral studies at the same university (1966–1969), he completed his PhD in Mathematics, in 1969, with a dissertation about the "Regularity of Differential Operators". During the period from 1964 to 1973 he was successively a Preparatory Assistant, Assistant, and Lecturer and then Associate Professor (1974–1980) and full Professor (since 1980) at the Faculty of Mathematics, Al. I. Cuza University of Iași.

V. Barbu published about 150 original works and more than ten books (monographs and treatises) in the field of partial differential equations, integral equations, and evolution and optimal control equations.

Among the most important monographs (co-)authored by V. Barbu are:

1. *Nonlinear Semigroups and Differential Equations in Banach Spaces*, Nordhoff, Leyden (1976); 2. *Convexity and Optimization in Banach Spaces*, Sijthoff (1978), second edition D. Reidel, Dordrecht (1986) – one of the most cited of his books; 3. *Optimal Control of Variational Equations*, Pitman, London (1984); 4. *Analysis and Control of Infinite Dimensional Systems*, Academic Press, New York, San Diego (1983); 5. *Mathematical Methods in Optimization of Differential Systems*, Kluwer Publishers, Dordrecht (1995); 6. *Boundary Value Problems for Partial Differential Equations*, Kluwer Publishers, Dordrecht (1998).

His papers have been quoted or used by over 800 foreign mathematicians in over 1200 works. Among these authors are the following mathematicians of international renown: J.L. Lions, H. Brezis, P.L. Lions, E. Magenes, A. Pazy, Avner Friedman, M.G. Crandall, L.C. Evans, J. Hale, H.T. Banks, J.A. Nohel, J. A. Peletier, H. Amann, H.O. Fattorini, R.T. Rockafeller and F. Clarke.

Viorel Barbu's results are also mentioned and presented in major mathematical encyclopedias like the *Encyclopedia of Mathematics* (Springer-Verlag 1991–1995), the *Systems & Control Encyclopedia* (Pergamon Press,1988,1995) and the *Matematiceskaya Enciclopedia* (Moscow 1983–1988).

V. Barbu has been a visiting professor at several universities including: Concordia University, Montreal, Canada; CNR University, Rome, Italy; INRIA, Paris, France; Purdue University, USA; Scuola Normalle Superiore Pisa, Italy; Ohio University, U.S.A.; Bologna; University, Italy; University Paris VI, France; Trento University, Italy. He was also an Otto Szaz Visiting Professor, University of Cincinnati, U.S.A.

V. Barbu has been a member of the Romanian Academy since 1991 and the President of the Iasi Branch of the Romanian Academy since 2001 and he was the Vice-president of the Romanian Academy from 1998 to 2002. Since 1990, he has been the Director of the Institute of Mathematics at the Romanian Academy in Iasi (North-eastern Romania) and is President of the Romanian Society for Cell Biology. He was Rector of Al. I. Cuza University of Iasi from 1981 to 1989.

He has received the following awards and honours: S. Stoilow Prize from the Romanian Academy (1972); Honorary Doctor of Nebraska University in Omaha (USA, 1993); Honorary Professor of Wuhan University (China, 1999).

V. Barbu is on the editorial boards of several international journals: *Numerical Functional Analysis and Optimization*; *Journal of Differential and Integral Equations*; *Communications in Applied Analysis; Advances in Differential Equations*; *Revue Roumaine de Mathematiques Pures et Appliquées*; *Panamerican Mathematical Journal*; *Nonlinear Functional Analysis*; *Abstract and Applied Analysis*.

Your field of research, differential equations, is strongly represented at Al. I. Cuza University in Iași. Could you tell us some of the history behind the Iași mathematical school, its present status and maybe speculate on its future?

Alexandru Myller,[1] the founder of the mathematical school at the University of Iași, was a former PhD student of David Hilbert at Göttingen and his thesis was on integral equations, a work that is still cited in literature. However, since returning to Romania and taking the professorship position with the University of Iași in 1910, his main scientific interest has been oriented toward Riemannian geometry. Before the war, differential equations at Iasi were studied by Constantin Popovici,[2] Simion Sanieleveci,[3] Mendel Haimovici[4] and Adolf Haimovici,[5] who continued their work into the late sixties and beyond. In 1956, Constantin Corduneanu[6] began his seminar on qualitative theory of differential equations, which ran for more than thirty years. In 1970, we began a new seminar on nonlinear analysis and applications to partial differential equations, which is still running. In this Seminar,

“O. Mayer” Institute of Mathematics in Iasi

“Al. I. Cuza” University Iasi

several mathematicians well-known for their outstanding contributions began their research activity. Let me mention a few of them: N. Pavel, C. Ursescu,T. Precupanu, Gh. Morosanu, N. Popescu, A. Rascanu, C. Zalinescu, I. Vrabie, O. Carja, D. Motreanu, R. Vescan, D. Tiba, D. Tataru, L. Nicolaescu, S. Anita and I. Sarbu. Some of them are now professors at American and European universities while others are with the Department of Mathematics of the Al. I. Cuza University or with the Institute of Mathematics of the Romanian Academy in Iasi. The main directions of research are nonlinear partial differential equations (PDEs) and control theory of PDEs, convex analysis, and stochastic analysis.

What is needed for a school or a tradition in mathematics to be established and to last?

A school in mathematics or in science is created by a group of dedicated young mathematicians around a scientifically productive leader able to orient research and provide new ideas. To last, it needs continuous influx of talented young people and new leaders. In general, a school disappears or changes its profile with the retirement of the leader who created it.

What have been the main trends and results in your area of interest in the last 30–40 years and what are the present trends?

If I am referring strictly to my field of scientific interest, perhaps I should mention here the new methods and functional techniques in the theory of nonlinear partial differential equations known as „monotonicity methods“, the theory of nonlinear semigroups, which has influenced the existence theory of dynamic PDEs, as well as optimal control of parameter distributed control. A special mention should be made for the new sharp existence and uniqueness results for Hamilton Jacobi equations (the theory of viscosity solutions) and the new techniques and results on controllability and stabilization of parabolic equations, hyperbolic equations and the Navier-Stokes equations.

Let us discuss the present situation of mathematics research in Romania, in both universities and research institutes. How do you see its evolution in the last fifteen years and what do you predict for the near and far future?

Most of the research groups and schools in the big Romanian universities and institutes of the Romanian Academy have continued to exist and produce scientific results, though perhaps not at the same level as in the past. On the other hand, many young Romanian mathematicians (most of whom are members of foreign universities now) are represented in the best international mathematical journals and are in the ‘elite’ of the international mathematics community. However, there are very few bright young mathematicians who apply for academic positions in Romania nowadays and this will have, without any doubt, a devastating effect in the near future at the level of school and research.

What is your opinion about the extent to which the current brain drain affects mathematics in East European countries, in particular Romania?

The so-called ‘brain drain’ effect has a noticeable negative impact on the quality of research in institutes as well as at the level of graduate programs in mathematics. The fact that the best students apply for graduate studies at foreign universities and after graduation remain abroad is something new in Romanian history and the consequences are hard to evaluate. For mathematics in Romania, there is the real possibility that in a few years professional mathematicians will have almost disappeared.

In the same context, what can be done to attract talented young students into mathematics and especially to keep the best qualified mathematicians in the departments of mathematics of Romanian universities?

A governmental program, comparable with that of Western societies, to attract the best young scientists with well-paid positions (obtained by national competition) at Romanian universities, institutes and research facilities would bring, without any doubt, many brilliant people back into Romania. Such a program has already been implemented by several countries (e.g. China, Mexico) and the results have been positive. On the other hand, this venture should be connected to the forthcoming reform of the Romanian university and research system.

Do you agree that supporting short visits abroad for people teaching at university could be a possible short-term solution?
Yes, for a short term this is a solution, but Romania should stabilize its research and university system, creating competitive positions for at least a few percent of its brightest young mathematicians.

Does any 'pressure to publish' exist at universities and research institutes? Is it of benefit for researchers or should the scientific work be left to the researcher's discretion?
Of course there is, but this not only true in Romania but throughout the world. To find a good position at university or in research and in order to be promoted or to get financial support for research, you must publish in good journals. Many thousands of papers are submitted each year to a few main mathematical journals, some taking years to be published or rejected. This also puts pressure on the mathematical journals and the peer review system, which was intended for a smaller workload. The scientific work published is, however, the principal product of research activity and so it should be evaluated and monitored.

What do you think about 'fashion' in mathematics? Are you receptive to fashionable mathematics and do you pay attention to it?
No, I am not receptive to 'fashion' in mathematics but it should not be blamed because this is one of the main ways that novel and new fields are spread in mathematics. After the novelty goes away, there always remains something practical and permanent.

Differential equations had and have perhaps the most important number of applications in other sciences. In the last decades not only the theory but also numerical methods, software and applied examples in biology, medicine, the social sciences etc. have developed significantly. Is this still influencing the theory?
Since most of physical laws are expressed in terms of variations, the differential and, implicitly, differential equations, have a fundamental role in the construction of mathematical models in the sciences. This is true not only of physics but also of chemistry, biology, econometrics and the social sciences. From the time of Newton, the mathematical field of differential equations has developed under the direct influence and impulse of Newtonian mechanics, electromagnetism (the Maxwell equations), quantum mechanics, the theory of relativity, fluid mechanics and, more recently, automatic control theory and new models arising in mathematical biology, thermodynamics and engineering. There is of course a 'pure component' of this theory that apparently has an autonomous evolution (the theory of dynamic systems for instance) but the 'applied component' is, without any doubt, dominant. For this part of the theory, most of the research arguments and problems come from the applied arena and were originally physical or engineering problems. For instance, this is the case with chaos phenomena and inertial manifolds in the stability of nonlinear systems, accidentally discovered in the numerical treatment of a differential system used in meteorology (Lorenz system). Other examples are numerous.

How do you see the classical dichotomy between 'pure' and 'applied' mathematics, with special emphasis on your field of interest?
In our field, the distinction between 'pure' and 'applied' is less apparent. It refers mainly to the objectives and goals rather than the research arguments and problems. Applied research is mainly devoted to predicting evolutions and computing or putting into a new light a specific physical phenomenon. However, this usually involves sharp arguments of 'pure' mathematics.

What is your opinion about the direction in which research in mathematics is going nowadays? What do you think about the increasing tendency toward hyper-specialization in recent years?
It is a hard question because nobody can predict the evolution of mathematics. The research arguments in mathematics are closely related with evolution of other sciences and of technology. Of course, mathematics has its own open problems and conjectures awaiting answers but the spectacular results are to be expected from problems arising in the most dynamic fields of contemporary science. As regards to specialization, this is a general phenomenon in modern science but it should not be dramatized because it is necessary for getting sharp results and, in mathematics at least, it is not absolute. Indeed, in spite of growing specialization of its methods, mathematics also provides science with the general tools for integrating and understanding apparently uncorrelated and distant phenomena and theories.

What do you think makes a mathematical result outstanding? Could you present some crucial moments and results in your area of interest during your experience of research?
The mathematical community has its own system of evaluation for validating outstanding results. One might include in this category a mathematical result that puts a large class of existing results into a new perspective or relationship. An outstanding result might also be the answer to an old or famous conjecture or one that has a great impact in physics, in the natural sciences or in economics. For instance, characterization of hypoelliptic differential operators (L. Hörmander), division of distributions (L. Hörmander), the introduction and calculus of pseudo-differential operators (Kohn and L. Nirenberg), the existence theory of nonlinear infinite dimensional equations of monotone type (G. Minty, F. Browder, T. Komura, M.G. Crandall, A. Pazy, H. Brezis) to mention just a few examples.

What recent development in mathematics in general, in your field of research or in science at large has made the greatest impression on you?
Perhaps chaos phenomena in differential systems and in general long time behaviour of trajectories of differential

and dynamic systems. Spectacular phenomena arise here that are related to undeterministic behaviour, turbulence and unpredictable evolution in physical systems, which are real mathematical challenges.

Most people think that the mathematical world is now becoming divided into two parts: on one side an elite of researchers who don't have teaching duties and on the other side active teachers trying to cope with the research competition. Do you agree with this? What do you think the situation is in Romania in this respect?

Of course the mathematical research should be done by professional mathematicians and it would be desirable that these people have no other duties to perturb their activity. On the other hand, the university should not be removed from research. The best university professors are those who are active in research as well. I should also mention that the students in mathematics represent a high scientific potential that must be oriented and integrated by professional mathematicians.

Differential equations is one of the most important subjects of mathematics. Do you expect major advances in the future, both in theory and applications? What are the research challenges in this area just now?

I tried to point out above some hot directions of research related to long time behaviour of infinite dimensional dynamic systems and of evolution equations in particular.

Do you sometimes question yourself about the way in which what's important in mathematical research and what's not are decided? Case study: Romania?

This reminds me of what one physicist said about mathematics: "What I really do not understand is how mathematicians realize that a certain result is important or not". The truth is that we do not have very precise criteria to immediately evaluate a certain discovery or a new result in mathematics. Maxwell's equations, which were without any doubt among the greatest scientific discoveries of the nineteenth century, remained ignored by mathematicians and physicists for almost twenty years, while Fourier's work on heat conduction was denied a prize by the French Academy. There are many other examples, some quite recent.

Notes

1 Al. Myller (1879–1965), Romanian mathematician, Professor of Mathematics at Al. I. Cuza University of Iasi (AICU). He obtained his PhD from Göttingen in 1906. In 1912, he founded a famous mathematical seminar, which is nowadays named after him.
2 C.C. Popovici (1870–1956), Romanian mathematician, Professor of Mathematics at AICU and the University of Bucharest. He obtained his PhD from Sorbonne in 1908. He was the first in Romania to study the fundamentals of functional equations.
3 S. Sanielevici (1870–1963), Romanian mathematician, Professor of Mathematics at AICU.
4 M. Haimovici (1906–1973), Romanian mathematician, Professor of Mathematics at AICU.
5 A. Haimovici (1912–1993), Romanian mathematician, Professor of Mathematics at AICU.
6 C. Corduneanu (1928–), Romanian mathematician, Professor of Mathematics at AICU and the University of Texas in Arlington (U.S.A.).

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The Hungarian Mathematical Society (BJMT)

Ákos Császár (Budapest, Hungary)

These days, the Hungarian Mathematical Society is officially called the János Bolyai Mathematical Society (Bolyai János Matematikai Társulat, BJMT). However, this society, founded in 1947, is one of two successors to the Mathematical and Physical Society (Matematikai és Fizikai Társulat, MFT) that was founded in 1891 and named the Loránd Eötvös Mathematical and Physical Society (Eötvös Loránd Matematikai és Fizikai Társulat, ELMFT) in 1921.

Until the end of World War II

In the last decades of the 19th century, two centres of research in mathematics and physics in Hungary developed, namely the Technical University in Budapest and the University in Kolozsvár (today Cluj-Napoca, Rumania). The need for collaboration was first recognized by the mathematical and physical researchers in Budapest and a society was formed, comprising researchers of private character, with meetings held nearly twice a month in a restaurant in Budapest, where new results could be discussed over an informal dinner. The number of participants was between twenty and thirty, mainly professors from Budapest and occasionally from Kolozsvár.

During December 1890, one of the main participants, a famous researcher in physics named Loránd Eötvös formulated the idea of bringing together researchers and professors in mathematics and physics to form an officially recognized society and of publishing a periodical with the aim of propagating and popularising results in mathematics and physics. The audience, about a hundred in number, enthusiastically adopted these ideas and a committee was formed in order to elaborate on the statutes of a new society. The Minister of Inner Affairs approved the foundation of the Mathematical and Physical Society (Matematikai és Fizikai Társulat, MFT) in 1891. The first meeting of the general assembly was held on 5th November 1891, where Loránd Eötvös was elected president and the mathematicians Gyula Kőnig and Gusztáv Rados were elected vice-president and secretary respectively. The number of participants was 298 and in a few months the number of members reached 400.

At the end of World War I, it was decided at the Versailles peace treaties to annex more than the half of the territory of Hungary to different neighbouring countries and so the number of members reduced to about 200.

The other proposal of Eötvös was realised in 1891: a periodical *Mathematical and Physical Journal* (*Matematikai és Fizikai Lapok*) with the purpose of publishing original results and papers in order to acquaint the readers with new results in mathematics and physics. The number of subscribers was slightly more than 400. The editor of the mathematical part was Gusztáv Rados until 1914, Lipót Fejér from 1914 to 1932 and Dénes Kőnig from 1932 until the end of World War II.

The main field of activity of the MFT was to organise reports on new results in mathematics and physics. In addition, in 1894, when president Loránd Eötvös of the society had been nominated as Minister of Education, the general assembly founded a competition in mathematics and physics for students who had finished secondary school. This competition was organised by the MFT (with some interruption in the last years of WW1) and ran from 1894 until the end of WW2. After Loránd Eötvös died in 1919, the society was named the Loránd Eötvös Mathematical and Physical Society (Eötvös Loránd Matematikai és Fizikai Társulat, ELMFT) in 1921 and the competition was named the Loránd Eötvös Competition.

In 1929, as an indisputable sign of the high standard of the competition, József Kürschák assembled a collection of the mathematical problems that had been used in the competition during the first 32 years; a second volume followed it in 1957 (edited by György Hajós, Gyula Neukomm and János Surányi) as did two more books, the last one in 1998, in addition to an English translation of the first book that was published in New York in 1953.

As another important activity of the MFT, the society had to decide on the winner of the Kőnig prize, founded in 1918 by the sons of Gyula Kőnig: György and Dénes. The prize was awarded to young mathematicians who had achieved significant results in pure mathematics. The list of the recipients of the Kőnig prize is very respectable: Mihály Bauer (1922), Gábor Szegő (1924), Gyula Szőkefalvi Nagy (1926), Károly Jordan (1928), Ottó Szász (1930), Jenő Egerváry (1932), Pál Veress (1934), László Kalmár (1936), István Lipka (1938), László Rédei (1940), György Hajós and Béla Szőkefalvi Nagy (1942), Ottó Varga (1944).

In the period between the two wars, the ELMFT made some international contacts; however, these contacts were only invitations to researchers from abroad to hold lectures, e.g. Felix Klein, Gaston Darboux, Hans Rademacher, Waclaw Sierpiński and János Neumann.

After World War II

The last months of WWII caused terrible devastation in Hungary, especially in Budapest, and ELMFT could not continue its operations. However, a few years later, the mathematicians in Szeged organized one of the two successors to the society of mathematicians and physicists; the János Bolyai Mathematical Society (Bolyai János Matematikai Társulat, BJMT) held its first general assembly on the 21st June 1947 in Szeged (the other successor was the Loránd Eötvös Physical Society). There were forty-one participants and twenty mathematicians announced in letters their intention to join. The leaders were elected; Lipót Fejér, Frigyes Riesz, Gyula Szőkefalvi Nagy were the first honorary presidents. However, the position of Szeged, so near to the frontier of the country, made it difficult to organise work, so the presidium soon decided to move to Budapest, a move that was made in 1949.

Very soon after its formation, the number of members of the society reached 1500, and nowadays it is a fairly steady 2500.

Since 1948, the BJMT has been a member of the Association of Technical and Scientific Societies (Mőszaki és Természettudományi Egyesületek Szövetsége). It has also been a member of the International Mathematical Union (IMU) since 1956 and the European Mathematical Society (EMS) since 1990 (from 1978 the BJMT had a delegate in the legal predecessor of the EMS: the European Mathematical Trust).

As a sign of the intensive international contacts of the BJMT, mathematicians from abroad have visited Hungary as guests of the BJMT in large numbers (1091 persons from thirty countries, excluding guests invited to congresses and conferences) and the BJMT has conversely assisted 878 Hungarians travelling to 25 other countries.

There was an important historical factor that led to the strengthening of our mathematical society. The new political system after World War II gradually forbid and eventually stopped all civilian movements between organizations. There were very few exceptions but amongst them were the societies of scientific disciplines. These were controlled by the umbrella organization MTESZ but the control was relatively loose. Our society had the right to organise international conferences, publish proceedings, etc., which in other circumstances was the privilege of state. The other possible establishment for such science related activities was the Hungarian Academy of Sciences. However, it was virtually a ministry of science and was a very bureaucratic organization. These facts channelled the activity of mathematicians to our mathematical society, making it ever stronger. The organisation of international conferences and the publication of its proceedings made 'Western money', which had an extraordinary value in those days in the Eastern block. A certain percentage could even be used by the Society; a very limited number of scientific 'Western travels' of its members were supported.

Fields of activity

From the very beginning of its formation, the activity of the BJMT was separated into a Scientific Department and an Educational Department. In 1963, a Department for Application of Mathematics was also formed. It is very important that the three departments work not only in Budapest but also in a large number of locations, many of them established after 1949; after Szeged and Budapest, the cities of Debrecen, Miskolc, Eger, Székesfehérvár, Győr, Kecskemét, Nyíregyháza, Pécs, Sopron, Szombathely, Szolnok, Veszprém, Kaposvár, Békéscsaba, Tatabánya, Salgótarján, Nagykanizsa became locations for branches of the BJMT.

The main purpose of the Scientific Department is the organisation of congresses and conferences and the publication of scientific periodicals and books. Similarly, the Educational Department organises conferences and organises publication of periodicals, as does the Department for Application of Mathematics. In addition all three departments award various prizes and organise competitions, with the Educational Department taking the natural lead in the latter.

All three departments organise sessions for talks, often with invited speakers from abroad. During the early years new scientific results were often the subject of such sessions but during the last few decades this activity has been rather concentrated in seminars of research institutes and universities, so that seminars organised by the BJMT are run mostly by hosts from abroad.

Congresses

Together with the Hungarian Academy of Science (Magyar Tudományos Akadémia, MTA), the BJMT was the organizer of the First Hungarian Mathematical Congress in 1950. The main purpose of the congress, held in Budapest, was the celebration of the 70th birthdays of Lipót Fejér and Frigyes Riesz. There were 232 participants, with about fifty from abroad.

In 1957, a session closer to the character of a traditional congress (with Hungarian participants only) was held in Szeged in order to give an overview of the activities of BJMT, in sixty lectures, covering the ten years since its foundation.

The Second Hungarian Mathematical Congress was organized (again with the collaboration of the MTA) in 1960, located in Budapest again, with the purpose of commemorating the centenary of the death of János Bolyai. The 628 participants (nearly half of them from abroad) held 309 lectures and an exhibition on the work of Bolyai was presented.

In 1972, a small congress was organised, with 450 Hungarian participants, in order to celebrate the 15th anniversary of the foundation of the BJMT.

In 1996, as the BJMT was already a member of the EMS, the Hungarian Society was given the honour of organising the Second European Mathematical Congress. There were 724 participants, mostly from abroad.

Conferences

A conference was organised in 1952 in Budapest, in conjunction with the MTA, with the subject of geometry and topology, in order to commemorate the 150th anniversa-

A. Kolmogorov and A.Renyi at the first Hungarian Mathematical Conference

ry of the birth of János Bolyai. A large number of participants from Hungary and abroad (among them P.S. Alexandroff and E. Čech) emphasised the importance of this field and the outstanding significance of Bolyai's work.

From 1953, the BJMT began to organise a yearly number of conferences (a maximum of five per year) on different fields of mathematics and their applications, in various cities and towns around the country. They were always of international character, with the majority of participants always coming from abroad. In general, the material of the conference was published by the BJMT in one or more volumes.

In order to give a brief survey, below are the subjects of the conferences (in parentheses the number of conferences with theses topics since 1953 and the accumulated number of participants).

- Geometry (10; 526)
- Constructive function theory (1; 19)
- Probability theory and mathematical statistics (10; 1000)
- Algebra (7; 477)
- Differential equations (7; 487)
- Theory of real functions (3; 76)
- Set theory and mathematical logic (6; 649)
- Stochastic processes (1; 32)
- Topology (9; 700)
- Diophantine approximation (1)
- Functional analysis (1)
- Numerical methods (7; 544)
- Biometrics (1)
- Group theory (5; 200)
- Combinatorics and graph theory (13; 1776)
- Matrix theory with applications (1)
- Theory of series (1)
- Probability theory in physics (2)
- Fundaments of mathematics and computers (1)
- Mathematical education (4; 2700)
- Number theory (6; 300)
- Probability theory in economy (1; 165)
- Linear spaces and operators (1; 55)
- Information theory (3; 300)
- Recursive functions (1; 33)
- Theory of reliability (1; 137)
- Hilbert spaces (1; 49)
- Operations research (8; 1914)
- Theory of rings (1; 100)
- Storing theory (1; 130)
- Functional equations (1)
- Computing science (3; 862)
- Theory of limit distributions (4; 357)
- Differential geometry (4; 374)
- Approximation theory (8; 893)
- Theory of analytic functions (1; 46)
- Point processes and queuing problems (1; 44)
- Theory of programming (2; 144)
- Statistical physics (3; 266)
- Lattice theory (1; 60)
- GAMM (Gesellschaft für Angewandte Mathematik und Mechanik) conference (1; 539)
- Matroid theory (1; 59)
- Theory of radicals (2; 112)
- Theory of algorithms (1; 87)
- Irregularities of partitions (1; 39)
- Nonlinear oscillations (1; 238)
- Varieties of higher dimension (1)
- Extremal systems of sets (1; 43)
- Hausdorff dimensions (1; 36)
- Set theoretical topology (1; 27)
- Combinatorial number theory (1; 38)
- Colouring problems (1999, 21)
- Hypergraphs (1; 82)
- Mild congruences (1; 50)
- Commemorating the Neumann centenary (1; 81)

Providing help in mathematical education

One of the strengths of our society is that it comprises both mathematics teachers and researchers. This ensures a solid framework for joint activities like adoption of new trends in education, making decisions upon experiments in mathematics teaching, organising contests for elementary and high school students, publishing a journal for these students, and further training for mathematics teachers.

One of the main purposes of the educational department has always been in providing assistance to mathematical education. Therefore, nearly every branch organises lectures each year discussing questions relating to this field. The management of the department evaluates every arrangement made by the Ministry of Education concerning mathematical education and often makes some criticism; conversely, the ministry regularly asks the opinion of the BJMT in connection to such arrangements.

An important event was the International Symposium for Mathematical Education in 1963, instigated by the UNESCO and organised by the Hungarian Ministry of Education and the BJMT. The positions regarding many questions of mathematical education taken at this sym-

Congress for teachers

posium influenced, for a long period of time, the work in the field, in Hungary and in several other countries.

Every branch regularly organises meetings of young students in order to help their mathematical development. Similar ones are held for students selected from the whole country under the title of Mathematical Circle for Youth.

The most important means of exercising influence over mathematical education are the 'wandering congresses', organised every year in various cities and towns around Hungary. The participants are teachers of mathematics in elementary and secondary schools, in addition to university professors, consistently numbering a few hundred. Invited teachers are present each year at a considerable number of lectures analysing current questions of mathematical education; the participation at these unions is considered as an important factor of their professional development.

Another conference that discusses questions of mathematical education is the Tamás Varga Didactic Days organised in Budapest by the BJMT and the Mathematical Department of the Faculty for Teachers' Training of the L. Eötvös University. (T. Varga was the secretary of the UNESCO conference in 1963 and an excellent teacher of mathematics; he worked hard for the reform of mathematical education in primary schools). It has been held every year since 1990.

Publications

The material of a large number of different conferences is edited (in English) by the BJMT; this series contains 72 volumes and two scientific books. The society published a special volume entitled *Panorama of Hungarian Mathematics in the Twentieth Century I*, recently edited by J. Horváth. It is an historical survey of some branches of Hungarian mathematics such as constructive function theory, harmonic analysis, geometry, topology and stochastics. This will be followed by a second volume containing chapters on combinatorics, logic, etc. In Hungarian, a number of lecture notes on different courses are edited by the BJMT. Since 1990, the material of the Tamás Varga Didactic Days has been regularly published; in 2004, the 7th volume was published.

Two scientific periodicals in English are produced by the BJMT: *Periodica Mathematica Hungarica* (since 1971) and *Combinatorica* (since 1981).

Among the periodicals in Hungarian is the successor to the mathematical part of the *Mathematical and Physical Journal*, i.e. the *Mathematical Journal* (*Matematikai Lapok*), published by the BJMT since 1950. It contains original papers on various branches of mathematics, reviews on various scientific areas and regular reports on the activity of the BJMT.

The periodical published in Hungarian by the BJMT that is arguably the most important is the *Mathematical Journal for Secondary Education* (Középiskolai Matematikai Lapok), successor to the *Mathematical and Physical Journal for Secondary Education* (Középiskolai Matematikai és Fizikai Lapok), published since 1894, formally independently to the MFT but in close connection with it. This periodical was halted in 1939 due to WWII but, almost immediately after the end of the war, the mathematical part was again published by the newly founded BJMT. The BJMT continues to edit this periodical with the help of the Hungarian Ministry of Education and, since 1959, has enlarged it with a physical column while still keeping the traditional title. The mathematical part of the periodical contains articles on various branches of elementary mathematics but its essential purpose is to regularly set forth different problems of elementary mathematics, providing a school-year long problem-solving competition, and to publish the solutions submitted by the readers, who are primary and secondary school students.

The collaboration of the BJMT with the Hungarian Ministry of Education is apparent in the publication of the periodical, *Teaching of Mathematics* (*A Matematika Tanítása*), published from 1953 to 1990, which targets teachers of mathematics in primary and secondary schools and discusses current questions concerning mathematical education.

The BJMT took over the publication of the *Journal for Applied Mathematics* (*Alkalmazott Matematikai Lapok*) and the publication of *ABACUS* in 1997 (a periodical with similar purposes to the *Mathematical and Physical Journal for Secondary Education* but intended for primary school students).

Competitions

One of the most successful methods for influencing the development of talent for mathematics in young people is the organisation of mathematical competitions, so the BJMT undertook, in 1949, the organisation of a mathematical competition dating back to 1891 called the József Kürschák Competition (in order to popularise the author of the famous book on mathematical competition problems). It has always remained a competition for students who have just finished secondary school but later the participation of younger students was also accepted.

A new type of competition was founded in 1949 that was organised for university students, called the Miklós Schweitzer Competition (M. Schweitzer was a talented young student of mathematics who lived in Budapest during World War II and was a victim of the Holocaust). Except for the first year, the participants received a collection of mathematical problems (about ten each time) that were to be solved at home over a period of ten days. Due to the new type of this competition, the material (problems and solutions) from between 1949 and 1961 appeared in a book in English (*On tests in higher mathematics,* Akadémiai Kiadó) and that of the competitions between 1962 and 1991 in another (*On tests in higher mathematics, Miklós Schweitzer competition,* Springer).

Similarly, 1949 was the year of the foundation of the Dániel Arany Competition (D. Arany was the first editor of the *Mathematical Journal for Secondary Schools*). This is a competition similar to the J. Kürschák Competition but aimed at younger students, no older than grade 10. Every year there are several thousand participants.

A very similar competition for students of up to grade 8 is the Tamás Varga Competition. This competition was organised by the BJMT from 1985 until 1999.

On behalf of the Hungarian Ministry of Education, the mathematical section of the national students' competition (somewhat similar to the J. Kürschák competition) was organized by the BJMT from 1951 until 1976.

The competitions mentioned above are all of national character and each is an annual event. Several branches of the BJMT also organise mathematical competitions of local character, intended for students of a certain region. The International Mathematical Olympiad was first organized in 1959. The BJMT had, on behalf of the Ministry of Education, the task of organising preparatory courses for possible participants of the Olympiad. Due to these courses (and, of course, to the talent of the participants), during the 46 Olympiads so far, the Hungarian participants have obtained 70 first prizes, 121 second prizes and 69 third prizes.

As part of the courses that prepare the participants of the Mathematical Olympiad, a competition for secondary school students in Hungary and Israel has been organised since 1990, alternately based in Israel and in Hungary (although the location is sometimes dependent upon the war situation in Israel). In Hungary the organiser is the BJMT and in 2005, the 15th competition was held in Budapest.

Prizes

In order to promote the purposes of the Society, the general assembly of the BJMT has founded various prizes in order to express the thanks of the members for achievements of prominent mathematicians who make outstanding contributions.

For those people prominent in the furthering of mathematical education, the Manó Beke Commemorative Prize (M. Beke was a professor of mathematics in the early years of the 20th century who did much for the reform of mathematical education) has been awarded to a maximum of seven people each year since 1950. So far, 342 prizes have been awarded, mostly to teachers of mathematics in primary and secondary schools.

The Géza Grünwald Commemorative Prize has been awarded every year since 1953 to successful young researchers in mathematics (up to a maximum of four per year).

The Tibor Szele Commemorative Medal (T. Szele was a very successful research worker in algebra who died very early in 1955 as a result of an infection) was founded in 1970 and is distributed (at most one medal every year) to mathematicians who are outstanding in forming a school of researchers in some field of mathematics. So far, 35 medals have been awarded.

The Kató Rényi Commemorative Prize (K. Rényi was the wife of Alfréd Rényi and an eminent research worker in analysis as well as being very successful in encouraging young university students in their research into some branch of mathematics; she died rather young in 1970) is distributed to at most eight university students every year who do outstanding work in mathematics research. The prize was founded in 1973.

The Gyula Farkas Commemorative Prize (Gy. Farkas was a professor in Kolozsvár at the end of the 19th century and one of his results had a considerable impact on linear programming) has been awarded every year since its foundation in 1973 (up to a maximum of four prizes every year) to young researchers who are successful in some field of applied mathematics.

The Prize of the Patai foundation is given to young mathematicians (at most one each year since 1986) who have already found remarkable results in some area of mathematical research.

There are also some prizes founded and distributed by other institutions where the BJMT have obtained the task of preparing the proposition of the persons receiving the prize, e.g. the Ericsson Prize and the Professor Rátz Prize (Rátz Tanár Úr Életműdíj), both designated to acknowledge outstanding accomplishments for a longer period in mathematical education.

The sessions at which various prizes are awarded have always had a considerable effect on the popularisation of the activities of the BJMT (in the case of the Tibor Szele Commemorative Prize, one of the disciples of the prizewinner gives a review on the results of the latter).

Presidents and general secretaries

Every three years the general assembly of the BJMT elects the board of directors, in particular the president, who has to determine the main direction of the activity of the Society, and the secretary-general, whose task is to execute the dispositions of the presidium. In every case these persons have been outstanding members of the BJMT.

Presidents: László Rédei (1947–1949), György Alexits (1949–1963), György Hajós (1963–1972), László Fejes Tóth (1972–1975), Pál Turán (1975–1976), János Surányi

BJMT-presidents, from left to right: László Rédei, György Alexits, György Hajós, László Fejes Tóth, Pál Turán, Ákos Császár, András Hajnal, Imre Csiszár.

(1976–1980), Ákos Császár (1980–1990), András Hajnal (1990–1996), Imre Csiszár (1996–).

Secretary-generals: László Kalmár (1947–1949), Alfréd Rényi (1949–1953), János Surányi (1953–1963), László Fuchs (1963–1966), Ákos Császár (1966–1980), András Hajnal (1980–1990), Gyula Katona (1990–1996), Gábor Fejes Tóth (1996–2000), István Juhász (2000–).

The general assembly also elects honorary presidents from among the outstanding members of the Society. The list so far includes (with the names of those who are alive written in italics): Lipót Fejér, Frigyes Riesz (cf. photos on the cover page), Gyula Szőkefalvi Nagy, György Alexits, László Kalmár, Rózsa Péter, László Rédei, Pál Szász, Pál Erdős, László Fejes Tóth, *János Surányi*, Béla Gyíres, *Ákos Császár*, Béla Szőkefalvi-Nagy, Károly Tandori, *András Hajnal*, *András Prékopa*, *Vera T. Sós*.

Cecília Kulcsár

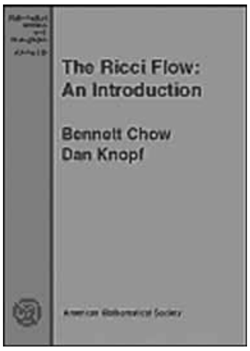
In the compilation of the present paper, the author appreciates the paper Társulatunk 75 éve (75 years of our Society) of Barna Szénássy (*Matematikai Lapok*, 17 (1966), 295–308) and, first of all, the aid of Cecília Kulcsár, director of the BJMT.

Ákos Császár [csaszar@elte.ludens.hu], born 1924, is a member of the Hungarian Academy of Sciences and winner of the Kossuth prize (1963). His main interests are in real analysis and in general topology. His most important result is the classification of different topologies by introducing the syntopogen structures.

Book review

Gérard Besson (Grenoble, France)

Bennett Chow and Dan Knopf
The Ricci Flow: An Introduction
Mathematical Surveys and Monographs 110 (2004), 325 pages
American Mathematical Society
ISBN: 0-8218-3515-7



The idea of using the Ricci flow to construct special Riemannian metrics goes back to R. Hamilton who proved, in 1982, a deep result in three dimensions. He showed that a compact 3-manifold that admits a metric of positive Ricci curvature has a metric of constant positive sectional curvature. Starting from this seminal result, a series of important theorems were obtained by R. Hamilton and other mathematicians. In the last couple of years, this activity has culminated in G. Perelman posting three papers on the web aimed at proving Thurston's geometrisation conjecture (including the Poincaré conjecture) using the Ricci flow, which was the original motivation for R. Hamilton. At the time of writing of this review, it is highly probable that this attempt has been successful. This achievement opens a wide area of applications of the method, among them the search for Einstein metrics in arbitrary dimension. The Ricci flow can be thought of as an ordinary differential equation on the space of metrics but this is a point of view that is difficult to use for precise study. A more useful approach consists of considering it as a parabolic partial differential equation on the manifold, which shares properties with the heat equation. The method is a wonderful combination of analysis and geometry and relies on the knowledge of most of the main features of Riemannian Geometry: comparison theorems, compactness theorems (à la Gromov), classification of manifolds of nonnegative curvature, study of natural operators and parabolic partial differential equations on manifolds and so on. This is an important topic of study for any student starting to learn geometry as well as for those who are more experienced in the field.

This book is by far the best introduction to the subject presently available. It contains nine chapters and two appendices; the first two chapters, devoted to examples, would deserve a monograph by themselves. It is now a well-known fact that in three dimensions there are eight model 'geometries', meaning eight homogeneous geometries, and that any 3-manifold should decompose into pieces, each of which carries one of these structures (Thurston's geometrisation conjecture). Chapter 1 describes the Ricci flow on these model spaces, a problem that is more algebraic than analytic and of prime importance to understand. Chapter 2 deals with special solutions that appear as models of singularities in the works of Hamilton and Perelman, in particular those that have an infinite past, an infinite future or both. The crucial example, which is studied in detail, is the so-called neck-pinch, a metric on a manifold that pinches off in a cylindrical region. It plays a central role in the proof of the geometrisation conjecture (in three dimensions) since one has to perform surgery on the evolving manifold and these surgeries take place in regions that are neck-like. The description of this example is covered in arbitrary dimension. These two chapters constitute a very good warm-up for the rest of the book and they help to develop an intuition of how a metric evolves under the Ricci flow. Questions regarding the possibility of collapse are addressed. We should emphasise that it is not often that a textbook starts with sixty pages of examples; however, this is arguably the best way to study a new subject.

The next two chapters are devoted to the basis of the analysis of the parabolic partial differential equation that translates the Ricci flow. Chapter 3 is concerned with the short-time existence of solutions of this equation. This is not an easy matter, even in the compact case, since the parabolic equation is not strongly parabolic due to the invariance of the equation by the diffeomorphisms group. The existence of solutions is thus, even for short time, not obvious. This was a major difficulty solved by R. Hamilton in his first article on the subject (later, D. Deturck provided a modification of the equation that transforms it into a strongly parabolic equation, which is related to the harmonic map equation and is described in this chapter). Once one has a solution for short time, one can write the evolution equations of the various curvatures in order to obtain geometric information. The first result one can get comes from the application of the maximum principle for parabolic equations. This is the subject of chapter 4 and it is presented in a very pedagogical way: it starts with the scalar versions and then goes onto the vector valued versions, since it is to be applied to the equation satisfied by the Riemann curvature tensor. Although it is an analytic tool, the geometry plays an important role and this interplay is quite fascinating. The only reservation that I can make is that no version of the strong maximum principle is stated even though the principle is used several times in the book. The authors mention that this will be addressed in the planned successor to this book.

Chapters 5 and 6 are the core of the text since they concern the 2- and 3-dimensional situations. If one wants to use this technique to prove the geometrisation conjecture, it is a natural question to ask whether it proves the uniformisation of surfaces. This is the content of chapter 5; in two dimensions, the flow or its normalised version (when the volume is kept constant along the flow), converges to a metric of constant curvature without encountering any singularity. It thus proves the uniformisation of surfaces except for the most difficult sphere case, for which one has to use the complex structure on S2. This limitation has been overcome very recently, after the publication of the book, in a paper by X. Chen, P. Lu and G. Tian. In this case, two nice proofs are given. We should emphasise that the original paper by R. Hamilton is rather a sketch than a rigorous proof and is thus difficult to read. Most of the techniques used in higher dimensions and in particular in Perelman's work, appear in an elementary form in this important section of the book. A graduate course on the Ricci flow could start with one semester on the 2-dimensional case and this chapter together with the previous one (on maximum principles) would be the perfect textbook. Chapter 6 is concerned with the 3-dimensional result that is mentioned at the beginning of this review. It covers all the important facts in three dimensions, in particular the so-called Hamilton-Ivey maximum principle. Once again, as for the case of surfaces, the flow on a compact 3-dimensional manifold that admits a metric of positive Ricci curvature never encounters any singularity.

Chapters 7, 8 and 9 logically focus on singularities that should (and do) occur when the manifold does not satisfy any assumption, for example when it is a general 3-dimensional manifold. The way to analyse these singularities is to dilate around a point where the curvature becomes very big and to show that the manifold there resembles a model. This is the purpose of chapters 8 and 9. In order to take a limit around these points, one should use a compactness theorem applied to a sequence of dilations of the manifold around the highly curved points. Some properties of the limit that one can obtain rely on the control of the derivatives of the curvature for an evolving metric. These estimates are the so-called Shi's estimates and are of extreme importance in Perelman's work. This is covered in chapter 7, together with the statement of Hamilton's compactness theorem. The 'no-collapsing' result of Perelman (section 4 of his first paper) is used in these chapters; the result says, essentially, that if a flow blows up in finite time (meaning that the curvature goes to infinity in finite time at some point) than the injectivity radius of the metrics is bounded below. In an important article about the formation of singularities, R. Hamilton classified the singularities in three types. Chapters 8 and 9 describe some features of this classification. This part is not involved in Perelman's work in three dimensions but it is important both for developing an intuition on the subject and for future work in higher dimensions. One important point is that the model singularities in three dimensions (called _-solutions) satisfy the so-called Li-Yau-Hamilton Harnack inequalities. This is mentioned in the chapter on surfaces and in chapter 8. This could be made more precise; once again the author announces that more details will be found in the successor to this book.

The two appendices concern some basics on tensor calculus and comparison geometry.

After reading this book, the overall impression is that the authors have certainly taught this subject and thus have made a great effort to motivate the introduction of any new material. This is clear since each chapter begins with a motivation section and the book itself starts with numerous examples. Since the 'publication' of Perelman's papers, quite a few sets of notes on geometric flows have been posted. This book is by far the best I have read so far and it is an indispensable reference. We all wait for the second volume, which should contain information about Perelman's great geometric achievements.

Prof. Gérard Besson [G.Besson@ujf-grenoble.fr] is Directeur de Recherches of the C.N.R.S. (France) at the Institute Joseph Fourier, in the Department of Mathematics of the University of Grenoble I, where he has been since 1981. He obtained his habilitation (Ph.D. degree) in 1987, in the field of Riemannian geometry under the supervision of Marcel Berger. He works currently on several topics, from which we should mention his joint work with G. Courtois and S. Gallot on minimal entropy of locally symmetric spaces.

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.

March 2006

1–July 31: Stochastic Analysis, Stochastic Partial Differential Equations and Applications to Fluid Dynamics and Particle Systems, Centro Di Ricerca Matematica Ennio De Giorgi, Pisa, Italy
Information: e-mail: crm@crm.sns.it;
web site: http://www.crm.sns.it/stochastic/

7–11: Holomorphic dynamics, Fields Institute, Toronto, Canada
Information: e-mail: holodynamics@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/holodynamics/holodynamics_workshop/

24–26: Fields Institute Workshop on Lie Algebras, University of Ottawa, Ottawa, Canada
Information: e-mail: neher@uottawa.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/lie_algebra/

27–29: Coxeter Lecture Series, Yair Minsky (Yale University), Fields Institute, Toronto, Canada
Information: e-mail: holodynamics@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/holodynamics/holodynamics_workshop/

29–1 April: Ischia Group Theory 2006. International Conference in Honour of Akbar Rhemtulla, Jolly Hotel – Ischia, Naples, Italy
Information: http://www.dmi.unisa.it/ischia2006/index.html

April 2006

5–7: PICOF'06 - Inverse Problems, Control and Shape Optimization (Third edition), Nice, France
Information: e-mail: henda.elfekih@enit.rnu.tn, Juliette.Leblond@sophia.inria.fr, jaoua@math.unice.fr;
web site: http://www-sop.inria.fr/apics/picof06/

10–13: 58th British Mathematical Colloquium, Newcastle upon Tyne, UK
Information : e-mail: bmc06@ncl.ac.uk ;
web site: http://www.ncl.ac.uk/bmc06/

11–12: Mathematical Education of Engineers V, Loughborough University, United Kingdom
Information: e-mail: conferences@ima.org.uk;
web site : http://www.ima.org.uk/Conferences/MathEdofEng.htm

20–22: Workshop on Logic, Models and Computer Science LMCS06,
Information: http://dmi.unicam.it/merelli/LMCS06/

23–May 7: Rigidity and Flexibility, Erwin Schroedinger International Institute for Mathematical Physics, Vienna, Austria
Information: e-mail: secr@esi.ac.at;
web site: http://www.geometrie.tuwien.ac.at/esi/

May 2006

2–9: Workshop on Stochastic and Harmonic Analysis of Processes with Jumps, University Angers, France
Information: http://www.harmonic-analysis.org/

5–12: Mathematical Models of the Heart, Longyearbyen, Svalbard, Norway
Information: e-mail: sundnes@simula.no;
web site: http://home.simula.no/ems2006/

6–11: International conference on Fourier and Complex analysis, classical problems-current view, Protaras, Cyprus
Information: e-mail: skoumand@ucy.ac.cy

8–19: CANT'2006 International School and Conference on Combinatorics, Automata and Number Theory, Liège, Belgium
Information: e-mail: M.Rigo@ulg.ac.be;
web site: http://www.cant2006.ulg.ac.be
[For details, see EMS Newsletter 57]

8–July 31: Gerbes, Groupoids, and Quantum Field Theory, Erwin Schroedinger International Institute for Mathematical Physics, Vienna, Austria
Information: e-mail: secr@esi.ac.at;
web site: http://www.esi.ac.at/activities/future-prog.html

10–12: Fields Institute Workshop on Numerical, Mathematical and Modeling Analysis related to Fluid Dynamics in Hydrogen Fuel Cells, University of Ottawa, Ottawa, Canada
Information: e-mail: novruzi@uottawa.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/fuelcells/index.html

12–13: Fields Institute Workshop, Ottawa-Carleton Discrete Mathematics Day, Carleton University, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/discrete_math/

14–17: Fields Institute Workshop on Covering Arrays, Carleton University, Ottawa, Ontario
Information: e-mail: programs@fields.utoronto.ca;

web site: http://www.fields.utoronto.ca/programs/scientific/05-06/discrete_math/

14–19: Random Walks in Random Environments, Fields Institute, Toronto, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/RWRE/

15–17: The First International Conference on Mathematical Sciences (ICMS), Gaza, Palestine
Information: e-mail: m.okasha@alazhar-gaza.edu;
web site: http://www.alazhar-gaza.edu/ICMS

15–17: Fields Institute/CRM Workshop on Probabilistic Symmetries and their Applications, University of Ottawa, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.mathstat.uottawa.ca/~givanoff/workshop.htm

17–19: Conference of Applied Statistics in Ireland, Cork, Ireland
Information: kingshuk@stat.ucc.ie

20: 4th IMA Younger Members Conference, University of Manchester, UK
Information: http://www.ima.org.uk/

21–25 : Dynamique et alea, Merlimont plage, France
Information: e-mail: frederic.paccaut@u-picardie.fr;
web site: http://www.lamfa.u-picardie.fr/Colloques/alea2006/index.html

22–27: Lie days in Martina Franca, Martina Franca, Italy
Information: e-mail: papi@mat.uniroma1.it;
web site: http://www.mat.uniroma2.it/~gavarini/RTN/Martinafranca-2006.html

23–27: Fields Institute Workshop on Hyperbolic geometry, Toronto, Canada
Information: e-mail: holodynamics@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/holodynamics/hyperbolic/

24–25: PQCrypto 2006. International Workshop on Post-Quantum Cryptography, Katholieke Universiteit Leuven, Netherlands
Information: http://postquantum.cr.yp.to/

24–27: Twenty-second Conference on the Mathematical Foundations of Programming Semantics (MFPS XXII), Genova, Italy
Information: http://www.math.tulane.edu/~mfps/mfps22.htm

25–27: Complex and Harmonic Analysis, Thessaloniki, Greece
Information: e-mail: betsakos@math.auth.gr;
web site: http://www.auth.gr/comhar/

28–June 1: Eurocrypt 2006, St. Petersburg, Russia
Information: http://www.iacr.org/conferences/eurocrypt2006/

29–June 1: Spectral Theory of Differential Operators. A conference held on the occasion of Michael Solomyak's seventy-fifth birthday, Rehovot, Israel
Information: e-mail: terry.debesh@weizmann.ac.il;
web site: http://www.math.technion.ac.il/~pincho/solomyak/Solomyak_Conference.htm

29–June 2: Semiclassical, Riemannian and Combinatorial aspects of Spectral Theory. International conference in honour of Yves Colin de Verdière, Grenoble, France
Information: e-mail: geraldine.touvier@ujf-grenoble.fr;
web site : http://www-fourier.ujf- grenoble.fr/CONGRES/ColinDeVerdiere05/index.html

30–June 6: 8th international Spring School on Nonlinear Analysis, Function Spaces and Applications (NAFSA 8), Prague, Czech R.
Information: e-mail: nafsa8@math.cas.cz;
web site: http://www.math.cas.cz/~nafsa8;
http://adela.karlin.mff.cuni.cz/nafsa/2006
[For details, see EMS Newsletter 56]

31–June 4: EUROMATH-2006: South-Eastern European Conference on Mathematics Education and Applications – 2006, Cyprus
Information: e-mail : makrides.g@intercollege.ac.cy;
web site: http://www.euromath.info;

31–June 4: MASSEE International Congress on Mathematics MICOM-2006, Cyprus
Information: e-mail : makrides.g@intercollege.ac.cy;
web site: http://www.cms.org.cy; http://www.massee-congress2006.info;

June 2006

1–3: International Conference on Computers and Communications, Baile Felix Spa, Oradea, Romania
Information: e-mail: idzitac@univagora.ro;
web site: http://www.iccc.univagora.ro/index.htm

1–3: Fields Institute Applied Probability Workshop, Carleton University, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/05-06/applied_probability/

2–9: Formal theory of partial differential equations and their applications, Mekrijärvi Research Station, University of Joensuu, Finland
Information : e-mail: pdes2006@joensuu.fi;
web site: http://www.joensuu.fi/mathematics/PDEworkshop2006/index.html

4–10: Dynamics, Topology and Computations DyToComp2006, Będlewo, Poland
Information: http://www.ii.uj.edu.pl/DyToComp2006/

4–10: Workshop on Commutative Rings, Cortona, Italy
Information: e-mail: cortona2006@mat.uniroma3.it;

web site: http://www.mat.uniroma3.it/users/cortona/cortona_2006.html

5–9: Workshop on Fourier Analysis, Geometric Measure Theory and Applications, Barcelona, Spain
Information: http://www.crm.es/Research/0506/AnalysisEng.htm

6–9: Conference on Lattice Theory. **In honour of the 70th birthday of George Grätzer and E. Tamás Schmidt**, Budapest, Hungary
Information: http://www.renyi.hu/conferences/grasch.html

7–9: Boltzmann's Legacy 2006, Erwin Schroedinger Institute for Mathematical Physics, Vienna, Austria
Information: e-mail: secr@esi.ac.at;
web site: http://www.esi.ac.at/activities/Boltzmann2006.html

7–10: Recent advances in nonlinear partial differential equations and applications. A conference in honor of Peter D. Lax and Louis Nirenberg on the occasion of their 80th birthday, Toledo, Spain
Plenary speakers (confirmed): L.L. Bonilla; H. Brezis; A.J. Chorin, D. Christodoulou; A.S. Fokas; F. Golse; J. Jimenez; B.L. Keyfitz; S. Klainerman; C.D. Levermore; Y.Y. Li; A. Linan; A.J. Majda; D.W. McLaughlin; C.S. Morawetz; P. Sarnak; S. Venakides.
Format: There will be a significant number of poster sessions. There is expectation that financial help for young researchers will be available.
Information: http://www.mat.ucm.es/~ln06

8–10: Xenakis Legacies Symposium, Fields Institute, Toronto, Canada
Information: email: programs@fields.utoronto.ca

8–11: Carthapos2006, a Workshop-Conference on Positivity at Carthage, Carthage, Tunisia
Information: http://www.cck.rnu.tn/carthapos2006/

9–14: Eight International Conference on Geometry, Integrability and Quantization, Sts. Constantine and Elena resort (near Varna), Bulgaria
Information: e-mail: mladenov@obzor.bio21.bas.bg;
web site: http://www.bio21.bas.bg/conference/

10–20: Mathematical Modeling of Infectious Diseases Summer School, Fields Institute, York University, Toronto, Canada
Information: e-mail: summer2006@yorku.ca;
web site: http://www.liam.yorku.ca/sc06/

11–14: ICMSE 2006 – International Conference in Mathematics, Sciences and Science Education, Aveiro, Portugal
Information: e-mail: icmse@mat.ua.pt;
web site: http://gag.mat.ua.pt/ICMSE/

12–16: Function Theories in Higher Dimensions, Tampere University of Technology, Tampere, Finland,
Information: e-mail: sirkka-liisa.eriksson@tut.fi;
web site: http://www.tut.fi/fthd/

13–16: SDS2006 – Structural dynamical systems. Computational Aspects, Hotel Porto Giardino, Capitolo, Monopoli, Italy
Information: e-mail: delbuono@dm.uniba.it;
web site: http://www.dm.uniba.it/~delbuono/sds2006.htm

13–16: Mathematics of Finite Elements and Applications (MAFELAP 2006), Brunel University, UK
Information: www.brunel.ac.uk/bicom/mafelap2006
[For details, see EMS Newsletter 56]

15–20: Operator Theory, Analysis and Mathematical Physics OTAMP 2006, Lund, Sweden
Information: e-mail: otamp2006@maths.lth.se;
web site: http://www.maths.lth.se/~kurasov/OTAMP2006/OTAMP2006.html

19–23: Conference "Modern stochastics:theory and applications", Kyiv National Taras Shevchenko University, Kyiv, Ukraine
Information: e-mail: probab.conf.2006@univ.kiev.ua;
web site:http://www.mechmat.univ.kiev.ua/probability/Events/2006/informletterengl.html
[For details, see EMS Newsletter 57]

19–23: Harmonic Analysis and Related Problems (HARP 2006), Zaros, Crete, Greece
Information: http://fourier.math.uoc.gr/~harp2006/

19–23: Quantile Regression, LMS Method and Robust Statistics in the 21st Century, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http://www.icms.org.uk/meetings/2006/quantile

19–24: Hodge Theory, Venice International University – Island of San Servolo, Italy
Information: web site: e-mail: hodge@math.unipd.it;
http://www.mat.uniroma3.it/GVA/HTVIU/

19–30: Third Banach Center Symposium – CAUSTICS'06, Warsaw, Poland
Information: http://alpha.mini.pw.edu.pl/~janeczko/Caustics'06.html

21–23: 6th International Conference on Mathematical Problems in Engineering and Aerospace Sciences, Budapest, Hungary
Information: e-mail: info@icnpaa.com; seenithi@aol.com;
web site: www.icnpaa.com
[For details, see EMS Newsletter 56]

23–26: 2006 International Conference on Topology and its Applications, Aegion, Greece
Information: http://www.math.upatras.gr/~aegion/

25–30: 9th International Vilnius Conference on Probability Theory and Mathematical Statistics, Vilnius, Lithuania
Information: http://www.mii.lt/vilconf9/;
e-mail: conf2006@ktl.mii.lt

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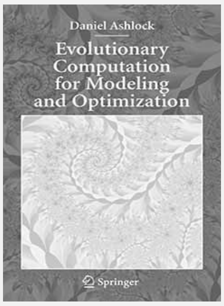
Applied Mathematics in Focus

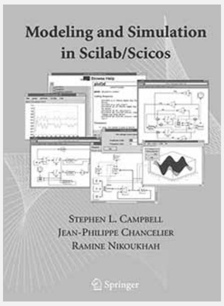


Evolutionary Computation for Modeling and Optimization

D. Ashlock, University of Guelph, ON, Canada

This book is an introduction to evolutionary computation, selectionist algorithms that operate on populations of structures. It includes over 100 experiments and over 700 homework problems that introduce the topic with an application-oriented approach.

2006. XX, 572 p. 163 illus. Hardcover
ISBN 0-387-22196-4 ► **€ 62,95 | £48.50**



Modeling and Simulation in Scilab/ Scicos

S. Campbell, North Carolina State University, NC, USA; J.-P. Chancelier, CERMICS ENPC, France;
R. Nikoukhah, INRIA, France

The book is based on the new Scilab 3.0. While the book will provide useful information to experienced users it is designed to be accessible to beginning users from a variety of disciplines.

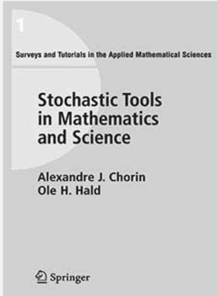
2005. X, 313 p. 103 illus. Hardcover
ISBN 0-387-27802-8 ► **€ 42,95 | £33.00**

Visualization and Processing of Tensor Fields

J. Weickert, Saarland University, Saarbrücken, Germany;
H. Hagen, Technical University of Kaiserslautern, Germany (Eds.)

This book is the first edited volume that presents the state of the art in the visualization and processing of tensor fields.

2006. XV, 481 p. (Mathematics and Visualization) Hardcover
ISBN 3-540-25032-8 ► **€ 89,95 | £69.00**



Stochastic Tools in Mathematics and Science

A. Chorin, O. H. Hald, University of California, Berkeley, CA, USA

Stochastic Tools in Mathematics and Science is an introductory book on probability-based modeling. It covers basic stochastic tools used in physics, chemistry, engineering and the life sciences.
The book is based on the new Scilab 3.0. While the book will provide useful information to experienced users it is designed to be accessible to beginning users from a variety of disciplines.

2006. VIII, 152 p. (Surveys and Tutorials in the Applied Mathematical Sciences, Vol. 1) Softcover
ISBN 0-387-28080-4 ► **€ 34,95 | £27.00**

Python Scripting for Computational Science

H. P. Langtangen, Simula Research Laboratory, Lysaker, and University of Oslo, Norway

The goal of this book is to teach computational scientists how to develop tailored, flexible, and human-efficient working environments built from small programs (scripts) written in the easy-to-learn, high-level language Python. The focus is on examples and applications of relevance to computational scientists. The second edition features new material, reorganization of text, improved examples and tools, updated information, and correction of errors.

2nd ed. 2006. XXIV, 736 p. 62 illus. (Texts in Computational Science and Engineering, Vol. 3) Hardcover
ISBN 3-540-29415-5 ► **€ 49,95 | £38.50**

26–29: ACA 2006 12th International Conference on Applications of Computer Algebra, Varna, Bulgaria
Information: http://www.math.bas.bg/artint/mspirid/ACA2006/

26–30: Applied Asymptotics and Modelling, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http://www.icms.org.uk/meetings

26–July 8: Course on On Limit Cycles of Differential Equations, Barcelona, Spain
Information: http://www.crm.es/Conferences/0506/Limitcycles/limitcycles.htm

27–30: Perspectives of System Informatics. Sixth International Andrei Ershov Memorial Conference, Novosibirsk, Russia
Information: http://www.iis.nsk.su/PSI06

29–July 4: 21th International Conference on Operator Theory, Timisoara, Romania
Information: http://www.imar.ro/~ot/

July 2006

1–December 31: Thematic Program on Cryptography, Fields Institute, Toronto, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/crypto/

3–22: Valuation Theory and Integral Closures in Commutative Algebra, Fields Institute, University of Ottawa, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.mathstat.dal.ca/%7Efaridi/integral-closure.html

3–7: XII Meeting on Real Analysis and Measure Theory (CARTEMI), Ischia, Italy
Information: http://www.dma.unina.it/~cartemi/

5–8: Numerical Analysis and Approximation Theory (NAAT 2006), Cluj-Napoca, Romania
Information: e-mail: naat2006@cs.ubbcluj.ro;
web site: http://www.cs.ubbcluj.ro/~naat2006/

6–8: 4th Portuguese Finance Network (PFN) Finance Conference, Porto, Portugal
Information: e-mail: pfn2006@fep.up.pt;
web site: http://www.pfn2006.org

7–10: 2nd International Conference "From Scientific Computing to Computational Engineering" (2nd IC-SCCE 2006), Athens, Greece
Information: e-mail: ic-scce2006@upatras.gr;
web site: http://ic-scce2006.upatras.gr

9–12: International Symposium on Symbolic and Algebraic Computation (ISSAC 2006), Genova, Italy
Information: http://issac2006.dima.unige.it/

9–22: Horizon of Combinatorics, Budapest, Hungary
Information: e-mail: comb06@renyi.hu;
web site: http://www.renyi.hu/conferences/horizon/

10–12: 6th Meeting on Game Theory and Practice dedicated to development, natural resources and the environment, Zaragoza, Spain
Information: http://www.iamz.ciheam.org/GTP2006/

10–14: New Directions in Applied Probability: Stochastic Networks and Beyond, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http://www.icms.org.uk/meetings

10–14: WavE 2006, EPFL Lausanne, Switzerland
Information: http://wavelet.epfl.ch/

10–14: CMPI-2006 Campus Multidisciplinar en Percepción e Inteligencia, Albacete, Spain
Information: e-mail: caballer@info-ab.uclm.es;
web site: http://www.info-ab.uclm.es/cmpi/

10–15: Conference on Arithmetic of Shimura Varieties and Arakelov Geometry, Barcelona, Spain
Information: http://www.crm.es/Conferences/0506/ConferenceShimura/conferenceshimura.htm

10–15: 6th Czech-Slovak International Symposium on Combinatorics, Graph Theory, Algorithms and Applications. Honoring the 60th birthday of J. Nesetril, Prague, Czech Republic
Information: email: cs06@kam.mff.cuni.cz;
web site: kam.mff.cuni.cz/cs06

12–13: Eighth International Workshop on Deontic Logic in Computer Science (DEON2006), Utrecht, The Netherlands
Information: http://www.cs.uu.nl/deon2006/

17–19: Geometric Aspects of Integrable Systems, Coimbra, Portugal
Information: e-mail: geomis@mat.uc.pt;
web site: http://www.mat.uc.pt/~geomis

17–21: Stochastic Processes and Applications (SPA XXXI), Paris, France
Information: e-mail: spa2006@math-info.univ-paris5.fr;
web site: http://www.proba.jussieu.fr/pageperso/spa06/index.html

17–21: Extremal Kähler Metrics and Stability, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http://www.icms.org.uk/meetings

17–21: Eleventh International Conference on Hyperbolic Problems Theory, Numerics, Applications, Lyon, France
Information: e-mail: hyp2006@math.univ-lyon1.fr;
web site: http://math.univ-lyon1.fr/~hyp2006/

18–21: 13th ILAS Conference, Amsterdam, The Netherlands
Information: http://staff.science.uva.nl/~brandts/ILAS06/

24–27: Joint GAMM-SIAM Conference on Applied Linear Algebra (ALA 2006), Düsseldorf, Germany
Information: http://www.ala2006.de/

24–28: 2nd SIPTA School on Imprecise Probabilities, Madrid, Spain
Information: e-mail: enrique.miranda@urjc.es;
web site: http://bayes.escet.urjc.es/~emiranda/sipta

24–27: Modeling and Optimization: Theory and Applications (MOPTA 06), Fields Institute, University of Waterloo, Waterloo, Canada
Information: email: hwolkowicz@uwaterloo.ca;
web site: http://www.stats.uwaterloo.ca/stats_navigation/Mopta/index.shtml

24–August 4: Computational and Combinatorial Commutative Algebra, Fields Institute, Toronto, Canada
Information: e-mail: ragnar@math.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/comalgebra/

25–30: 9th International Vilnius Conference on Probability Theory and Mathematical Statistics, Vilnius, Lithuania
Information: e-mail: conf2006@ktl.mii.lt;
web site : http://www.mii.lt/vilconf9/

August 2006

7–11: Partial Differential Equations on Noncompact and Singular Manifolds, University of Potsdam, Germany
Information: e-mail: pdensm@math.uni-potsdam.de;
web site: http://pdensm.math.uni-potsdam.de/

7–12: Algebraic Theory of Differential Equations, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http://www.icms.org.uk/meetings

7–13: Third European Summer School in Mathematics Education (YESS-3), University of Jyväskylä, Finland
Information: website: http://ermeweb.free.fr/news.php

11–21: Methods of Integrable Systems in Geometry. London Mathematical Society Durham Symposium, Durham, United Kingdom
Information: http://maths.dur.ac.uk/events/Meetings/LMS/2006/IS/

13–19: Workshop on Triangulated Categories, University of Leeds, UK
Information: e-mail: tholm@maths.leeds.ac.uk;
web site: http://www.maths.leeds.ac.uk/pure/algebra/TriCat06.html

14–16: Canadian Computational Geometry Conference (CCCG), Fields Institute, Queen's University, Kingston, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.cs.queensu.ca/cccg/

14–18: International Conference on Spectral Theory and Global Analysis, Carl von Ossietzky University, Oldenburg, Germany
Information: e-mail: stga@mathematik.uni-oldenburg.de;
web site: http://www.mathematik.uni-oldenburg.de/personen/grieser/stga/

14–18: MCQMC 2006 Seventh International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing, Ulm, Germany
Information: http://mcqmc.uni-ulm.de/

16–19: Geometric Methods in Group Theory, Fields Institute, Carleton University, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/group_theory/

22–30: International Congress of Mathematicians (ICM2006), Madrid, Spain
Information: e-mail: icm2006@unicongress.com;
web site: http://www.icm2006.org

31–September 2: Geometry and Topology of Low Dimensional Manifolds, El Burgo de Osma, Spain
Information: http://mai.liu.se/LowDim/

31–September 2: Advanced Course on Combinatorial and Computational Geometry: trends and topics for the future, Alcalá de Henares, Spain
Information: http://www.crm.es/Conferences/0607/CCGeometry/combinatorial_index.htm

31–September 2: Lorenz-Gini Type Asymptotic Methods in Statistics, Fields Institute, Carleton University, Ottawa, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/

31–September 5: Workshop on Geometric and Topological Combinatorics, Alcalá de Henares, Spain
Information: http://www2.uah.es/gtc06/

September 2006

1–4: Topics in Mathematical Analysis and Graph Theory, Belgrade, Serbia and Montenegro
Information: e-mail: pefmath@etf.bg.ac.yu;
web site: http://magt.etf.bg.ac.yu

1–4: Conference on Mathematical Neuroscience, Universitat d'Andorra, Principat d'Andorra
Information: e-mail: CMathNeuroscience@crm.es;
web site: http://www.crm.es/CMathNeuroscience

2–5: 37th Annual Iranian Mathematics Conference, Azarbaijan University of Tarbiat Moallem, Tabriz, Iran
Information: e-mail: aimc37@azaruniv.edu;
web site: http://www.azaruniv.edu

4–8: Groups in Geometry and Topology Málaga 2006. The First Group Action Forum Conference, Màlaga, Spain
Information: http://agt.cie.uma.es/~ggt06/

4–8: Barcelona Analysis Conference (BAC06), Barcelona, Spain
Information: e-mail: bac06@imub.ub.es;
web site: http://www.imub.ub.es/bac06/

4–9: International Conference on Applied Analysis and Differential Equations, Iasi, Romania
Information: e-mail: icaade@uaic.ro;
web site: http://www.math.uaic.ro/~icaade

4–29: The Painleve Equations and Monodromy Problems, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK
Topic: ODE and Dynamical Systems
Information: e-mail: s.wilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/PEM/

5–8: CDDE 2006, Colloquium on Differential and Difference Equations, Brno, Czech Republic
Information: e-mail: cdde@math.muni.cz;
web site: http://www.math.muni.cz/~cdde/2006

6–8: The Second International Workshop on Analysis and Numerical Approximation of Singular Problems, Karlovassi, Samos, Greece
Information: e-mail: iwanasp06@aegean.gr;
web site: http://www.tech.port.ac.uk/staffweb/makrogla/conf/IWANASP06/samos06.html

10–17: Parabolic and Navier-Stokes Equations, Będlewo, Poland
Information: http://www.impan.gov.pl/~parabolic/

11–13: 21st British Topology Meeting, Powys, Wales, UK
Information: http://www-maths.swan.ac.uk/btm21/

18–20: Algebraic curves in cryptography (The 10th Workshop on Elliptic Curve Cryptography (ECC 2006), Fields Institute, Toronto, Canada
Information: e-mail : programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/crypto/#ECC2006

19–21: Credit Risk under Lévy Models, Edinburgh, UK
Information: e-mail: enquiries@icms.org.uk;
web site: http:///www.icms.org.uk/meetings

21–24: Fifth International Conference on Applied Mathematics (ICAM5). In honour of Professor Ioan A. Rus at the occasion of his 70th birthday, Baia Mare, Romania
Information: e-mail: marieta.gata@rdslink.ro; vberinde@ubm.ro;
web site: http://www.ubm.ro/ro/icam5

October 2006

2–6: Quantum cryptography and computing, Fields Institute, Toronto, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/crypto/quantum/

23–December 15: Stochastic Computation in the Biological Sciences, Isaac Newton Institute for Mathematical Sciences, Cambridge, UK
Information: e-mail: s.wilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/SCB/

30–November 3: Computational challenges arising in algorithmic number theory and cryptography, Fields Institute, Toronto, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/crypto/number_theory/

November 2006

27–December 1: Cryptography: Underlying Mathematics, **Probability and Foundations,** Fields Institute, Toronto, Canada
Information: e-mail: programs@fields.utoronto.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/crypto/crypto_foundations/

January 2007

8–June 29: Analysis on Graphs and its Applications, Cambridge, UK
Information: e-mail: swilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/AGA/index.html

15–July 6: Highly Oscillatory Problems: Computation, Theory and Application, Cambridge, UK
Information: e-mail: swilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/HOP/index.html

March 2007

26–30: Workshop: Homotopy theory of schemes, Fields Institute, Toronto, Canada
Information: e-mail: jardine@uwo.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/homotopy/index.html

May 2007

14–18: Workshop: Stacks in geometry and topology, Fields Institute, Toronto, Canada
Information: e-mail: jardine@uwo.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/homotopy/index.html

June 2007

1–June 30: Geometric Applications of Homotopy Theory, Fields Institute Thematic Program, Toronto, Canada
Subprograms: Higher categories and their applications (January-February), Homotopy theory of schemes (March-April), Stacks in geometry and topology (May-June)
Information: e-mail: jardine@uwo.ca; web site: http://www.fields.utoronto.ca/programs/scientific/06-07/homotopy/ index.html

9–13: Workshop: Higher categories and their applications, Fields Institute, Toronto, Canada
Information: e-mail: jardine@uwo.ca;
web site: http://www.fields.utoronto.ca/programs/scientific/06-07/homotopy/index.html

25–26: Mathematical Modelling in Sport, Manchester, UK
Information: http://www.ima.org.uk/Conferences/conferences.htm

July 2007

1: Summer Conference on Topology and its Applications 2007, Castellón, Spain
Information: http://www.sumtop07.uji.es

16–20: 6th International Congress on Industrial and Applied Mathematics (ICIAM 07), Zurich, Switzerland
Information: http://www.iciam07.ch

23–December 21: Strong Fields, Integrability and Strings, Cambridge, UK
Topic: Differential Geometry, Mathematics in Engineering and the Sciences, Others
Information: e-mail: swilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/SIS/index.html

September 2007

3–December 21: Phylogenetics, Cambridge, UK
Topic: Mathematics in Engineering and the Sciences, Others
Information: e-mail: swilkinson@newton.cam.ac.uk;
web site: http://www.newton.cam.ac.uk/programmes/PLG/index.html

Recent books

edited by Ivan Netuka and Vladimír Souček (Prague)

M. Anderson, T. Feil: A First Course in Abstract Algebra: Rings, Groups and Fields*, second edition, Chapman & Hall/CRC, Boca Raton, 2005, 673 pp., USD 89,95, ISBN 1-58488-515-7*
This is an interesting undergraduate textbook on general algebra. It starts from the very beginning with algebraic and number theoretic properties of integers and of polynomials over rational numbers and it develops the standard theory of rings, fields and groups, ending with basics of Galois theory. It contains the following chapters: I. Numbers, Polynomials, and Factoring. II. Rings, Domains and Fields. III. Unique Factorization. IV. Ring homomorphisms and Ideals. V. Groups. VI. Group Homomorphisms and Permutations. VII. Constructibility Problems. VIII. Vector Spaces and Field Extensions. IX. Galois Theory. A remarkable feature of the book is that it starts first with the concept of a ring, while groups are introduced later. The reason of that is that students are usually more familiar with various number domains rather than with mappings and matrices. There is a huge number of examples in the book; abstract notions are built on these examples and motivated by historical remarks explaining the development of the abstract approach to modern algebra. The book contains a lot of nice exercises of various degrees of difficulty so that it can also be used as a practice book. Last but not least, there are two interesting chapters with classical applications of modern algebra: the impossibility of certain constructions with straightedge and compass, and (non)solvability of polynomials in radicals. (dst)

R. P. Agarwal, M. Bohner, W.-T. Li: Nonoscillation and Oscillation: Theory for Functional Differential Equations*, Pure and Applied Mathematics, vol. 267, Marcel Dekker, New York, 2004, 376 pp., USD 199,95, ISBN 0-8247-5845-5*
The book addresses the question of existence of oscillatory solutions to ODE's with delays. Oscillatory solutions are solutions with infinite number of zeros in a given interval. In most cases the author treats a single equation. The delays can depend on time or even become negative (advanced equations). The book is organized as follows: Chapter 1 summarizes the preliminaries. In fact, not much is required, which makes the book accessible also to non-specialists and students. Chapters 2 and 3 deal with first order equations. Chapter 4 reviews the oscillation theory for second order equations without delays. These results are extended in Chapters 5 and 6 to delayed equations of second and higher orders, respectively. While the previous chapters dealt with a single equation, Chapter 7 is devoted to systems of two equations. The final Chapter 8 introduces the reader to a new and interesting area of differential equations at time scales. Roughly speaking, here one studies an evolutionary equation with time varying over an arbitrary subset T (the "time scale") of real numbers. (dpr)

M. Aitkin, B. Francis, J. Hinde: Statistical Modelling in GLIM 4*, second edition, Oxfords Statistical Science Series 32, Oxford University Press, Oxford, 2005, 557 pp., GBP 60, ISBN 0-19-852413-7*
Preface to the first edition of the book claims that its aim is to give an exposition of the (linear) statistical modelling completed with a necessary statistical background as a tool to analyse a wide spectrum of practical problems by applying the statistical package GLIM (Generalized Linear Interactive Modelling). The second edition is its extended reconstruction based on facilities of GLIM4, the most recent release of GLIM (by the Statistical Computing Group of the Royal Statistical Society). The authors describe GLIM as a command driven package. Commands for manipulation, transformation, display and fitting of data may be entered in any order and saved for later use. GLIM is primarily designed for interactive modelling, but may also serve for standard time consuming procedures such as the fitting of models to extended sets of data. The book covers the following subjects: Regression and analysis of variance, Binary response data, Multinomial and Poisson data, Survival data, Finite mixtures models, Random effects models, Variance component models, Random coefficient models, Variance component model fitting, Autoregressive random effect models, IRT models, Spatial dependence and Multivariate correlated responses. The book will be appreciated by graduates, PhD-students and professional statisticians as a tool that provides a comprehen-

sive treatment of the statistical theory with an emphasis on application. Wide range of case studies and a gentle self-contained presentation of GLIM4 complete the monograph as an extremely useful publication. (jste)

V. I. Arnold, Ed.: Arnold's Problems, Springer*, Berlin, 2004, 639 pp., EUR 99,95, ISBN 3-540-20614-0*

The collection of problems presented by V. I. Arnold together with comments on their solutions were published (in Russian) in 2000. The collection now appears in English version. The second edition is considerably enlarged, both in the part collecting problems and in the part containing comments. Almost one third of the book contains statements of problems, more than two thirds contain comments on solutions of problems by 59 authors. V. I. Arnold announced his problems twice a year at his Moscow seminar, he also published other problems in his books and papers. These are sources of problems collected here. Problems were chosen to stimulate a long-term research, many of them are still open and inspiring. The comments describing the present status of solutions form a very valuable part describing many interesting branches of contemporary research. They are mostly written by former Arnold's students. The book covers broad parts of mathematics and it offers an interesting and inspiring reading for any mathematician or mathematical physicists. (vs)

M. F. Atiyah: Collected Works, *vol. 6, Oxford Science Publications, Clarendon Press, Oxford, 2004, 1030 pp., GBP 95, ISBN 0-19-853099-4*

The sixth volume of Collected works of M. F. Atiyah contains papers published in the period between 1987 and 2004. It includes four longer contributions – the monograph on geometry and dynamics of magnetic monopoles (written together with N. Hitchin); a beautiful theme of the Jones theory and its Witten's reformulation in terms of TQFT described in the Lincei Lectures on geometry and physics of knots (together with three shorter related papers); cohomological and arithmetical properties of the Dedekind η-function and relations to index theorems discussed in the Rademacher Lectures in 1987 and a long paper (with E. Witten) on M-theory on a manifold with G2-holonomy (together with two companion papers on related topics and two papers on twisted K-theory and its relation to physics). The whole volume contains 49 papers. Shorter contributions fall into several different groups. A series of six papers is devoted to unexpected relations among the spin statistic theorem, configurations of different points in the space, equivariant cohomology, representations of the symmetric group and the Nahm equation. There are two papers on Skyrmions written with N. Manton. There is a paper (with L. Jeffrey) on equivariant Euler class in infinite dimension and the paper (with G. Segal) indicating a possible role of the K-theory in string theory. There is a series of papers describing the work of outstanding mathematicians and physicists (S. Donaldson, E. Witten, V. Jones, F. Hirzebruch, R. Bott, R. Penrose, J.A. Todd, K. Kodaira, H. Weyl, I. M. Gel'fand). The turn of the century was an occasion to evaluate the evolution of mathematics. The volume includes (besides others) the survey looking back to mathematics of the 20th century, which was many times reproduced and translated. The book contains more than a thousand pages of elegant ideas, deep insights and extraordinary mathematics. It should be on the shelf of any mathematical library. (vs)

Y. Aubry, G. Lachaud, Eds.: Arithmetic, Geometry and Coding Theory (AGCT 2003)*, Séminaires & Congres, Société Mathématique de France, Paris, 2005, 215 pp., EUR 41, ISBN 2-85629-175-9*

The book contains 11 of the lectures presented at two conferences (Algebraic Geometry and Information Theory and the 9th international conference Arithmetic, Geometry and Coding Theory) devoted to arithmetic, geometry and their applications in coding theory and cryptography which were held in Centre International de Rencontres Mathématiques in Marseille (France) in May 2003. Their subjects cover many topics of the modern algebraic number theory and geometry which found applications in the mentioned areas. The topics discussed in the book include functions fields, curves and polynomials over finite fields, towers of function fields, numerical semigroups, hyperelliptic curves, p-adic representations, class field towers, Galois groups, rational points, bilinear complexity, or hyperelliptic jacobians. This nice collection contains many interesting surveys on geometric and algebraic methods applied in coding theory and cryptography with necessary references. (špor)

C. S. Bertuglia, F. Vaio: Nonlinearity, Chaos & Complexity. The Dynamics of Natural and Social Systems*, Oxford University Press, Oxford, 2005, 387 pp., GBP 85, ISBN 0-19-856790-1*

The book is thematically divided into three parts. In the first part, the reader is slowly introduced to basic concepts of the theory of dynamical systems. Many simple, both linear and nonlinear examples, are discussed. The second part is devoted to problems connected with stability, instability, and in particular, the concept of chaos. Again, a number of examples are presented, including the well-known Lorenz attractor and logistic map. The last part focuses on the dynamics of systems that are "complex", which is seen as a special regime between stable and chaotic behaviour. The book is written in an essentially non-technical language, which makes it easily accessible to the audience with only elementary mathematical background. More importantly, the authors are obviously trying to discuss the problems from very wide perspective, and the book contains a lot of digressions to the philosophical topics. The reader can thus also read (among others) about the antropic principle, the questions related to determinism and reductionism, and the philosophical background of doing mathematics in general. Despite of the fact that some considerations can be found to be a little speculative (as for example the suggestion that the review of the concept of "number" or "infinity" might lead to establishing successful complexity theory), the book will certainly bring a lot of pleasure to the reader with philosophical inclinations. (dpr)

I. Bialynicki-Birula, I. Bialynicka-Birula: Modeling Reality: How Computers Mirror Life*, Oxford University Press, Oxford, 2004, 180 pp., GBP 25, ISBN 0-19-853100-1*

The book presents a broad overview on modelling principles, ideas and modelling reality. Covered fields are from cellular automata, discrete probability, basic statistics, dynamic systems, evolution of dynamic systems, notion of chaos, fractals, statistical linguistics, graph theory, game theory, genetic algorithms, neural networks, modelling society to Turing machine and artificial intelligence. Each subject is discussed in a separate chapter with historical introduction and provided with well-known persons connected with the subject. Each chapter contains also a problem characterizing the subject and demonstrated on enclosed CD.

The book originated from a series of lectures delivered by the first author at the Warsaw School of Social Psychology and at Warsaw University. The authors' aim is to give a broad overview of various aspects and principles of mathematical modelling for a mixed audience, from students of mathematics, computer science, and physics to students of biology and social sciences. The book is equipped with a CD containing implementations of problems mentioned in chapters. These programs allow the reader to practice his knowledge on modelling. He can see and work with Galton's board, Pascal's triangle, genetic algorithm, Schelling's model, etc. I recommend the book to any reader interested in mathematical modelling. The book is convenient as a textbook for tutorial introductory courses on mathematical modelling for a mixed audience, from students of mathematics, computer science, and physics to students of biology and social sciences. (pl)

R. Bornat: Proof and Disproof in Formal Logic. An Introduction for Programmers, *Oxford Texts in Logic 2, Oxford University Press, Oxford, 2005, 243 pp., GBP 30, ISBN 0-19-853027-7*
An intention of the book is to present formal logic as a useful tool for some parts of computer science. It is done just on a basic level: a small and simple part of mathematical logic is presented only but an elementary and useful application is also developed. The mentioned material was lectured in a first-year university class. Part I, Basics, is an introduction to the idea of formal (mathematical) logic. Part II presents the notion of formal (syntactic) proof. Part III treats formal (semantic) disproof (how to construct counter-examples); we can find here explanations of notions as mathematical model and constructive and classical semantics. Part IV, Proof of programs, gives some applications to precise description and verification of programs; a simple programming language is introduced for logically based study of loops and arrays. The text is written in a reasonably informal but sufficiently precise manner and, moreover, it is very lively. (jmlč)

C. J. Bradley: Challenges in Geometry. For Mathematical Olympians Past and Present*, Oxford University Press, Oxford, 2005, 205 pp., GBP 19,95, ISBN 0-19-856692-1*
J. Bradley has been for many years deeply involved in training the United Kingdom teams for the International Mathematical Olympiad. The book contains a number of topics of geometrical nature, in which lengths, areas, etc., have integer values. About 3500 years ago geometers were aware of the existence of right-angled triangles having integer sides (Pythagorean triangles) and may have had some methods for constructing them. Problems involving integers have always been considered fascinating (see, e.g., the Fermat last theorem). In the book the reader can also find problems concerned with triangles and circles (circumcircle, incircle, nine-point-circle, etc.). It contains the proof of Pick's theorem and deals also with rational points on curves and with polygons and solids. It is recommendable for students who are interested in geometry and number theory and getting ready for competitions. The book contains numerous exercises, hints and solutions. (lbo)

S. Carter, S. Kamada, M. Saito: Surfaces in 4-Space, Encyclopaedia of Mathematical Sciences*, vol. 142, Springer, Berlin, 2004, 213 pp., EUR 84,95, ISBN 3-540-21040-7*
The new volume of the long term project Encyclopaedia of Mathematical Sciences belongs to the sub-series Low-dimensional topology. The topic described in the book is topology of surfaces in 4 dimensions. The first chapter describes various diagrammatic methods (motion pictures, normal forms, marked vertex diagrams, surface braids, etc.) and their relations. Constructions of knotted surfaces are discussed in the second chapter. The third chapter introduces a lot of invariants for knotted surfaces. A quandle is a set with a self-distributive binary operation. The quandle cocycle invariants are discussed in the last chapter of the book. There is also a geometric interpretation of quandle homology using colored cobordisms. Twenty five pages of quandles and their homology groups are available in the Appendix. Ten pages of references are included. Even though drawings of surfaces in four-dimensional space are impossible, the book is richly illustrated by many drawings and diagrams. (vs)

S. T. Chapman: Arithmetical Properties of Commutative Rings and Monoids*, A Series of Lecture Notes in Pure and Applied Mathematics, vol. 241, Chapman & Hall/CRC, Boca Raton, 2005, 391 pp., USD 169,95, ISBN 0-8247-2327-9*
The book is the joint proceedings of the Special AMS session "Commutative Rings and Monoids" and of the Mini-Conference "Factorization Properties of Commutative Rings and Monoids" held at University of Nothern Carolina in Fall 2003. The volume consists both of original research papers and surveys on arithmetical properties of commutative rings and monoids. The focus is on factorization of elements in a domain or commutative monoid, however, also factorizations of ideals and the non-domain case are considered. The first seven papers of the volume are based on the main talks of the Mini-Conference delivered by D. D. Anderson (non-atomic unique factorization), D. F. Anderson (divisibility properties in the graded case), J. Coykendall (extensions of half-factorial domains), F. Halter-Koch and A. Geroldinger (C-monoids, C-domains, Transfer principles) and U. Krause (Cale monoids). There are 19 more papers in the volume, written by further leading experts in the area, including S. Glaz, W. Hassler, E. Houston, and B. Olberding. The book is indispensable for anyone interested in current trends, methods and results on arithmetic of commutative rings. (jtrf)

C. Clapham, J. Nicholson, Eds.: A Concise Oxford Dictionary of Mathematics *(third edition), Oxford University Press, Oxford, 2005, 510 pp., GBP 9,99, ISBN 0-19-860742-3*
Fifteen years after the first edition and nine years after the second one, this great reference book appears for the third time. It has now five hundred pages of reference items and eight appendices. The level has been carefully chosen to suit a wide public with emphasis on sixth-form pupils, college students and the first-year university students. Such students will hardly meet any mathematical term that would not be explained in the dictionary. The book, however, will be of interest also for students of all other levels, their teachers, engineers, and, in fact, pretty much for anybody with any kind of interest in mathematics and/or its history. Even a professional mathematician can learn

a lot from it because it covers a fairly wide range of mathematical subjects, including applied mathematics, statistics, and related branches.

Compared to previous editions, the dictionary has been enriched with over five hundred new entries. The newly added stuff reflects the growing importance of applied mathematics and, in particular, applied statistics. Apart from definitions of mathematical terms and simple explanations of their meaning and use, the book contains also biographical data of important mathematicians. The third edition has more of these than the previous editions, mainly on the 20th century mathematicians. The eight appendices are of great value as well. They contain basic area and volume formulas, differentiation and integration tables, a list of the most important Taylor expansions, a useful and well-arranged table of trigonometric formulas, a comprehensive list of various mathematical symbols of all types, the Greek alphabet, and, finally, the complete list of all Fields medal winners since 1936. This dictionary is likely to become an indispensable tool for both students and teachers. It provides admirably comprehensive and deep information in a reader-friendly style. It makes it very difficult for a reader to stop browsing once started. (lp)

J. W. Cogdell, D. Jiang, S. S. Kudla, D. Soudry, R. Stanton, Eds.: Automorphic Representations, L-Functions and Applications: Progress and Prospects*, Ohio State University Mathematical Research Institute Publications 11, Walter de Gruyter, Berlin, 2005, 430 pp., EUR 148, ISBN 3-11-017939-3*

The book is the proceedings of a conference held in 2003 in honor of the 60th birthday of S. Rallis. The volume contains 14 articles of interest to specialists on automorphic forms; surveys by D. Bump and H. Jacquet (on the Rankin-Selberg method and the relative trace formula, respectively), as well as research articles on topics ranging from representation theory of p-adic groups (E. M. Baruch; S. Kudla, S. Rallis; C. Moeglin; J. W. Cogdell, I. I. Piatetski-Shapiro, F. Shahidi). Through constructions of automorphic representations (W. T. Gan, N. Gurevich; D. Ginzburg, S. Rallis, D. Soundry) and investigations of Rankin-Selberg L-functions (D. Ginzburg, D. Jiang, S. Rallis; E. M. Lapid, S. Rallis) to p-adic and (mod p) automorphic forms (M. Harris, J.-S. Li, Ch. M. Skinner; F. Vigneras). S. Rallis himself is a coauthor of five articles in this volume! (jnek)

A. C. C. Coolen, R. Kühn, P. Sollich: Theory of Neural Information Processing Systems, *Oxford University Press, Oxford, 2005, 569 pp., GBP 75, ISBN 0-19-853023-4*

Within the last decade, artificial neural networks have become a well-established research discipline. Due to its interdisciplinary character, many currently appearing books on neural network theory are quite specialised and focused primarily on problems and methods applicable in the field. The presented book fills the gap between older textbooks dealing with the progress done in the 1980's and up-to-date specialised texts. Among others, these new areas comprise applications of Bayesian methods, Gaussian processes and support vector machines, information theory for neural networks and Amari's information geometry.

The whole text is divided into five parts. The introductory Part I explains the basic principles of neurocomputing and two fundamental neural network architectures – perceptrons and recurrent networks. Part II discusses more advanced neural network models – vector quantization, Gaussian processes and RBF-networks, Bayesian techniques and support vector machines. The following Part III deals with information theory (measuring information, entropy, Shannon's information theory and statistical inference) and its application to neural networks. Part IV is devoted to macroscopic analysis of learning dynamics. The final Part V concludes with the equilibrium statistical mechanics of neural networks. Each of the five parts encompasses a brief overview of the discussed methods. Attached are nine appendices explaining the background of some essential theoretical concepts.

The book provides an excellent class-tested material for graduate courses in artificial neural networks. It is completely self-contained and includes also a thorough introduction to the discussed discipline-specific areas of mathematics. Each chapter is accompanied with multiple exercises on the discussed topic. Notes on historical background and further reading included at the end of each part guide the reader into the literature. The text is written clearly and it contains a lot of illustrative figures, supporting graphs and sufficient references. Therefore, this book represents a good reference source of applicable ideas for a wide audience including students, researchers and application specialists as well. (imr)

L. Crosilla, P. Schuster, Eds.: From Sets and Types to Topology and Analysis: Towards Practicable Foundations for Constructive Mathematics*, Oxford Logic Guides 48, Oxford University Press, Oxford, 2005, 350 pp., GBP 70, ISBN 0-19-856651-4*

The book is a collection of contributions to constructive mathematics, which arose from the workshop held in 2003. The main idea of the workshop was to find a closer link between practise and foundations of constructive mathematics. The articles can be roughly divided into two main groups: foundations and practise, each of which has two further parts. For the first part it is type theory and set theory, for the second part it is analysis and topology. There is also an introductory chapter, where the contributions are reviewed from a more general perspectives. It is also possible to find here an introduction to the subject of constructive mathematics together with basic references. Altogether there are 21 papers, which are fairly self-contained and include a useful link of references and indications towards further reading. (akč)

G. Da Prato: Kolgomorov Equations for Stochastic PDEs*, Advanced Courses in Mathematics CRM Barcelona, Birkhäuser, Basel, 2004, 182 pp., EUR 32, ISBN 3-7643-7216-8*

The monograph treats a stochastic differential equation $dX(t,x) = AX(t,x) + F(X(t,x))\, dt + B\, dW \;\; X(0,x)=x, x \in H$ in a separable Hilbert space H, where A and B are operators, F a nonlinear map and W the cylindrical Wiener process. A solution $X(t,x)$ is asked to be L_2-continuous stochastic process adapted to $W(t)$. The equation is known as a model for the evolution of an infinite dimensional dynamical system that is perturbed by noise and covers reaction-diffusion, Burges and Navier-Stokes equations. The corresponding elliptic and parabolic Kolmogorov partial differential equations are discussed with considerable details and in each case, transition group, strong Feller property, irreducibility and invariant measures, are investigated. A good book to study is presented. A clear and compact presentation of a topic that is of considerable interest both in mathematics and statistical physics. Some results appearing here are completely new. The text might provide a material for an advanced course directed to students who are familiar with stochastic analysis, basic functional analysis and theory of partial differential equations. (jste)

***G. David: Singular Sets of Minimizers for the Mumford-Shah Functional**, Progress in Mathematics, vol. 233, Birkhäuser, Basel, 2005, 581 pp., EUR 108, ISBN 3-7643-7182-X*

Image processing is ranked among the most topical sources of inspiration for recent mathematical analysis. The Mumford Shah functional has been proposed as a model for image segmentation. Given a bounded measurable function g on an n-dimensional domain G (the most important case is n=2) which represents the original image, we look for another function u, which represents a simplified image. The balance between simplicity and fidelity is expressed by the functional J, which is composed from three summands. The first part of J is the fidelity, this is represented by the distance of u from g measured by the square of the L_2-norm. The second part is the (n-1)-dimensional Hausdorff measure of the singular set K of u. Namely, we believe that the singular set what we find describes the boundaries between objects which are displayed on the picture. The function u is allowed to jump across K whereas it is assumed to be smooth outside K. The last summand is the Dirichlet integral of u outside of K which measures the smoothness of u. The major problem in dimension 2 is the celebrated Mumford-Shah conjecture which claims that if u minimizes J, then the singular set K is a finite union of C_1 arcs. This would help very much to understand the planar case.

Even less complete is the knowledge in the higher dimensional case. The open problems are of fine nature which is perhaps not so exciting for technically oriented readers but the more stimulates the development of mathematics behind. The importance of the functional does not consist only in its interpretation but more in the fact that it represents a whole class of free boundary problems whose theory will make profit from methods developed for the particular model case. This is also the main motivation of the author. Hence, he does not write a handbook of image segmentation for practicians, but a monograph on the Mumford-Shah Theory.

For the definition of a global minimizer the fidelity part is omitted (hence this is independent of data). There are four types of global minimizers of the functional: a constant function, a function attaining two values separated by a line, a function attaining three values separated by a propeller (a union of three half-lines emanating from the same point and making mutually the angle 120 degrees), and finally the so called crack-tip, a special nonconstant solution with a singular half-line. The Mumford-Shah conjecture is equivalent to the conclusion that each minimizer at each point looks locally as one of these fundamental global minimizers.

This discussion is one of the most important achievements of the book. Although the book is focused on the regularity theory in dimension 2, the existence issue and general dimension problems are also treated. The text is comprehensible for graduate students. The author spreads his enthusiasm and the presentation sometimes looks as an fascinating adventure. The most in-readers will surely make profit from the development and find inspiration for new inventions in the theory of free boundary problems. The book has been awarded the Ferran Sunyer i Balaguer 2004 prize. (jama)

***T. A. Davis, K. Sigmon: Matlab Primer**, seventh edition, Chapman & Hall/CRC, Boca Raton, 2005, 215 pp., USD 19,95, ISBN 1-58488-523-8*

As everybody knows, MATLAB joints programming, computing and visualisation in a friendly, flexible and open environment. It provides to mathematicians, and to scientists in general, a language for writing down a problem, and to compute its solution both mathematically and graphically. Problems, however, might be complex in symbolics or numerically, might be solved in a fraction of time required by programming in standard languages. This seventh edition book covers topics as Matrices and matrix operations, Submatrices and colon notation, MATLAB functions, Control flow statements, M-files, Calling C, Fortran and Java from MATLAB, Two and three dimensional graphics, Sparse matrix computations, Symbolic variables and computations, Polynomials, Interpolation and Integration, Equations (linear, differential). This primer offers a direct and complex coverage of MATLAB specifics, and it might recommended without hesitation both to new users and those using it to solve real problems. (jste)

***J. W. Dawson, Jr.: Logical Dilemmas. The Life and Work of Kurt Gödel**, A.K. Peters, Wellesley, 2005, 361 pp., USD 34, ISBN 1-56881-256-6*

This biography offers a complete picture of life and work of logician and philosopher Kurt Gödel. It is known that Gödel's results – completeness and compactness theorems, incompleteness theorems, constructible sets, consistency proof – opened some fundamental branches of modern mathematical logic and set theory. Moreover, his cosmological and philosophical opinions (formalization of Anselm's ontological argument of the existence of God) are also treated. The book is a narration of Gödel's life, interrupted by two excurses in the history of mathematical logic and set theory (chapters III, VI). In the text, we can find a plastic picture of Gödel's personality and a devoted and intelligible explanation of his scientific results and their impact to various branches of mathematics. Appendix C consists of brief biographical vignettes of some mentioned persons. The book illuminates comprehensively knowledge and history of modern foundations of mathematics. (jmlč)

***M. Emmer, Ed.: Mathematics and Culture I**, Springer, Berlin, 2004, 352 pp., 54 fig., EUR 49,95, ISBN 3-540-01770-4*

This book is the first English translation of an italian original (with the same title, also published by Springer). M. Emmer is organizing regularly all Italian meetings with the same title in various historical Italian locations (Bologna, Venezia). These large meetings attract scientists from all branches of mathematics but also artists (visual but also actors, movie makers, musicians) but also architects and literary people. Articles reflect various approaches to now popular topic. The scope of the book is amply reflected by the titles of individual chapters: Mathematics (articles by C. Procesi and H. W. Kuhn); Mathematics and history (a remarkable article by G. Israel), Mathematics and economics; Mathematics, Arts and Aesthetics (an article by an artist A. Perilli); Mathematics and Cinema (an article by P. Greenaway); Mathematical Centers; Mathematics and Literature; Mathematics and technology; Homage to Venice; Mathematics and Music; and Mathematics and Medicine. It is a remarkable project and an interesting book. (jneš)

***T. Franzén: Gödel's Theorem. An Incomplete Guide to its Use and Abuse**, A.K. Peters, Wellesley, 2005, 172 pp., USD 24,95, ISBN 1-56881-238-8*

The book presents an exceptional exposition of Gödel's incompleteness theorems for non-specialists. The author explains clearly and thoroughly, without too many technical details, what the theorems really say and, as the title of the book suggests, also what they do not. The book corrects frequent misunderstandings and misapplications to various areas like philosophy, physics, theology and others. It also presents some interesting historical comments on the discovery of the theorems. Finally, it briefly describes examples of some more recent results revealed by Gödel's incompleteness theorems. Among others, connections between incompleteness and Kolmogorov complexity, a notion from the area of algorithmic randomness, and Paris-Harrington theorem are briefly discussed. To summarize, it is a valuable addition to the literature. (akč)

***O. Gascuel, Ed.: Mathematics of Evolution & Phylogeny**, Oxford University Press, Oxford, 2005, 416 pp., GBP 45, ISBN 0-19-856610-7*

This is a treatise on a mathematical approach to evolution, which reflects considerable progress that mathematical and computational means used in this field made in recent time. That progress, caused also by increasing flood of genomic data of the last years, has made these means more powerful, efficient, complex, and their conclusions more realistic. In 14 survey chapters written by top researchers in the area, we find a compact summary of the state of mathematical techniques and concepts currently used in the field of molecular phylogenetics and evolution. The authors concentrate on fundamental mathematical concepts and research in current reconstruction methods, they describe probabilistic and combinatorial models that address evolution at different stages, from segments of DNA sequences to whole genomes. Methods of exploiting these models for reconstructing phylogenetic trees and networks are shown. It is explained how these reconstructions can be tested in a statistical sense and what are the inherent limits of them. The book presents a number of mathematical results, which give an in-depth understanding of the phylogenetic tools. The book is of multidisciplinary nature, being a link between biology and mathematics. It is of great value for graduate students and researchers in phylogeny, and it offers a wide field for applied mathematicians. (jdr)

***A. Grothendieck, Ed.: Cohomologie locale des faisceaux cohérent et théoremes de Lefschetz locaux et globaux** (SGA 2), Documents Mathématiques 4, Société Mathématique de France, Paris, 2005, 208 pp., EUR 40, ISBN 2-85629-169-4*

This is an annotated, corrected and newly typeset reedition of the second volume of A. Grothendieck's seminar on algebraic geometry. The main theme is local cohomology of schemes (in the "classical" language predating derived categories) and its geometric applications to theorems of Lefschetz type (comparison of topological and geometrical invariants of a projective scheme and its hyperplane section). This reedition contains numerous comments by the editor (Y. Laszlo) on more recent results in this area. (jnek)

***N. M. Katz: Moments, Monodromy, and Perversity: A Diophantine Perspective**, Annals of Mathematics Studies, no. 159, Princeton University Press, Princeton, 2005, 475 pp., GBP 38,95, ISBN 0-691-12330-6*

In this book the author studies equidistribution properties of several classes of trigonometric sums in characteristic p depending on a sufficiently large number of parameters. As in his previous work, the key point is to identify the perverse sheaf on the parameter space responsible for the trigonometric sum in question and then determine its geometric monodromy groups G. In the first two chapters, the author develops a new, global method for determining G. He begins by proving approximate "orthogonality relations" for trace functions of irreducible perverse sheaves, which allow him to compute the dimensions of tensor invariants of G in degrees less than a bound depending on n. On the other hand, results of M. Larsen – suitably generalized – imply that G is, essentially, determined by its tensor invariants in degree 8. In subsequent chapters, this general method is applied to additive character sums, multiplicative character sums and sums related to L-functions of elliptic curves (even though other techniques have to be used to distinguish the cases $G=SO(N)$ and $O(N)$). The penultimate chapter investigates equidistribution results when p is variable, and the last chapter is devoted to equidistribution results for analytic ranks in families of elliptic curves over function fields. (jnek)

***A. A. Kirillov: Lectures on the Orbit Method**, Graduate Studies in Mathematics, vol. 64, American Mathematical Society, Providence, 2004, 408 pp., USD 65, ISBN 0-8218-3530-0*

The orbit method played and will play a very important role in description of basic facts concerning representations of Lie groups. Originally, they were developed for nilpotent Lie groups. The book offers a nicely written, systematic and readable description of the orbit method for various classes of Lie groups. The book starts with the description of the coadjoint action and its orbit structure, including the moment map and polarizations. The study of the case of nilpotent Lie groups starts with the important special case of the Heisenberg group. The orbit method is then fully described for the classical case of nilpotent Lie groups. The next two chapters describe the use of the orbit methods for solvable and compact Lie groups. The last chapter contains a short indication how the method works in other cases, including semisimple Lie groups, Lie groups of general type, infinite-dimensional groups, or in the case of groups over other fields. There are also general intuitive comments on the orbit method and suggestions for further research.

To understand the book, the reader needs quite a lot of preliminary knowledge. For the convenience of the reader, the book contains five log appendices on topology, category theory, cohomology; real, complex, symplectic and Poisson manifolds; homogeneous spaces of Lie groups, basics of functional analysis, infinite dimensional representation and induced representations. These appendices form the second part of the book (almost 200 pages). The book is an excellent addition to the existing literature and should be on the shelves of mathematicians and theoretical physicists using representation theory in their work. (vs)

***P. K. Kythe, M. R. Schäferkotter: Handbook of Computational Methods for Integration**, Chapman & Hall/CRC, Boca Raton, 2005, 508 pp., USD 89,95, ISBN 1-58488-428-2*

This book, excellent in form and ideas which it contains, is devoted to the very often occured problem of computation of integrals in one variable. There are given very many integration and quadrature rules and the choice of the material covers most of the areas of practice in which the numerical integration is required to. The book is not only the overview of rules but it explains the ideas for which the given formula were previously derived and studied. There are also overviewed some application areas such us differential and integral equations, Fourier integrals and transforms, Hartley transform, fast Fourier and Hartley transforms and wavelets. The first chapter provides some useful definitions and results needed in the book. The topics treated in other chapters include interpolatory and Gaussian quadratures, improper and singular integrals, Fourier integrals and transforms, inversion of Laplace transforms, wavelets and integral equations. The enclosed CD-R contains of over 5800 formulas for indefinite and definite integrals, quadrature tables in ASCII format and computer codes in C++, f90, MATLAB, and Mathematica, all in ASCII format. The reviewer is persuaded that the book is a very useful source for researchers in many fields of mathematics and for graduate students. (jkf)

***A. Laptev, Ed.: European Congress of Mathematics, Stockholm, June 27-July 2, 2004**, European Mathematical Society, Zürich, 2005, 879 pp., EUR 118, ISBN 3-03719-009-4*

Following ECMs in Paris 1992, Budapest 1996 and Barcelona 2000, the Fourth European Congress of Mathematics took place in Stockholm in July 2004. There were 7 plenary lectures, 33 invited lectures, 12 European network lectures, 6 science lectures and 322 poster presentations covering all areas of mathematics and its various applications. The proceedings includes 32 contributions of invited speakers, 11 presentations of the EU Research Training Networks in Mathematics and Information Sciences and Programmes from European Science Foundation in Physical and Engineering Science and all 7 papers by plenary speakers. Further, 5 contributions of EMS Prize winners are included in the Proceedings. There is also foreword by the President of the EMS, Opening speech and Scientific Report by the President of the 4ECM Organization Committee. The book represents a nice overview of many fields of contemporary mathematics. (in)

***P. Maisonobe, L. Narváez Macarro, Eds.: Éléments de la théorie des systèmes différentiels géométriques**, Séminaires et Congrès, no. 8, Société Mathématique de France, Paris, 2004, 430 pp., EUR 72, ISBN 2-85629-151-1*

The book contains written versions of lectures presented at the summer school on coherent modules over the ring of linear differential operators held at Séville in 1996. The book starts with a description of the inverse image and the local cohomology functors (by P. Maisonobe and T. Torrelli). Two shorter papers treat the local duality theorem (L. N. Macarro) and a regular meromorphic extension of an integrable holomorphic connection (J. Briançon). L. N. Macarro and A. R. León describe an elementary proof of the faithful flatness of the sheaf of infinite order linear differential operators over the sheaf of finite order ones. Calculations of classical invariants (characteristic variety and its multiplicity, slopes along a smooth hypersurface) of coherent modules over the sheaf of linear differential operators can be found in the paper by F. J. Castro-Jimenéz and M. Granger. The long paper (almost 150 pages) by Z. Mebkhout is devoted to the positivity theorem, the comparison theorem and the Riemann existence theorem. The irregularity sheaf for a holonomic module and a hypersurface is defined and the fundamental regularity criterion gives its vanishing. The existence theorems of Riemann type and of Frobenius type are proved here. The comparison theorem for vanishing cycles is discussed by P. Maisonobe and Z. Mebkhout. The book ends with papers devoted to irregular holonomic modules (by B. Malgrange) and geometric irregularity (by Y. Laurent). The book offers a very nice and comprehensive survey of the theory. (vs)

***S. B. Maurer, A. Ralston: Discrete Algorithmic Mathematics**, third edition, A.K. Peters, Wellesley, 2004, 772 pp., USD 88, ISBN 1-56881-166-7*

Discrete mathematics and combinatorial algorithms have already become a well-established part of most undergraduate mathematics and computer science curricula. However, many mathematicians still view algorithms as second-class citizens and computer scientists tend to do likewise with mathematical theorems. This book tries to bridge the gap between the two disciplines and leads the reader through an interesting amalgam of both, frequently switching between using mathematics to analyze algorithms and employing algorithms to prove theorems constructively. In addition to the standard topics like relations, graphs and counting methods, the book also includes more advanced chapters involving solving difference equations, discrete probability and applications to practical problems, e.g. mathematical biology. The exposition is self-contained, complemented by diverse exercises and also accompanied by an introduction to mathematical reasoning, culminating in a separate chapter on the basics of logic. The book is an excellent textbook for a one-semester undergraduate course and it includes a lot of additional material to choose from. (mmar)

***E. Mezzetti, S. Paycha, Eds.: European Women in Mathematics**. Proceedings of the Tenth General Meeting, World Scientific, New Jersey, 2003, 409 pp., USD 118, ISBN 981-238-190-2*

The EWM organization (European Women in Mathematics) is an affiliation of women bound by a common interest in the position of women in mathematics. A lot of information about EWM is given in the introductory part of this book, including the history and the aim of EWM, the list of European countries involved in the activities of EWM, basic data about the previous meetings of EWM since 1986 in Paris and a lot of other interesting information. The Tenth General Meeting took place in Malta in August 2001. The mathematical part of the Proceedings is mostly formed by invited lectures. They are devoted to "Mathematics applied to finances" (5 lectures), "Geometry" (4 lectures on cohomology and 4 lectures on applications) and a series of lectures by the EMS lecturer M. Vergne on convex polytopes. All talks are accessible to a broader audience, they often bring a new approach or new results. There are also abstracts of 35 posters from various branches of mathematics. A part of the book is devoted to some problems of the interrelationship of mathematics and human society. The book is valuable not only for mathematicians. It brings many precise and valuable information to the reader interested in the role of women in mathematics and, more generally, in gender studies. (vt)

T. W. Müller, Ed.: Groups: Topological, Combinatorial and Arithmetic Aspects*, London Mathematical Society Lecture Notes Series 311, Cambridge University Press, Cambridge, 2004, 587 pp., GBP 55, ISBN 0-521-54287-1*
The book contains the proceedings of the meeting held in 1999 in Bielefeld. The subject of the meeting was quite broad, it covers a lot of different aspects of infinite (and finite) groups. There is altogether 17 contributions, both review and research papers. A long survey written by I. M. Chiswell (150 pages) describes the theory of Euler characteristics, its various definitions and relations among them. Short reviews of basic homology algebra and the cohomological dimension of a group are included. The paper by J. R. Parker and C. Series is devoted to the mapping class group of a torus with punctures. It describes first a simpler case of the torus with one puncture. Generalizing this case step by step, the authors describe the mapping class group of the torus with two punctures. Three papers by A. Mann (applications of probability in group theory), T. W. Müller (parity pattern in Hecke groups and Fermat primes) and D. Segal (finite images of infinite groups) are devoted to various aspects of the theory of subgroup growth. The contribution by B. Remy (based on his Ph.D. thesis) treats the Kac-Moody groups from combinatorial point of view. The paper by E. B. Vinberg and R. Kaplinsky is devoted to pseudo-finite generalized triangle groups. There are 10 other shorter contributions in the book on various other topics, including topological properties of groups, the connections between groups and formal languages and automata, the Magnus-Nielsen method and hyperbolic lattices in dimension three. (vs)

S. Müller-Stach, C. Peters, Eds.: Transcendental Aspects of Algebraic Cycles*, London Mathematical Society Lecture Note Series 313, Cambridge University Press, Cambridge, 2004, 290 pp., GBP 35, ISBN 0-521-54547-1*
The book is based on lectures presented at Summer School on transcendental aspects of algebraic cycles held in Grenoble . The book is divided into four chapters. The first chapter contains introductory material on algebraic cycles, their equivalence relations, Chow varieties and consequently Lawson homology of a projective variety. The second chapter is devoted to an axiomatic set-up of Chow topology on the spaces of cycles, allowing to distinguish homotopy type of cycle spaces and leading to the notion of Lawson homology. Also the morphic cohomology as a cohomology counterpart of Lawson homology and class maps into various cohomology theories are explained. The third chapter treats from scratch classical themes of Grothendieck theory of pure motives and standard conjectures, illustrated by many examples like the motives of curves, Picard and Albanese motives and elliptic modular motives. The definition of motivic cohomology based on the higher Chow groups is given and its various functorial properties are studied. This chapter terminates with spectral sequence from higher Chow groups to algebraic K-theory. The last chapter contains a few lectures on Hodge conjecture. After a general introduction, Hodge conjecture is proved for many hyper-surfaces, e.g. the quintic fourfold. The next section of this chapter treats some infinitesimal Hodge theoretic methods with applications to the study of algebraic cycles. The last part presents applications of Hodge theoretic invariants of non-compact varieties to the study of algebraic cycles. (pso)

I. Neeman: The Determinacy of Long Games*, de Gruyter Series in Logic and Its Applications, vol. 7, Walter de Gruyter, Berlin, 2004, 317 pp., EUR 128, ISBN 3-11-018341-2*
Suppose that two players play the following game. A subset C of the unit interval I is given and the players take turns in choosing digits 0 or 1 to produce a real number $0,x_1 x_2 x_3\dots$. The objective of the first player is to keep the resulting real number in *C*, while the second one endeavours to avoid it. This is very much reminiscent of the plays of two persons with full information (only the play sequences are infinite) but the outcome can be radically different. While in "short games", there is always a winning strategy (or, depending on the evaluation, non-losing one) for some of the two players, there may be none in the "long games" case. Using the axiom of choice, it is not hard to produce a C such that the game is not determined; if, however, the target set C is "nice", a winning strategy does exist. These two facts marked the two main areas in which the long games substantially influenced set theory and logic.

On the one hand, Mycielski and Steinhaus (1962) started studying set theories in which the axiom of choice is replaced by the assumption (contradicting AC, of course) that each infinite game of the above mentioned type is determined (the Axiom of Determinacy, or Mycielski Axiom – this has very interesting consequences: for instance, every subset of the real line is measurable). On the other hand, there is a flourishing theory keeping the choice and studying the nature of the sets C. This led to very involved theories featuring rather advanced techniques (extenders, iteration trees, big cardinals). The book contains author's recent results in this second branch of the long games theory. It is intended for well-informed specialists (the reader should follow the author's advice concerning prerequisities in the Preface). But there is an excellent extensive Introduction presenting a view of the theory that can be profitable for a non-specialist as well. (ap)

V. L. Popov, Ed.: Algebraic Transformation Groups and Algebraic Varieties*, Encyclopaedia of Mathematical Sciences, vol. 132, Springer, Berlin, 2004, 238 pp., EUR 84,95, ISBN 3-540-20838-0*
The conference 'Interesting Algebraic Varieties Arising in Algebraic Transformation Groups Theory' was held in the E. Schrödinger International Institute for Mathematical Physics in Vienna in October 2001. The book contains the proceedings of the meeting. The complete list of talks given at the conference shows that several lectures do not have a written counterpart in the proceedings. Among 11 contributions the reader can find a long paper by J. M. Landsberg and L. Manivel on representation theory and projective geometry, two papers by C. Ciliberto and V. Di Gennaro and papers written by C. De Concini, J.-M. Hwang and N. Mok, D. Krashen and D. J. Saltman, S. Mukai, V. L. Popov, E.A.Tevelev, D.Snow and F. L. Zak. (jbu)

G. L. Price et al., Eds.: Advances in Quantum Dynamics*, Contemporary Mathematics, vol. 335, American Mathematical Society, Providence, 2003, 328 pp., USD 79, ISBN 0-8218-3215-8*

The presented volume contains the proceedings of a AMS-IMS-SAIM Joint Summer Research Conference, devoted to recent progress in quantum dynamics. The first third of the book consists of two review articles prepared by leading experts in the field. W. B. Arveson prepared a series of four lectures covering, mostly without proofs, basics of the theory of semigroups of endomorphisms of type I factors and its relation to causal dynamics, the dilation theory, and the classification of E_0-semigroups. R. T. Powers describes in his four lectures various constructions of spatial E_0-semigroups based on the so called CP-semigroups, i.e., on strongly continuous semigroups of completely positive maps of the algebra $B(H)$ of all bounded operators on a separable Hilbert space H. The rest of the proceedings contains 18 papers devoted to various branches of quantum dynamics. (vs)

***M. M. Rao: Measure Theory and Integration**, second edition, Pure and Applied Mathematics, vol. 265, Marcel Dekker, New York, 2004, 761 pp., USD 195, ISBN 0-8247-5401-8*

This monograph provides a significantly revised and expanded version of the original edition published in 1987 on the classical topics in measure theory and integration. The book starts with chapters on classical notions of measure theory (measurability, measure, measurable functions including sections on Lebesgue--Stieltjes measures, Carathéodory process, metric outer measures, or convergences of measures) and integration (abstract Lebesgue integration, convergence theorems, the Lp-spaces and the Vitali-Hahn-Saks theorem). Next chapters are devoted to differentiation and duality (the Hahn decomposition, the Radon-Nikodˇm theorem, dual spaces) and product measures and integrals. The material in the new chapter is concerned with the Henstock-Kurzweil nonabsolute integration, both on the real line and in Banach spaces.It follows an interesting chapter on analytic sets and Choquet's theory of capacities with an application to the Daniell integral. Last chapters treat materials on an elementary proof of the lifting theorem and on topological measures (the Riesz-Markov theorem, Haar measures). The final chapter is devoted to relations between abstract and topological measures. Each chapter is companioned by many exercises of varying difficulty which give further applications and extensions of the theory.

The book is equipped with a bibliography (more than 170 references), list of standard symbols and notation and with the author and subject indices. The book is well understandable and requires only a basic knowledge of advanced calculus; moreover, some results from topology and set theory are collected in a short appendix, and also a section on basic cornerstones of Banach spaces is included. It can be warmly recommended to a broad spectrum of readers – to graduate students as well as young researches who wish to become acquainted with the basic elements and deeper properties of abstract analysis and its applications. (jl)

***U. Stammbach: Die Zürcher Vorlesung von Issai Schur über Darstellungstheorie**, Schriftenreihe der ETH-Bibliothek, band 5, ETH-Bibliothek, Zürich, 2004, 66 pp., CHF 30, ISBN 3-909386-02-4*

The small booklet offers a testimony about the origin of representation theory. It starts with an introduction by W. Ledermann followed by a curriculum of I. Schur. The reader can find here copies of the invitation of I. Schur to lecture in Zürich and his answer from the year 1936. The main body of the book consists of I. Schur's lectures "Darstellungstheorie der Gruppen", which was worked up and published by E. Stiefel in 1936. The text starts with matrix calculus, an introduction to linear transformations and a concept of a group. In the first chapter, basic notions and methods of representation theory are introduced. The theory of representations of finite groups is presented in the second chapter. In the last chapter theory, the author develops the theory of characters for finite groups. (jbu)

***J. Steuding: Diophantine Analysis, Discrete Mathematics and its Applications**, Chapman & Hall/CRC, Boca Raton, 2005, 261 pp., USD 69,95, ISBN 1-58488-482-7*

The book offers a nice introduction to fundamentals of number theory with the emphasis to Diophantine analysis and Diophantine approximation and their mutual interactions. In 15 chapters and one Appendix the reader finds many interesting basic principles and results, which can be used as a springboard to a deeper study of the subject. Besides standard material covered in such books (as classical approximation theorems, continued fractions, Pell equation, etc.), the reader finds here also a chapter on the Roth theorem, *abc*-conjecture, factorization with continued fractions, *p*-adic numbers, Hensel lemma or the local-global principle. Every chapter ends with exercises (more than 200 in total) of different level (the difficult ones are denoted by an asterisk). Moreover the text contains many historical notes, which can help especially the neophytes in the historical orientation. The book is written in a lively and lucid style and is principally self-contained and requires only standard mathematical background. It is thus directed not only to graduate or advanced undergraduate students, but to everybody interested in this important part of number theory. (špor)

***M. Talagrand: Spin Glasses: A Challenge for Mathematicians. Cavity and Mean Field Model**, A Series of Modern Surveys in Mathematics, Springer, Berlin, 2003, 586 pp., EUR 129,95, ISBN 3-540-00356-8*

This is a book on structures, which are very interesting for physics and – at the same time – rather fundamental for mathematics. The subject of spin glasses played a very special role in theoretical and mathematical physics for more than 20 years. While the formulations of basic objects and hypothesis of the theory are typically very simple and natural, they require almost no mathematical and physical prerequisities and are understandable even to a novice in the field, there are almost no easy and simple results in this theory. In contrast, exact answers even to most basic questions are extremely difficult to obtain. Many different opinions concerning the behavior of these objects still exists after decades of their studies.

The theory of spin glasses remained for long time purely in domain of theoretical physics. The great achievements in the field, due to Parisi and others, created a long time ago a challenge also for mathematical physicists, due to the fact that these results were very non-rigorous mathematically. A considerable progress in mathematical understanding of these ideas was achieved in recent years by the work of several researchers, most notably Guerra. Thus, the field became more and more interesting not only for mathematical physicists but also for mathematicians. The author of the book is a prominent example of a pure mathematician attracted finally by these physical models and discovering that they describe objects of rather fundamental, abstract mathematical nature.

The book describes most of this recent progress, achieved in the mathematical theory of spin glasses by the author and other mathematicians and mathematical physicists. It is directed to mathematical community, thus requiring almost no prerequisities outside of probability theory. It starts with the investigation of a "trivial" random energy model of Derrida. Even in this introductory chapter we find a delicate and detailed material, the description of low temperature behavior of the REM model. Chapter 2 describes the Sherrington Kirkpatrick model (while the short range spin glass models are even more complicated so that even among physicists, there is no real consensus about their low temperature behavior), where any two spins interact randomly. First, the basic work for the high temperatures is reviewed. Then the famous cavity (induction) method is described in detail, incorporating the recent important results of Guerra, the author and others. Chapter 3 deals with the "capacity of a perceptron", and Chapter 4 treats its special cases: the gaussian and spherical models. Chapter 5 describes the Hopfield model, a popular "model of memory" (which is somehow more accessible mathematically than the true spin glass model). Chapter 6 treats the p-spin interaction model (replacing the two spin interactions of usual models), Chapter 7 discusses the "diluted" SK model, and Chapter 8 the "assignment problem" for permutations. A short Appendix collects prerequisities from probability theory, namely some basics on tail estimates, nets, random matrices, Poisson point process, etc.

In conclusion, this is a very important, impressive book, written by a prominent mathematician and leading expert in the field on some fundamental mathematical questions and deep technical estimates in "high dimensional" probability theory. Even if a remarkable new progress in the field of spin glasses was recently (after publication of the book) achieved in a new seminal paper of its author, the book remains indispensable as a basic introduction and reference on this extremely difficult and interesting subject. (mz)

J. Trzeciak: Writing Mathematical Papers in English. A Practical Guide*, European Mathematical Society, Zürich, 2005, 49 pp., EUR 8, ISBN 3-03719-014-0*

As written in the author's preface: 'The booklet is intended to provide practical help for authors of mathematical papers' (p.1). Jerzy Trzeciak, the author of the booklet, has been dealing with mathematical texts from the point of view of their grammatical and stylistic structures and lexis for all his professional life. It would really be difficult to find any other specialist studying these aspects of mathematical texts deeper than him. At present, Jerzy Trzeciak, formerly of Polish Scientific Publishers, is the senior copy editor at the Institute of Mathematics of the Polish Academy of Sciences, and is responsible for such journals as Studia Mathematica, Fundamenta Mathematicae or Acta Arithmetica. What is really important for mathematicians is the fact that he has concluded and structured all his long-term observations and experience with mathematical texts in the reviewed book, which represents a great help for not only non-native English speaking writers but also native English speakers who are beginning to write mathematical texts. The book consists of two basic parts. Part A, Phrases Used in Mathematical Texts, provides ready-made sentences and expressions typical of mathematical texts.

The examples are divided into chapters according to their use – in abstracts and introductions, definitions, notation, assumptions, referees' reports, etc. The language of various stages of a proof is specified in details (the beginning, arguments, consecutive steps, conclusion and remarks.) Part B, Selected Problems of English Grammar, offers its users the most typical problems of English grammar and usage in mathematical texts. It encounters and gives manifold examples of how articles, infinitives, ing-forms, the passive voice, quantifiers, numbers and commas are and should be used. Authors of mathematical texts are recommended how to avoid repetition and organize the word order in their texts. The most typical errors are summarised as well.

The booklet is a revised edition of the first edition published ten years ago. The structures of both editions are not significantly different, however, the author of the text has changed and deepened numerous examples, taking them from more recent mathematical texts. It was a good idea to republish this highly important source of information and inspiration which can be warmly recommended to all mathematicians, editors, philologists and language teachers dealing with mathematical texts. (mbu)

G. Uhlmann, Ed.: Inside Out: Inverse Problems and Applications*, MSRI Publications, vol. 47, Cambridge University Press, Cambridge, 2003, 400 pp., USD 80, ISBN 0-521-82469-9*

Inverse problems appear in many practical situations of everyday life. The most popular example is perhaps the computerized tomography (CT) but there are many other important situations, where measurements made from exterior are used to get the information on an inaccessible interior (of the human body, of the Earth,…). There was an enormous progress in the last 20 years in this field, due to substantial advances in theory as well as to greatly expanded computational possibilities. The book gives an up to date information on this progress. It collects articles by leading specialists on most important subjects. An attempt is made to integrate the separate topics within the whole volume. Some main themes of the book are: Introduction (A. Faridari), Recent developments in the X-Ray Transform (D. V. Finch), Inverse Acoustic and Electromagnetic Scattering theory (D. Colton), Inverse Problems in Transport theory (P. Stepanov), Near Field Tomography (P. S. Carney and J. C. Schotland), Time Harmonic Electrodynamics (P. Ola, L. Paivarinta, E. Somersalo), X-Ray Transform with Sources in a Curve (D. Finch, I. Lan, G. Uhlmann), Seismic Inverse Scattering (M. V. de Hoop), Singularities of the Scattering Kernel (V. Petkov, L. Stoyanov), Geometry and Analysis of Many Body Stattering (A. Vasy), Time Reversal Mirror (C. Bardos). This collection will be undoubtedly very useful both to the researchers in the field and postgraduate students as well. (mzahr)

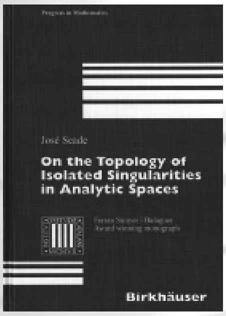
T. Wurzbacher, Ed.: Infinite Dimensional Groups and Manifolds*, IRMA Lectures in Mathematics and Theoretical Physics, vol. 5, Walter de Gruyter, Berlin, 2004, 248 pp., EUR 36,95, ISBN 3-11-018186-X*

The book contains seven papers connected with lectures at two meetings of mathematicians and theoretical physicists at IRMA, Strasbourg and CIRM, Marseille-Luminy in 2002. The main topic is the theory of infinite dimensional groups and manifolds and their use in mathematical physics. The contribution by H. Glöckner describes basic facts on the group $\Gamma(K,G)$ of germs of analytic maps from a compact subset K in a metrizable topological vector space to a Banach Lie group G. The flow completions are discussed in the paper by B. A. Khesin and P. W. Michor. They consider the universal (possibly non-Hausdorff) completion of a smooth manifold equipped with a given vector field. They use it for a class of partial differential equations interpreted as vector fields on infinite dimensional manifolds. M. Mariño presents a longer review of a conjecture on a large N duality between links in 3-dimensional manifolds and strings in 6-dimensional Calabi-Yau manifolds, including various numerical tests of the conjecture. A discussion of anomalies in quantum field theory is contained in the contribution by J. Mickelsson. He describes a relation of anomalies to projective bundles, Dixmier-Douady classes and to associated gerbs. Twisted K-theory classes are related to families of supercharges in the supersymmetric WZW model.

The paper by K.-H. Neeb contains a comprehensive discussion of central extensions of two types of current groups. He considers the case of smooth maps with a compact support from a non-compact manifolds with values in a (possibly infinite dimensional) Lie group and the case of smooth maps on a compact manifold vanishing to all orders on a closed subset. He shows that a central extension of a given type exists for these current groups only if the manifold is a circle. S. Paycha and S. Rosenberg study in their paper analogues of the Chern-Weil classes in infinite dimensional setting. They specify the structure group of infinite dimensional vector bundles and construct the classes using a chosen connection and various traces. The paper by S. G. Rajeev describes an interpretation of the large N limit in Yang-Mills theory as a version of a classical limit. These ideas are nicely used in a discussion of modular forms. The book contains a lot of interesting material useful for readers interested in recent intensive exchange of ideas between mathematics and theoretical physics. (vs)

R. Zaharopol: Invariant Probabilities of Markov-Feller Operators and Their Supports, *Frontiers in Mathematics, Birkhäuser, Basel, 2005, 108 pp., EUR 28, ISBN 3-7643-7134-X*

The text is centred around discrete time homogeneous Markov-Feller processes and it investigates supports of corresponding invariant measures. These processes are employed in the study of stochastic difference equations, to be applied in financial mathematics, for example. The processes are dealt within the framework of the associated transition probabilities and operators. As a principal outcome, the supports of ergodic probabilities and of ergodic Markov-Feller operators are characterized in terms of topological limits. As a setting for handling ergodic probabilities, an original extension of the standard Bogolioubov-Yosida ergodic decomposition is built up. The main parts of the book treat preliminaries on Markov-Feller operators, the Krylov-Bogolioubov-Beboutoff-Yosida decomposition, unique ergodicity and equicontinuity (and unique ergodicity). Even though the book presents new results and deals mostly with topics of intense contemporary research, the beginner is helped to gain a deeper understanding of the theory of Feller processes and Markov processes in general. The book offers a good material for an advanced PhD seminar. (jste)



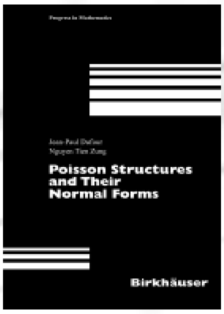
Seade, J., Universidad Nacional Autónoma de México

On the Topology of Isolated Singularities in Analytic Spaces

2006. XIV, 238 p. Hardcover
€ 48.– / CHF 78.–
ISBN 3-7643-7322-9
PM – Progress in Mathematics, Vol. 241

Award-winning monograph of the Ferran Sunyer i Balaguer Prize 2005

The aim of this book is to give an overview of selected topics on the topology of real and complex isolated singularities, with emphasis on its relations to other branches of geometry and topology.
The first chapters are mostly devoted to complex singularities and a myriad of results spread in a vast literature, which are presented here in a unified way, accessible to non-specialists. Among the topics are the fibration theorems of Milnor; the relation with 3-dimensional Lie groups; exotic spheres; spin structures and 3-manifold invariants; the geometry of quadrics and Arnold's theorem which states that the complex projective plane modulo conjugation is the 4-sphere.
The second part of the book studies pioneer work about real analytic singularities which arise from the topological and geometric study of holomorphic vector fields and foliations. In the low dimensional case these turn out to be related to fibred links in the 3-sphere defined by meromorphic functions. This provides new methods for constructing manifolds equipped with a rich geometry.



Dufour, J.-P., Université de Montpellier, France /
Zung, N.T., Université Paul Sabatier, Toulouse, France

Poisson Structures and Their Normal Forms

2005. XV, 321 p. Hardcover
€ 48.– / CHF 78.–
ISBN 3-7643-7334-2
PM – Progress in Mathematics, Vol. 242

Poisson manifolds play a fundamental role in Hamiltonian dynamics, where they serve as phase spaces. They also arise naturally in other mathematical problems, and form a bridge from the „commutative world" to the „noncommutative world". The aim of this book is twofold: On the one hand, it gives a quick, self-contained introduction to Poisson geometry and related subjects, including singular foliations, Lie groupoids and Lie algebroids. On the other hand, it presents a comprehensive treatment of the normal form problem in Poisson geometry. Even when it comes to classical results, the book gives new insights. It contains results obtained over the past 10 years which are not available in other books.

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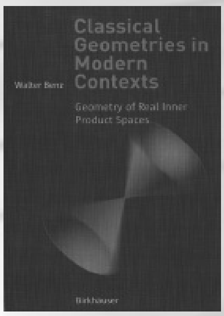


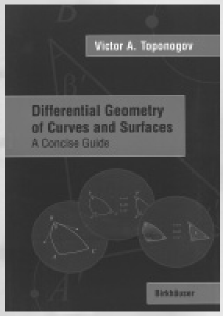
Benz, W., University of Hamburg, Germany

Classical Geometries in Modern Contexts

Geometry of Real Inner Product Spaces

2005. XII, 244 p. Hardcover
€ 78.– / CHF 128.–
ISBN 3-7643-7371-7

This book is based on real inner product spaces X of arbitrary (finite or infinite) dimension greater than or equal to 2. With natural properties of (general) translations and general distances of X euclidean, hyperbolic translations and distances, respectively, are characterized. For these spaces X also the sphere geometries of Möbius and Lie are studied (besides euclidean and hyperbolic geometry), as well as geometries where Lorentz transformations play the key role. The geometrical notions of this book are based on general spaces X as described. This implies that also mathematicians who have not so far been especially interested in geometry may study and understand great ideas of classical geometries in modern and general contexts. Proofs of newer theorems, characterizing isometries and Lorentz transformations under mild hypotheses are included, like for instance infinite dimensional versions of famous theorems of A.D. Alexandrov on Lorentz transformations. A real benefit is the dimension-free approach to important geometrical theories. .



Toponogov, V.A., Sobolev Institute of Mathematics, Novosibirsk, Russia

Differential Geometry of Curves and Surfaces

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2006. XII, 206 p. 70 illus. Softcover
€ 48.– / CHF 78.–
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The study of curves and surfaces forms an important part of classical differential geometry. *Differential Geometry of Curves and Surfaces: A Concise Guide* presents traditional material in this field along with important ideas of Riemannian geometry. The reader is introduced to curves, then to surfaces, and finally to more complex topics. Standard theoretical material is combined with more difficult theorems and complex problems, while maintaining a clear distinction between the two levels.
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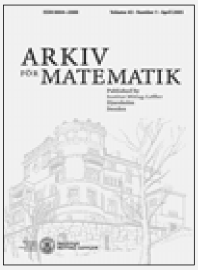

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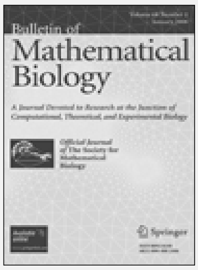

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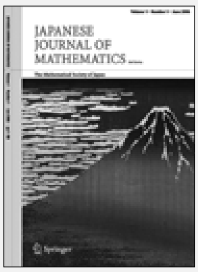

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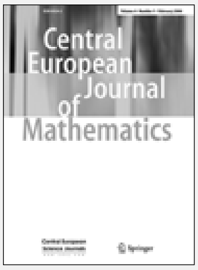

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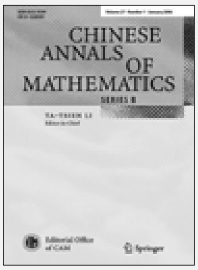

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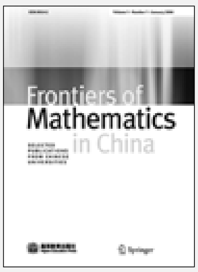

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