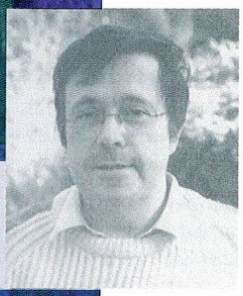
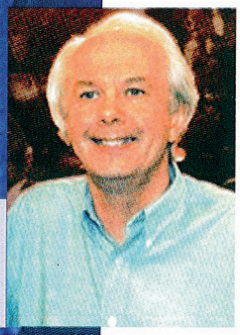
European Mathematical Society

June 1999 *Issue 32*





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NEWSLETTER

EDITORIAL TEAM

EDITOR-IN-CHIEF
ROBIN WILSON
Department of Pure Mathematics
The Open University
Milton Keynes MK7 6AA, UK
e-mail: r.j.wilson@open.ac.uk
ASSOCIATE EDITORS
STEEN MARKVORSEN
Department of Mathematics
Technical University of Denmark
Building 303
DK2800 Lyngby, Denmark
e-mail: s.markvorsen@mat.dtu.dk
KRZYSZTOF CIESIELSKI
Mathematics Institute
Jagiellonian University
Reymonta 4
30-059 Krakow, Poland
e-mail: ciesiels@im.uj.edu.pl
KATHLEEN QUINN
Open University [address as above]
e-mail: k.a.s.quinn@open.ac.uk
SPECIALIST EDITORS
INTERVIEWS
Steen Markvorsen [address as above]
SOCIETIES
Krzysztof Ciesielski [address as above]
EDUCATION
Vinicio Villani
Dipartimento di Matematica
Via Bounarotti, 2
56127 Pisa, Italy
e-mail: villani@dm.unipi.it
MATHEMATICAL PROBLEMS
Paul Jainta
Werkvolkstr. 10
D-91126 Schwabach, Germany
e-mail: PaulJainta@aol.com
ANNIVERSARIES
June Barrow-Green and Jeremy Gray
Open University [address as above]
e-mail: j.e.barrow-green@open.ac.uk and j.j.gray@open.ac.uk and
CONFERENCES
Kathleen Quinn [address as above]
RECENT BOOKS
Ivan Netuka and Vladimir Souèek
Mathematical Institute
Charles University
Sokolovská 83
18600 Prague, Czech Republic
e-mail: netuka@karlin.mff.cuni.cz and soucek@karlin.mff.cuni.cz
ADVERTISING OFFICER
Martin Speller
Department of Mathematics
Glasgow Caledonian University
Glasgow G4 0BA, Scotland
e-mail: msp@gcal.ac.uk
OPEN UNIVERSITY PRODUCTION TEAM
Daniel Dubin, Kathleen Quinn, Liz Scarna

EUROPEAN MATHEMATICAL SOCIETY

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June 1999

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NOTICE FOR MATHEMATICAL SOCIETIES

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

INSTITUTIONAL SUBSCRIPTIONS FOR THE EMS NEWSLETTER

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

EMS News: Committee and Agenda

EXECUTIVE COMMITTEE
PRESIDENT (1999–2002)
Prof. ROLF JELTSCH
Seminar for Applied Mathematics
ETH, CH-8092 Zürich, Switzerland
e-mail: jeltsch@sam.math.ethz.ch
VICE-PRESIDENTS
Prof. ANDRZEJ PELCZAR (1997–2000)
Institute of Mathematics
Jagellonian University
Raymonta 4
PL-30-059 Krakow, Poland
e-mail: pelczar@im.uj.edu.pl
Prof. LUC LEMAIRE (1999–2002)
Department of Mathematics
Université Libre de Bruxelles
C.P. 218 – Campus Plaine
Bld du Triomphe
B-1050 Bruxelles, Belgium
e-mail: llemaire@ulb.ac.be
SECRETARY (1999–2002)
Prof. DAVID BRANNAN
Department of Pure Mathematics
The Open University
Walton Hall
Milton Keynes MK7 6AA, UK
e-mail: d.a.brannan@open.ac.uk
TREASURER (1999–2002)
Prof. OLLI MARTIO
Department of Mathematics
P.O. Box 4
FIN-00014 University of Helsinki
Finland
e-mail: olli.martio@helsinki.fi
ORDINARY MEMBERS
Prof. BODIL BRANNER (1997–2000)
Mathematical Institute
Technical University of Denmark
Building 303
DK-2800 Lyngby, Denmark
e-mail: branner@mat.dtu.dk
Prof. DOINA CIORANESCU (1999-2002)
Laboratoire d'Analyse Numérique
Université Paris VI
4 Place Jussieu
75252 Paris Cedex 05, France
e-mail: cioran@ann.jussieu.fr
Prof. RENZO PICCININI (1999–2002)
Dipto di Matem. F. Enriques
Universit à di Milano
Via C. Saldini 50
I-20133 Milano, Italy
e-mail: renzo@vmimat.mat.unimi.it
Prof. MARTA SANZ-SOLÉ (1997–2000)
Facultat de Matematiques
Universitat de Barcelona
Gran Via 585
E-08007 Barcelona, Spain
e-mail: sanz@cerber.mat.ub.es
Prof. ANATOLY VERSHIK (1997–2000)
P.O.M.I., Fontanka 27
191011 St Petersburg, Russia
e-mail: vershik@pdmi.ras.ru
EMS SECRETARIAT
Ms. T. MÄKELÄINEN
Department of Mathematics
P.O. Box 4
FIN-00014 University of Helsinki
Finland
tel: (+358)-9-1912-2883
fax: (+358)-9-1912-3213
telex: 124690
e-mail: makelain@cc.helsinki.fi
website: http://www.emis.de

EMS Agenda

1999

28 June – 6 July
EMS Summer School, jointly with CIME, at Martina Franca (Italy) in Pure Mathematics: *Iwahori-Hecke algebras and representation theory*
contact: V. Baldoni (Rome), *e-mail: baldoni@axp.mat.uniroma2.it*

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

6 – 21 September
EMS Summer School at Heidelberg, Freiburg, Karlsruhe, Stuttgart, Tübingen (Germany) and Zürich (Switzerland) in Applied Mathematics: *Numerical simulation of flows*
organiser: University of Heidelberg
contact: Gabriel Wittum, *e-mail: wittum@iwr.uni-heidelberg.de*

30 September
Deadline for submission of proposals for the *2001 EMS Summer Schools*
contact: Rolf Jeltsch, *e-mail: jeltsch@math.ethz.ch*

9 – 10 October
Executive Committee Meeting, hosted by the ETH, Zürich (Switzerland)

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

December
Second announcement of the *Third European Congress of Mathematics (3ecm)*, Barcelona (Spain)
contact: S. Xambó-Descamps, *e-mail: sxd@grec.upc.es*
website: www.iec.es/3ecm/

3 – 4 December
Diderot Mathematical Forum, *Mathematics and music*, in Lisbon (Portugal), Paris (France) and Vienna (Austria)
contact: Mireille Chaleyat-Maurel, *e-mail: mcm@ccr.jussieu.fr*

2000

25 – 26 March
Executive Committee Meeting, hosted by the Polish Mathematical Society and the Institute of Mathematics of the Polish Academy of Sciences, Bedlevo, near Poznañ (Poland)

3 – 7 July
ALHAMBRA 2000: a joint mathematical European-Arabic conference in Granada (Spain), promoted by the European Mathematical Society and the Spanish Royal Mathematical Society
contact: Ceferino Ruiz, *e-mail: ruiz@ugr.es*
website: www.ugr.es/~ruiz/

10 – 14 July
Third European Congress of Mathematics (3ecm) in Barcelona (Spain)
contact: S. Xambó-Descamps, *e-mail: sxd@grec.upc.es*
website: www.iec.es/3ecm/

Editorial by EMS Vice-President Luc Lemaire

The 5th RTD Framework Programme of the European Commission

The EMS and the EU

At the end of this editorial, you will find a practical guide to the various 'Calls for Proposals of the European Commission' (Networks, Marie Curie Fellowships, Conferences, ...), but before getting there I would like to describe briefly some interactions between the EMS and the European Institutions over the years.

At the founding meeting of the EMS in 1990, the Council created a Committee for relations with the European Union (which was the European Community at the time), recognising the importance of interaction with that institution. I happened to be present as representative of the Belgian Mathematical Society, and an Italian colleague suggested that it might be convenient if somebody living in Brussels were to be a member of that Committee. This offhand remark was for me like a small perturbation of a chaotic system: being the only Brussels-based member of the Council on that day sent me to a quickly increasing involvement with the EMS and the EU.

Common aims

It is quite natural that the EMS looked for such an interaction with the EU. Indeed, both aim at adding a European dimension to national programmes, without replacing them. Thus all programmes of the DGXII (in charge of research at the EU) must involve more than one member state, so as not to repeat simply what individual states do. Likewise, the EMS does not replace the 52 regional societies that it represents.

The action of the EMS towards the EU (accomplished by many people over many years) aims at establishing a two-way communication: on the one hand to inform mathematicians of the EU programmes, and on the other to inform the EU officials of the specifics of mathematical research in Europe.

A declaration of the EMS

On that last point, the EMS has prepared a detailed declaration (to be found on the website *http://www.emis.de/etc/declaration.html*), showing the specific needs of mathematical research in the context of the EU aims of economic and sociologic development. The specific purpose of that declaration was to influence the structure of the Fifth RTD Framework Programme of the EU which started recently. This text is however still of interest, since the arguments it presents are quite general and apply to other decision-making bodies.

European research in mathematics is at the highest level, both in the West and in the East of the continent. To maintain it at that level requires some European investment, but not so much as to make it a hopeless task. The EMS must and will continue to play its role in that endeavour.

The Calls for Proposals, a practical guide

The Calls for Proposals can be found on the web server of the European Commission's DGXII. In the middle of the home page, you can find a list of subjects that evolves quite rapidly, and the most important one at this stage for mathematics is the Improving Human Potential Programme Call for Proposals – 16.03.1999. Clicking there, you find a list of eight subprogrammes. Clicking on each of these, you'll find a long array of documents to download, sometimes with rather cryptic titles: Guide for proposers, information, proposal forms, guidelines, annexes, guide for evaluators, call for proposals, call text, work programme, ... Altogether there are a few hundred pages of reading, luckily with some tables of contents. You really should browse through those, fishing for relevant information. Here is a brief summary of programmes that may concern mathematicians directly.

Member States and Associated States

First, a major new aspect of the programme: it will not be restricted to the fifteen countries of the European Union, but will involve the Associated States, namely those outside the EU who have a participation agreement in the research programmes. These states contribute to the research budget and their citizens can be full partners in the programme.

So far, Israel is an Associated State, and it is expected that the following will become so during 1999: Iceland, Liechtenstein, Norway (as EFTA–EEA members), and Bulgaria, the Republic of Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia (as candidates for EU membership). For Switzerland, the negotiations are finalised.

For these countries, applications are evaluated in the same way as for the others, but granting of the contract is conditional on the agreement's coming into force before the contract's commencement. Other countries can participate without EU funding on a project by project basis, if they contribute to the level of the proposal (for all this, see the website *http://www.cordis.lu/fp5/src/3rdcountries.htm*).

Marie Curie Fellowships

These come in six categories.

(1) Individual Fellowships

These fellowships are awarded to young post-doctoral researchers for high-level training in an institution established in a country other than their own. Both the fellow and the institution must belong to the EU or to an Associated State. For the fellow, it could be by nationality or by residence for at least five years. The age limit for the fellow is 35 (except for some specific cases such as military service or child care).

Such an appointment would be for a duration of 12 to 24 months. The proposal must be introduced by the candidate and include the agreement of the host institution, a work project and a letter of recommendation. Personally, I think the panel examining the application would be happy to have 2 or 3 letters instead of one. It is obvious that to prepare such an application, serious contacts must have been established between the fellow and the scientist in charge in the host institution, in order to write a good project.

The first deadline for applications has already passed, but others will follow more or less every six months (in March and September until March 2002). The precise dates can be checked in the Guide for Proposers or the Work Programme on *http://www.cordis.lu*. Watch out because the deadlines are strict, and because it takes some time to prepare a good proposal – both from the scientific and administrative points of view (two months is certainly not too much).

(2) Return Fellowships

These fellowships are to help Marie Curie fellows from a less favoured region (LFR) to return to a LFR in their own country at the end of their two years fellowship. The

duration of a return fellowship is limited to 12 months.

(3) Experienced Researchers' Fellowships

These fellowships can be awarded to high level researchers for transfer of knowledge between industry and academia or towards institutions in a LFR of the Community, for a period between 3 and 12 months.

(4) Industry Host Fellowships

Here, registered companies apply to become host institutions, and then choose and appoint postgraduate and postdoctoral fellows to work in their research groups. Appointments are in two stages, and for the moment the call is open for companies. Those selected will be able to call for applications from fellows later.

(5) Development Host Fellowships

These fellowships are awarded to institutions in a LFR, who (when selected) can call for applications by fellows.

(6) Stays at Marie Curie Training Sites

This scheme will support short stays by young researchers pursuing doctoral studies in training sites in a country other than their own. Again, the potential sites will apply to the EU, and those selected will be able to choose the visitors.

For the last two categories, a call for proposals is announced in June, with a deadline of 13 October 1999 (to be confirmed). This call concerns the potential training sites; the fellows apply later.

Research Training Networks

A Research Network consists of at least five groups in at least three different states, proposing a programme of joint research and training of doctoral and postdoctoral fellows. The idea is to have a fairly expensive project, where typically each group will fund a fellow for the entire time. The upper financial limit is 1.5 million euros! However, there is no minimum, and we shall observe in the first round of applications (for which the deadline has past) whether smaller sums are sometimes allocated.

The only other call for proposals is announced for June 2000, with a deadline of 4 November 2000 (to be confirmed). This seems far away, but to set up a good Network project takes time and many preliminary contacts.

Important criteria in the choice will be scientific level (of course), actual plans for interactions and training contents of the project.

Access to Research Infrastructure

A research infrastructure is here a top-level European facility to which researchers of all countries would want to gain access. The programme aims both at directly funding the visit of scientists, and at research and development of the infrastructure to improve access.

The EMS, together with a number of partners, has introduced an application in this programme to further develop the level of *Zentralblatt*-MATH, as a unique European tool for all mathematicians. The aim of the application is a general improvement of access, search facilities and global production of the reviews. The first deadline for applications has passed.

High-level Scientific Conferences

This obviously concerns most of us. The variety of allowable conferences has increased, and we find the following categories:

Euroconferences (up to 5 days and up to 100 participants)

Euro Summer Schools (training for young researchers for up to 2 weeks and up to 80 participants – these may be held at any time of the year!)

Euroworkshops (up to 2 weeks and up to 30 participants)

Large conferences (funding being reserved for young researchers, in conferences of more than 100 participants).

Ph.D. Euroconferences (completely organised and handled by young scientists)

Eurotron Conferences (meetings in Cyberspace via the internet).

The deadlines for the reception of proposals are 1 February 2000, 2001 and 2002.

Raising Public Awareness

The objective of this programme is to bridge the gap between science and the public, thereby enabling citizens to understand the effects of scientific research on their lives. This will be done through four types of action (an indicative timetable is given on Cordis):

– cooperative networks to promote best practice in the raising of public awareness of science

– round table meetings

– the organisation of a 'Science and Technology Week'

– provision of science-related information via electronic networks and other means.

As we all know, a number of mathematicians around the world have in recent decades begun a great effort to popularise their science, realising that it is both necessary and possible – in particular, to encourage gifted young students to enter mathematics programmes. Most of the activities planned for Mathematical Year 2000 go in this direction. In fact, the EMS has sent an application to the EU, in the framework of the Science Week that will take place during year 2000, in particular to support a campaign of mathematical posters in the public transportation system of many European cities.

Note from the Editor

Thankyou to those of you who wrote to me concerning the new format of the *Newsletter*. Please continue to send me comments for improvement and suggestions for items to include. I am particularly keen to receive suggestions for feature articles and for interviews.

The articles on the Turner Collection in the last issue produced a lively postbag. Please send me letters on anything that you think would be of interest to EMS readers.

In the next issue I should like to start a 'Personal column' containing items of a personal nature – promotions, awards, brief obituaries, and so on. Please could you send me items for inclusion. I have started to build up a list of 'country representatives' who can help with this task. If you would like to be such a representative, please contact your local society and let me know.

I should also like to start a series on 'Looking back', in which distinguished retired mathematicians are interviewed about their mathematical life, their achievements, colleagues, and views about how the subject has developed. Please send me suggestions for possible interviewers and interviewees.

Robin Wilson

Introducing the Committee : part 2

Olli Martio (*Treasurer*) received his Ph.D. from the University of Helsinki in 1967, and became an associate professor there in 1972, a professor at the University of Jyvaskyla in 1980, and since 1993 has been Head of the Mathematics Department at Helsinki. He has been a visiting professor in the U.S.A., Norway and Spain, and has been an editor of *Mathematica Scandinavica* and *Acta Mathematica*; he currently edits the Finnish journal *Ann. Acad. Sci. Fenn. Math*.

His research interests include function theory (quasi-conformal maps), non-linear potential theory and associated partial differential equations. He has organised several conferences and edited nine international conference proceedings.

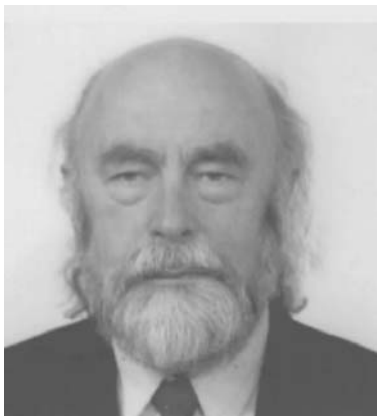
In addition to holding various positions in the Finnish Mathematical Society, he has been President of the Finnish Academy of Sciences and Letters and a member of the Committee for Natural Sciences in the Academy of Finland, as well as a member of several EU Scientific Panels for Mathematics. He is an honorary doctor of the Linköping Institute of Technology and the University of Volgograd.

Doina Cioranescu is directeur du recherche at the Centre National de la Recherche Scientifique (CNRS), Laboratoire d'Analyse Numérique Paris VI from 1981. She graduated from the University of Bucharest in partial differential equations in 1966, and became associate researcher at the CNRS in 1971, receiving her Doctorat d'État in 1978 at Université Paris VI.

Her research interests are mainly concentrated on the modelling of non-Newtonian fluids, homogenisation theory (in particular applied to perforated domains and reticulated structures), and control problems in heterogeneous media. She has been involved in several international scientific projects, including being scientific coordinator of the CE Eurohomogenisation Science programme. Since 1997 she has been a member of the management committee of the French Society of Applied Mathematics.

Renzo Piccinini received his Ph.D. in algebraic topology from the University of Wisconsin (Madison, USA). He is currently professor of mathematics at the Università di Milano-Bicocca in Milan, having formerly been a professor of mathematics in Newfoundland. He has also been a long-term visitor in Lille, Zürich and Munich.

In 1969–70 he was Secretary-General of the Sociedade Brasiliera de Matematica. While in Canada he became Vice-President of the Canadian Mathematical Society (1977–79), Editor-in-Chief of the *Canadian Mathematical Bulletin* (1980–83) and President of the Canadian Mathematical Society (1983–85). He is currently Executive Vice-President of the Istituto Nazionale di Alta Matematica (Rome).



Anatoly Vershik is a professor in the mathematics department at St Petersburg State University, where he has been since 1962. He travels widely, having recently held visiting appointments in France, Israel, Austria, the USA, the UK, Canada, Italy, Switzerland and Sweden.

His fields of research range from ergodic theory and representation theory to combinatorics, differential and convex geometry, probability theory and mathematical programming. He was an invited speaker at the International Congresses of Mathematics in Vancouver (1974) and Zürich (1994), on dynamical systems and combinatorics, respectively.

He is a member of the editorial board of many journals, including *Russian Mathematical Surveys*, *Functional Analysis and its Applications*, *Dynamical Systems and Control Theory*, and *Algebras and Representation Theory*. He is currently President of the St Petersburg Mathematical Society.

Andrzej Pelczar *(Vice-President)* received his Ph.D. from the Jagiellonian University, Kraków, Poland, in 1964. He has held various positions at this university, including Professor of Differential Equations (since 1981), Director of the Institute of Mathematics (1981–84 and 1987–90), Vice-Rector (1984–87) and Rector of the University (1990–93). He has held visiting positions in France and Nigeria.

He was President of the Polish Mathematical Society from 1987–91, was one of the founder members of EUROSCIENCE, and is currently Chairman of the General Council of Higher Education in Poland. He has been on the Executive Committee of the EMS since 1993.

EMS Executive Committee Meeting

in Barcelona, Spain, 17 – 18 April 1999

A weekend meeting, hosted by the Institut d'Estudis Catalans, was held in Barcelona on 17-18 April 1999. Committee members present were Rolf Jeltsch, Andrzej Pelczar, Luc Lemaire, David Brannan, Olli Martio, Bodil Branner, Doina Cioranescu, Renzo Piccinini, Marta Sanz-Solé and Anatoly Vershik. Others present by invitation were: Tuulikki Mäkeläinen, Jean-Pierre Bourguignon, Carles Casacuberta, Mireille Chaleyat-Maurel, Berndt Wegner, Sebastià Xambó-Descamps and Manuel Castellet (President of the Institut d'Estudis Catalans).
Among the items discussed were the following:

Officers' reports
The Treasurer reported that the reserves had reached a very satisfactory level (about 100000 euros), so that some would be invested in longer-term funds. The budget for each of 1999 and 2000 was agreed. The financial statement for the year 1998 was accepted and signed. 1000 euros were given to the Committee for the Support for Eastern and Central European Mathematicians to support attendance at the EMS lectures in 1999.

The fees for several member societies were waived or reduced for one year, in view of their financial situation. Arrangements were agreed for GAMM individual members to join EMS directly for a trial period.

The International Mathematical Union is considering the EMS application for affiliate IMU membership.

The Publicity Officer reported on the present state of the plans for the year 2000. There will be a new resolution of UNESCO on WMY2000 at the UNESCO General Conference in November. (The EMS has a poster competition in progress for WMY2000.)

Jean-Pierre Bourguignon was elected Chair of the EMS Committee on Special Events. A Group on Relations with European Institutions was appointed; this will include Rolf Jeltsch (Chair), Luc Lemaire, Jean-Pierre Bourgignon, Mireille Chaleyat-Maurel and M. Brunaud.

Congresses
S. Xambó-Descamps reported on the preparations for the 2000 European Congress of Mathematics (3ecm) in Barcelona. The first announcement of 3ecm had been sent out and also appears in EMS *Newsletter 31* and on EMIS, the EMS web server. The second announcement will be sent out in December 1999. Some financial support will be available to aid the travel of young mathematicians from Eastern and Central Europe to attend the Congress. A Colloquium on Lie Theory in Vigo, Spain, was added to the list of satellite meetings. [On the evening of 16 April several members of the Executive Committee visited the venue of the ECM Congress, the Barcelona Conference Centre, where all the activities of 3ecm will take place. The visitors expressed their appreciation and satisfaction with the arrangements proposed. Barcelona is an attractive historical city with excellent air and rail connections throughout Europe, and the city centre has easy rail and bus access from the airport. It is an excellent venue for the congress!]

A bid for the 2004 European Congress of Mathematics (ECM4) has been received; a Site Committee was appointed to inspect the venue and report to the October Executive Committee meeting.

Projects
The Committee discussed the project MPRESS (Mathematical PREprint Server System) in which a search engine looks at mathematics preprints held on different servers, and a project EMPRESSA to collect and make available articles of general interest to member societies

The EMS has signed a contract with the European Commission on the project 'Reference levels in school education in mathematics'. (An account of this project will appear in a forthcoming *Newsletter*.) The Committee approved a Memorandum of Understanding between various prospective partners covering the Jahrbuch project.

Bids
It was agreed to bid to the EU programme on 'Public Understanding of Science' for cooperation networks to compare good practice in the public understanding of science. A bid for cooperation between the EMS and UNESCO-Venice for summer schools had been made.

By the end of May, *Zentralblatt*-MATH would finish a project to prepare scanned page images of back numbers for the internet. An application to the EU 5th Framework Programme (via the large infrastructures programme of DGXII) for *Zentralblatt*-MATH was being finalised. Consortia have been formed in several countries to share the costs of subscribing to *Zentralblatt*, and the possibility of individuals subscribing to *Zentralblatt* is under discussion.

Publishing matters
The Committee agreed to a Memorandum of Understanding with The General Assembly of the Union Matematica de America Latina y el Caribean (UMALCA) for cooperation to improve the availability and accessibility of the services of *Zentralblatt*-MATH in Latin America and the Caribbean.

The first issue of JEMS, the *Journal of the European Mathematical Society*, was circulated and noted with pleasure; it is important that members support subscriptions to JEMS.

The Committee expressed its satisfaction at the March issue of the EMS *Newsletter*, which is in a rather different format from previous issues, and agreed to circulate complimentary copies of the next few issues fairly widely in order to encourage mathematicians to join the EMS.

The question of whether EMS should become a publishing house was discussed, and a small committee was set up to investigate the options.

Summer Schools and Diderot Fora
Financial support to the two 1999 EMS summer schools was agreed, to be used as a guarantee to support students. Two proposals for Summer Schools in 2000 were approved – one in Saint-Flour (P. Bernard) and one in Edinburgh (E. Somersalo). A call for proposals for EMS Summer Schools to be held in 2001 should be in the June *Newsletter* (see page 11) and EMIS. It was felt important that summer schools should move around Europe.

Progress reports were received on the Diderot Mathematical Fora on 'Mathematics and Music' and on 'Telecommunications'. Planning for these is progressing well, and bids for external funding are in hand. Possible future themes for Diderot Mathematical Fora include mathematics and medicine, safety in cars, and mathematics and risk.

Future Committee meetings
The next meeting of the Executive Committee will be in Zürich on 9 – 10 October 1999. The following meeting will be in Bedlewo (near Poznañ) in Poland on 25 – 26 March 2000.

And finally ...
The Executive Committee expressed its heartfelt thanks to the local Catalan organisers for a smooth organisation and hospitality enjoyed by all.

Journal of the European Mathematical Society

The first issue of this EMS journal appeared in January 1999. The contents of the first two issues are given below; further information can be obtained by e-mail: jems@mis.mpg.de

Volume 1, Number 1
J. Jost, Editorial
V. V. Batyrev, Non-Archimedean integrals and stringy Euler numbers of log-terminal pairs
M. Kurihara, On the ideal class groups of the maximal real subfields of number fields with all roots of unity
A. Gamburd, D. Jakobson and P. Sarnak, Spectra of elements in the group ring of SU(2)
L. Polterovich, Hamiltonian loops from the ergodic point of view

Volume 1, Number 2
M. Gromov, Endomorphisms of symbolic algebraic varieties
M. Burger and N. Monod, Bounded cohomology of lattices in higher rank Lie groups

Making the Magical Maze: preparing the Royal Institution lectures

Ian Stewart

On the back of the current British £20 note – though, I gather, not for much longer – there is an engraving of an intense-looking young man with his hair in some disarray, a signature that reads 'Michael' followed by an indecipherable surname, and the dates 1791-1867. It is, in fact, the face of the physicist Michael Faraday, founding father of electrical technology. The note also bears a picture of him giving a lecture. He stands at a large desk with a curious semi-circular indentation, and to his left rise tier upon tier of seated Victorians – mostly gentlemen, some ladies, a few children. Scientific apparatus of various kinds litters the bench, and a curious machine with two handles sits in the foreground. Underneath is a caption: *Royal Institution Christmas Lectures initiated in 1826: The magneto-electric spark apparatus.*

For ten days either side of Christmas 1997 I got to know that desk like an old friend, and its indentation – known as 'The Bight' – became a source of refuge, familiarity, and comfort. I too was surrounded by esoteric apparatus. The main difference, though, was that my audience consisted mainly of children, and there were six television cameras pointed at me. An average of 1.3 million viewers were staring at their TV screens at the other end.

The Royal Institution is often confused with the Royal Society, although it has a very different history. The confusion is understandable because in many ways the two institutions overlap. Indeed, the foundation of the Royal Society – the UK's premier scientific association – grew out of the Royal Institution and Gresham College (an even more curious institution which exists to this day as well).

Michael Faraday began his career at the Royal Institution as an assistant to Sir Humphrey Davy, and eventually became the Institution's director. Some time around Christmas 1826 he conceived the idea of an annual series of 'lectures for a juvenile auditory', to be given at the Royal Institution each Christmas, and the tradition has been continued ever since. To date there have been 169 lectures in the series (a few were missed during World War II). The first lecturer was J. Wallis (title 'Astronomy'), the second was Faraday himself ('Chemistry'), and Faraday ended up giving the lectures 17 times in 34 years. The most famous such occasion was in 1854, when the lecturer was attended by Prince Albert and one of the Royal Princesses ('The Chemistry of Combustion'). The best known lecture, though, is probably 'The Chemical History of a Candle' in 1860, which became the topic of a book by the same name. The previous year Faraday had established what is now another long-running tradition of lectures leading to books, and this was its continuation; the 169 lectures so far have generated about 50 books.

My intimate acquaintanceship with The Bight arose because I gave the 1997 Christmas Lectures, with the title *The Magical Maze*. Following Faraday's lead, I

published a book with the same title, but I managed to get my book in print before the lectures took place. The lectures are still given in the original lecture room, and The Bight is still there, but the seating has been refurbished and reduced in quantity to take account of modern safety regulations, and there have been lots of other changes. The audience sits in a severely raked (steep sloped) U-shape, with the lecturer at the open end of the U. The room holds about 450 people. For the Christmas Lectures, the main audience in the lecture theatre itself consists of schoolchildren aged between about 11 and 16, but a lot of adults attend as well, and we had at least one 8-year old. For televisual purposes the adults are seated on the upper levels, out of the eye of the cameras.

1997 was precisely the second time in 168 years (now 169) when the topic was mathematics – even if that's not clear from the title. (The aim was to find a non-threatening title: other publicity material made it abundantly clear that the lectures would be about mathematics.) The first time was 1978 when Christopher Zeeman lectured on 'Mathematics into Pictures'. There have also been a few lectures on applied mathematical topics such as waves and vibrations, but mathematics has been somewhat neglected as a topic, probably because it does not obviously lend itself to demonstrations. Both Zeeman and I proved that with a little imagination this is not an obstacle.

When Zeeman did the lectures, there were six to the series, each one hour long. They were presented in normal lecture format – the main visual aid was an overhead projector. However, they followed the long-standing tradition of including a large number of experiments and demonstrations, involving volunteers from the audience. By the time I gave them there were five lectures, and the influence of television had become more obvious. There were, for instance, lots of video clips, and although the lecture was given 'as live' – more on that later – it is probably best described as a TV programme made with a studio audience. No overhead projectors, none of the usual academic lecture trappings. But, again, lots of demonstrations and experiments.

How do you get chosen to give the Christmas Lectures? The bare bones is that the Royal Institution makes the choice, and invites the prospective lecturer to take on the job. There are early discussions with the British Broadcasting Corporation (BBC) which deals with the televisual side. But how do you become the sort of person who is going to get invited? Some kind of track record in 'public understanding of science' is necessary. In any field of science there are always a few people who have some sort of public profile and devote unusual effort to trying to make their subject comprehensible to non-specialists. In my case I had already published several hundred articles for magazines and newspapers, had taken part in about 150 radio broadcasts, done about 30 items for television, and given heaven knows how many public lectures around the globe. These activities secured me the 1995 Faraday Medal (that man again!) awarded by The Royal Society for significant contributions to the public understanding of science – one such medal being awarded each year for the last dozen years. The Faraday Medal is very much the Fast Track to the Christmas Lectures.

Anyway, I'd got myself the right kind of track record, and suddenly I was next in line.

The Christmas Lectures are 'an offer you can't refuse' – not in the sense of *The Godfather* (well, not exactly...) but because they are such an unusual opportunity to take your subject to a wide audience. They are broadcast around midday for five consecutive days somewhere between Christmas and the New Year; they typically get audiences of a million plus (slightly above the average for the relevant channel at that time of day). The home audience is much broader than the live audience: many people make it a family affair with everyone from the toddler to grandma watching.

The Christmas Lectures also involve an enormous amount of work – by the lecturer, and by a support team of about twenty people. Some of the support team work for the Royal Institution, and one of the essential jobs that they do is to locate equipment for the demonstrations and, if necessary, build it. Ilya Eigenbrot and Bipin Parma headed this part of the work. Most of the rest work for the BBC, and a few are volunteers, in my case graduate students from Imperial College London, who acted as 'runners' during the actual filming. When, for example, we needed half a dozen

teapots, one of the runners was sent out clutching several £20 notes to get them. (Why did we need so many teapots? See below.) While I was considering the invitation to present the lectures, I asked a few of the previous lecturers. The most helpful advice I received was 'write off the three months from November to December'. Fortunately I was in the first year of a special arrangement with the University of Warwick, which relieved me of all teaching duties in return for running an outfit called the Mathematics Awareness Centre (MAC@W), so I could do just that without having to rearrange my teaching. In the event, quite a bit of September and October got written off too. (I suppose I should also mention that the contract for the lectures included an obligation to give them all again in Japan six months later.)

The detailed organisation, and the evolution of the lectures themselves, was a highly interactive enterprise and it's impossible to summarise it. The initial focus was on coming up with a working draft of five scripts for the lectures, so that everybody knew what framework we were working with and could chip in with their own ideas for improvements, in the knowledge that we all had the same general picture. We selected the theme of the lectures: *the mathematics of nature*. Two broad subthemes soon emerged: 'up there', the solar system and the stars; 'down here', animals, plants, weather... We homed in on five topics:

- *Sunflowers and Snowflakes* (a pot-pourri of mathematical patterns in nature)
- *The Pattern of Tiny Feet* (mathematical patterns in animal locomotion)
- *Outrageous Fortune* (probability)
- *Chaos and Cauliflowers* (chaos theory and fractal geometry)
- *Fearful Symmetry* (pattern formation)

Now, I mentioned that the book based on the lectures was published before the lectures were given. Clearly there's not time to do this in a few months. So, like the recipes of the TV cooks, this one was 'made earlier'. The topics were then selected from the book. This back-to-front approach continued, because there was one item that did have to be written during those few months: a 32-page colour booklet, to accompany the videotapes of the lectures themselves. The booklet was already being printed before we had fully settled on the content of the lectures (and as a result includes a few items that we never actually put into the final programmes).

Then there was the pre-publicity – interviews, brief appearances on radio and TV, including the flagship childrens' programme Blue Peter (yes, I got a badge – UK readers will understand what I'm talking about here) and the Sky Book Show on satellite TV. And the BBC set up a website for the lectures, and I did a big Christmas puzzle page for a major national newspaper, with copies of the book as prizes. We even filmed a follow-up TV programme for the Open University before we had recorded any of the actual lectures. With so much of this kind of thing going on, an awful lot was riding on lectures that had not yet been given! What if I got ill? What if ...? – But it did concentrate the mind, I must say.

In the run-up to the filming, we did a couple of 'dry runs' of the opening lecture in front of a live audience (who got in free because these were not the real lectures, just a 'preview'). The first attempt was pretty awful; the second a lot better. The filming itself was done over a ten-day period, partly before Christmas and partly after. For each lecture, the first day was devoted to a 'stagger through' the script, item by item, finalising camera positions, making sure everybody (especially the lecturer) knew the running order, the timing, the approximate script, and the main points we wanted to make. In the evening all the resulting changes were transferred to a new version of the script. The second day consisted of a full-scale dress rehearsal in the morning, some rapid fine-tuning, a rest period over lunch for me, and then the lecture itself.

Each TV programme lasts an hour (actually, the second one was cut to 50 minutes because for some reason it went faster than we'd expected). It is filmed 'as live', meaning that the lecturer works through the material in order without any retakes, aiming at just over an hour of lecturing. Then any necessary retakes that involve the audience are done at the end (and the audience is not allowed out until this is completed). Finally the audience gets let out, and then there are various technical items, such as close-ups on bits of experiments, that get filmed without the audience being present. Because the design of the building is Victorian, and the needs of television in cramped locations blocks off some access routes, it takes about half an hour to get the audience into their seats. So they end up sitting in the room for about two hours, for one hour of TV.

As soon as filming is finished, the master-tape is edited (for length, to cut any glitches, and to insert video clips and the like) in one of the three Outside Broadcast vans that were parked outside the building for the entire filming period. The fifth lecture was filmed less than 16 hours before being broadcast. Incidentally, this hectic schedule has now been changed: the lectures are filmed several weeks before Christmas and edited in studio. New lightweight TV cameras were used from 1998 onwards, so my lectures were the last to be done the old way.

Although there is a 'script', it is not possible for the lecturer to use an autocue (a device that projects the script on to a half-silvered mirror in front of the camera lens). In a studio production, an autocue would be normal, but for a 'live' lecture, the lecturer should be looking at the audience, not the camera. The lecturer also should not be seen to consult notes, although notes can be visible on the desk. Learning the script by heart is not really feasible, and would destroy any spontaneity. So what happens is a compromise. The lecturer tries to learn the running order of topics, the places where they should stand for the cameras, the route to use when going from one place to another, and the general gist of what should be said. Then they do their best to fit it all together on the day. Clever editing papers over any cracks: for example the lecturer can appear to get back to the correct position during a cut-away to close-ups of attentive children in the audience. 'Didn't the children seem interested!' everybody told me. Well, they did, mostly – but a lot of the shots of the audience were carefully selected to look like that, and maybe half of them cover up something that had to be edited out. Indeed this is a necessary part of the technique, as I finally figured out by the time we got to lecture two: I realised I was making a TV programme that was supposed to look like a lecture – not actually giving a lecture. So I kept the script handy at the back of The Bight, mostly hidden from the cameras by set decor, and whenever I forgot what was supposed to happen next I wandered round, consulted the script, and returned to the correct place. All this faffing around was edited out of the programme, but the audience had to put up with it.

Anyone with any experience of TV knows that in any TV production, be it thirty seconds long, ridiculous things go wrong. It all adds to the fun, and the live audience gets the delicious feeling that they're getting some secret knowledge of what really happened. The lecturer just has to learn to put it out of their mind – to have confidence that it will be edited out. (It might, of course, turn up on some compilation of 'out-takes' in which everyone can see what really happened. The BBC gave me a set of tapes of everything that we filmed, and I've made good use of them since in public lectures about how the programmes were made, especially (for some reason) at science fiction conventions. I'll give some examples in a moment.

The most dramatic mathematical topic of the first lecture was the Fibonacci series, which we introduced in the time-honoured way as a problem on the population dynamics of rabbits. Because of the cramped space in the lecture room, all demonstrations are wheeled on and off using trolleys. For Fibonacci, the trolley bore a large top hat, out of which I first produced (with magic wand) a live rabbit. Bipin, hidden inside the trolley, handed it to me through the open bottom of the hat. This was followed by pairs of stuffed toy rabbits – they stay put better than live ones

– spelling out the solution to Fibonacci's problem. Eventually we had 24 toy rabbits sitting on the desk. It would have been 40, but despite scouring London for weeks we were three rabbits short of target. I still have two pairs of adults and one pair of babies on a shelf in my office.

Lecture 2 featured another rabbit, who gave a very professional demonstration of the 'hop' gait after a few gentle nudges; a dog which could jump – and could also disappear for a lengthy period in among the feet of people in the audience – some giant millipedes, and a stick insect. We also had two walking robots. Towards the end of the discussion we broadened the topic into collective movements of animals – flocks, herds, shoals... and crowds of humans. We demonstrated new state-of-the-art software, Legion, for simulating crowd flow. And we showed the audience speeded-up film of themselves forming a crowd as they entered the building.

It was around lecture 3 that various things began to go creatively wrong. To set up the idea of probability, we had a large plastic coin and a frying-pan, and a volunteer from the audience had to toss the coin using the pan. On her first attempt, the coin landed neatly on edge. Then came 'Marilyn and the goats', otherwise known as the Monty Hall problem. You know this one. A game show contestant has to open one of three doors. One door conceals the star prize, a sports car. The others hide booby-prizes – two goats. After the contestant makes their choice, the host opens another door to reveal a goat. Since he can always do this, it appears that no extra information can be gleaned from his action. But then the contestant is given an opportunity to change their mind and choose the only door not yet involved. Which strategy is best? I'm sure you know that (with suitable safeguards about the procedure) the initial choice has a 1/3 probability of winning the car, and the alternative has a 2/3 probability. That is, the best strategy is to change your mind.

Despite the simple arguments that establish this fact, many people never manage to grasp what's involved. We tried to persuade them with an analogous demonstration using ten cards – one bearing a picture of a car and nine with goats. This worked neatly. But when we came to stage the actual game show, with a set of miniature doors, an expensive toy car, and two cardboard goats, it didn't quite go as planned. For when our volunteer, young Jeremy, had made his first choice, he promptly opened the door to reveal the car! That time we broke the 'retakes at the end' rule, and re-ran the whole thing, with more carefully worded instructions. Jeremy, like a true pro, managed to look just as relaxed and uninitiated as he had the first time round.

The third programme overran and a few items had to be edited out. In consequence three toy buses, which started out in a group, ended up spread along the front of the desk – but only the live audience ever saw how they got there. (I was explaining why 'three buses always come along at once'.) Weeks later I got a puzzled letter from a bus driver who'd realised that something had been edited out, asking what I had said about them.

By Lecture 4 we were really getting into the swing of things. The high point was a cameo appearance by Suzanne Charlton, who presents the TV weather forecast, to illustrate the 'butterfly effect' in the context of weather prediction, using real data from the European Medium Range

Weather Forecasting Centre in which the weather for Christmas day was predicted ten days ahead. The low point was when a hose came adrift in some apparatus being used to demonstrate chaos in a dripping tap, spraying water everywhere. (Fortunately this was at dress rehearsal.)

Lecture 5... I'm particularly proud of Lecture 5. It began with an offstage recital of the final verse of William Blake's 'Tiger, tiger...' poem, and his own manuscript of the poem, complete with tiger drawing, on the screen. Then... we brought on a real tiger. Nikka was a six-month old Bengal tigress, whose mother had been killed by

poachers. (We did warn the audience, and we took pains to get the tiger accustomed to the lecture room, the people and the TV lights.) Nikka, like Jeremy, was a pro – she'd had long experience visiting schools and appearing in other TV programmes. I'm sure that in her short career she'd done more television than I had. Her mathematical role was to demonstrate pattern formation in animal markings. Her stripy tail was perfect for the job, and she displayed it with all the aplomb of a catwalk fashion model.

I doubt that I will ever give another lecture where I get to bring a live tiger into the lecture theatre. All other openings seem drab in comparison.

As well as the tiger, we had angel fish with moving stripes (though it takes about six weeks to see that they have moved, so this feature had to be taken on trust) and a boa constrictor.

The ending of the final lecture was very much a case of last-minute inspiration. We wanted to end with a bang – literally if possible – and we had a feeling we were a bit short of material. The evening after the stagger-through, we tore up the last bit of script and rewrote the last ten minutes from scratch. The topic became symmetry in time – time-reversal of the laws of nature, and time travel in relativity. The main demonstrations became a breaking teapot, reassembled by running the film backwards; a 'time tunnel' made by linking a black hole to a white hole; and the lecturer disappearing into the future in a puff of smoke.

You see where the teapots come in. The idea was that a volunteer would be given an 'incredibly valuable antique Royal Institution teapot' to hold. They would drop it on the floor, where it smashed. By the miracle of reversed videotape, it would then be reassembled, instantly. You will appreciate that in this case – the only such – our volunteer had to be rehearsed beforehand and play a role rather than just being their normal selves. The producer's son did a wonderful job. However, at rehearsal we found that the teapots that we'd bought didn't smash very easily, so we sent out a runner to buy some flimsier ones. We got half a dozen, and tested one, which smashed convincingly at the first attempt.

Come the actual lecture, though, the teapot bounced. (Wooden floor.) We tried again, and again the teapot bounced, losing just its handle. After five tries, I had to join in, and with a cry of 'If you're going to spoil our valuable teapot, you might as well do it right!' I hurled the teapot at the floor, and it exploded. Most of this was edited out, of course, but it took us five minutes to induce spontaneous breakage of that teapot.

Then we got the same volunteer to enter our wormhole time tunnel carrying a plastic bag with the broken teapot in it, only to emerge is the distant past when the teapot was intact, and carrying an intact teapot to prove it. (A new teapot was inside the tunnel, and that's where the fragments were left.)

The final sequence involved a fake time machine (we used some antique apparatus originally made by Charles Wheatstone, with lots of dials), some pyrotechnics, and me diving under The Bight and hiding myself from the overhead camera for the final title sequence.

Then, suddenly, it was finished. We did the retakes, got rid of the audience, and had a party. I got my life back again…

Until July, when we did the whole thing again – with minor changes – in Tokyo. Very enjoyably, and accompanied by outstanding hospitality... But that is definitely another story.

Interview with Helmut Neunzert (Kaiserslautern)

interviewer: Heinz W. Engl (Linz)

Q. You are the head of a new Institute for Technomathematics in Kaiserslautern. What are its aims?

A. The aim of the institute is to solve industrial problems using modern mathematical methods. The main steps are mathematical modelling and scientific computing and we deliver software that simulates, optimises or controls processes and products which cannot be treated by commercial software. Currently we are an independent association (*Verein*); but we are in the process of becoming a member of the Fraunhofer Society, a prestigious Research Organisation in Germany. The final decision is scheduled for March 2000. Fraunhofer has 48 institutes with around 9000 employees and an annual budget of 0.6 billion euros.

Q. Are there other mathematically-oriented institutes in the Fraunhofer network, and how do you see your role within that network?

A. Of course, there is a lot of computation, simulation and image processing going on in many Fraunhofer institutes. But there is not yet a mathematics institute inside Fraunhofer and we are looking forward to being the first one. Fraunhofer institutes have a lot of independence, they solicit and solve the problems themselves. However, there is also cooperation between these institutes and we strive at becoming *the* mathematics institute in the society, doing (properly paid) services for them. Fraunhofer is a fascinating world of high tech and it is a dream for an applied mathematician to work in this world.

Q. Which mathematical areas does your institute cover? What are some of your projects?

A. There is a large variety of problems – and therefore of mathematical methods too. I can give only a very short sketch of our activities: There is a department for 'Transport processes', where we deal mainly with compressible flows, with radiation and with acoustics. Think of a side airbag, which poses a more difficult problem than a front airbag: one has to compute the gas flow in the airbag, the extension of the envelope and the interaction of both. The computational domain for the gas flow is very complicated and changes rapidly: one needs grid-free methods for Euler flow, and to do so we extend particle methods like 'smoothed particle hydrodynamics'. This is one of the specialities of the institute: alternative CFD methods, which still work if the domain is very complex. Radiation shows a second competence of our institute: the combination of asymptotic and numerical methods. For radiation through glass, when in real 3-dimensional situations standard methods ('discrete ordinates') become too expensive, we use a 2-scale analysis which leads to approximations that are much better than the classical Rosseland, but almost as fast.

Another department is called 'Flow in complex structures' and deals more with incompressible Navier Stokes flow in porous media as textiles or solidifying metal flow in moulds. Again we try to develop alternative methods such as 'lattice Boltzmann methods' and make them useful for industrial applications. And again we use rigorous transitions from the microscopic to the macroscopic to get information about macroscopic parameters such as permeability and rarely used equations such as Darcy with memory or Darcy with inertia. Moreover, we try to develop parallel codes for the commercial codes on PC-clusters.

The department 'Adaptive systems' uses tools from system and control theory, neuronal networks, etc. There is a very wide variety of problems, but one main application field is medical diagnosis: one has to find hidden patterns in long-time records of some medical data. This is often an extremely difficult task and we need new mathematical theories and concepts. The design of analogue circuits belongs to the same area, but also uses methods from computer algebra.

Our department for 'Image processing' deals mainly with the inspection of surfaces: textile surfaces, metal surfaces, veneers, etc. There are many companies selling their image-processing competence; we try to cover the area in which quality and precision of the processed image is more important than processing speed. Mathematically this means wavelet filters, active contour methods, diffusion filters and methods from stochastic geometry.

Last but not least, our youngest department is for optimisation. They use mainly methods of combinatorial optimisation, for example in designing an optimal control for modern storage systems or in location of service centres, etc.

Q. What is your financing structure, and how much does your institute actually have to earn from industry?

A. The main entrance condition we have to fulfil for Fraunhofer is the 'financial mix'. 72% of our total budget (including salaries, rents for the building, purchase of computers, etc.) must be earned, 42% has to be 'hard money' – that is, money from industry. 30% should be project money from EU, the federal or state research ministries, German research foundation, etc. 28% is basic funding, which comes from Fraunhofer. In 1998 we overreached ourselves: 100 = 75 (= 45+30) + 25.

Q. Your institute has had a tremendous growth rate so far. Can you elaborate on this? How large is it now?

A. We started in November 1995, with 26 scientists by the end of 1996, 30 in 1997, 45 in 1998, and we currently have around 50 fully employed scientists. We added 5/6/10/12 Ph.D. students and around 40 students who do a time job. The budget increased from around 5 million DM in 1996 to 7.3 million in 1997 and 8.6 million in 1998; we expect a budget of 10.8 million DM for this year. You may compute from the percentages of the financial mix that we plan to earn around 8 million DM in 1999. The growth rate is around 25% per year – since our basic funding was fixed, this means a higher rate in our earnings, for example, between 35% and 60% in our industrial money.

Q. What about recruiting? Was it easy to find qualified people?

A. Recruiting is not easy. We have a high percentage of post-docs (over 70%) and pay reasonably, but not overwhelmingly. Most of our scientists are mathematicians (over 50%), but we have also physicists, engineers and computer scientists. Last year's recruiting was very hard as the market has been almost empty (due to the change of the century and the EURO), but it is slowly getting better. We have to attract people by the interesting work they are expected to do, and by the atmosphere in the institute which is still influenced by the idea that we are pioneers in a rather difficult, but fertile territory. And we still attract them – not only Germans: we are striving to become an international institute with presently 20% foreigners – from France, Italy, Russia, Bulgaria, India and Indonesia. All come from excellent institutions and with a PhD, and almost 20% of the staff are women.

Q. What are the qualifications, both scientific and personal, that you look for? What advice can you give students who want to work as mathematicians in an environment like yours?

A. Of course, we prefer applied mathematicians with a solid basis in numerics for pde, in scientific computing, system and control theory, optimisation or image processing, etc. And we need people who have communication skills, a good 'social behaviour' – we need people with all the properties that the SIAM study on mathematics in industry has mentioned. And, of course, they have to be able to handle a computer in a proper way.

My advice to students? If I said: 'study technomathematics in Kaiserslautern', it would be good advice, but not everybody would like it. But it means: study applied mathematics, which includes modelling and scientific computing; learn to use a computer and to write a C++ programme; learn the language of a technical field and learn to communicate with non-mathematicians; develop your creativity by attacking non-mathematical problems with mathematical methods on your own; do a PhD if you are able to finish before you are 30.

Q. Do you have plans to extend your activities beyond Germany?

A. Fraunhofer has a strong intention to become more international. In fact, the mathematics department of our university is already very international – at least half of our students after Vordiplom come from other countries, many from third-world countries. We have excellent relations with India, Indonesia and some other countries in Asia, and very friendly relations with similar institutes in Australia and the US. With Avner Friedman at IMA we tried to establish a Fraunhofer research centre for mathematics in Minneapolis, but the conditions that Fraunhofer offered in the US did not satisfy our American colleagues. We are now trying to establish a close connection with IMA on a different basis. Bangalore in India would also be a good place to found a branch, and we are trying to get into closer cooperation with the technical university of Saudi Arabia in Dhahran.

Q. What role does international cooperation in research and education play? After all, you were one of the founding fathers of ECMI [see the interview with R. S. Mattheij in EMS *Newsletter* 31].

A. International cooperation is for me one of the key points in research and education, for several reasons: it is a real pleasure to meet many people from other cultures – you learn so much about human beings, especially about yourself; there is so much brain in the world, eager to learn, to do research; since an institute like mine cannot make the money only from its own research, we need access to relevant research all over the world – and the easiest access to knowledge is still through human brains (they are much more associative than all the data bases you could imagine). ECMI provides excellent access to relevant knowledge in Europe – how beautifully different are the mathematical cultures in Europe, what a rich multifaceted landscape this 'country' has! We also need close contact with SIAM, and with applied groups in Japan, Australia, China, India, South-America, etc. I have to say that many of the students from third-world countries need a bit of additional 'western' education: there is still far too much learning by heart there, too little creation of creativity in many universities. But the brains are as good, the will is even stronger – and after two years' education we get excellent scientists.

Q. Your article 'Mathematics as a key to key technologies' will appear soon in the Springer Journal Surveys on Mathematics for Industry. Can you briefly summarise the views about the future of mathematics that you expressed there?

A. I would just recommend that you read the article. It takes some time to explain the nature of the challenges for applied mathematics in the design of materials, in the design of products, the simulation and optimisation of production processes, in the discovery of patterns in data from economy, image analysis, medicine. In all of these fields new mathematical concepts must be developed, new algorithms have to be found, new theories are necessary. But how can I know what kind of problems a technology that is not yet invented will pose in 20 years? Who thought about fatigue life analysis, financial mathematics, wavelets in image processing, 20 years ago? I am totally convinced that the number of problems in the world that need new mathematics for their solution is strongly increasing. There are really wonderful problems, striking challenges, important for knowledge and economy. It is still the best choice for a young intelligent human being to become a mathematician – at least, if he/she keeps some of my advice in mind.

EMS Summer Schools : Call for proposals

For some years the European Mathematical Society has run a successful series of Summer Schools. Readers of the *Newsletter* will recall reports of a 1996 Summer School in Hungary on Algebraic Geometry [issue 20] and a 1998 Summer School in France on Wavelets in Analysis and Simulation [issue 29].

The series is intended to include at least two summer schools each year – preferably at least one in pure mathematics and at least one in applied mathematics. With this activity, the Society aims to encourage young European mathematicians to meet and study current developments in mathematics and its applications. Topics (which may be single or composite) for summer schools, the sites, and the organisers of the schools are likely to vary from year to year so as to cover a wide range of subjects.

The Society's Summer School Committee will consider sponsoring proposals for summer schools fully organised by other institutions. To meet EMS expectations, each school should be at predoctoral level, should last from 2 to 3 weeks, and have 100–200 participants – mainly graduate students or young mathematicians from several European countries. Costs of participation should be kept low, and (where possible) grants should be available to people from countries that cannot afford financial support. The EMS will provide moral support to the selected Schools, plus advertising within the European Mathematical community; it will also do its best to help the organisers to raise funds.

The Society now invites proposals for at least two Summer Schools for 2001. Proposals should contain at least: the topic (title and short description), names of likely lecturers, the site, the timing, anticipated costs, conditions for participants, the organising committee membership, and the name and address of the organiser submitting the proposal. The deadline for proposals is 30 September 1999; the Committee hopes to decide on proposals within a month or so.

Please send proposals to Prof. David Brannan, Department of Pure Mathematics, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK. Fax: (+44)-1908-652140, e-mail: d.a.brannan@open.ac.uk

1999 Anniversaries

by Jeremy Gray

Felix Klein (b. 1849) and Sophus Lie (d. 1899)

Felix Klein

1999 marks the anniversaries of two intertwined lives, those of Felix Klein and his friend Sophus Lie. They first met in October 1869 at a meeting of the *Mathematischer Verein* in Berlin and hit it off almost at once. They made a contrasting pair. Klein was a thin, highly verbal young man with a precocious confidence in his abilities. Lie was a towering physical presence who spoke uncertain German and was more at home in the mountains of his native Norway than in German academic society. Klein was something of a prodigy, with a completed doctorate already behind him; Lie had yet to finish his, which may have caused him some embarrassment. But what brought them together in the heady milieu of the large mathematical community in Berlin was their shared passion for geometry, above all Plücker's theory of line-geometry, a field that elicited little or no interest in Berlin.

They wrote several papers either together or with Klein assisting with Lie's German, and Klein even presented Lie's work in Kummer's seminar because of Lie's lack of facility with the language. In the Spring of 1870 they went together to Paris, where they met several leading French mathematicians, including Chasles, Serret, Darboux and Jordan. Klein may well have been influenced by Jordan, but for Lie the most vital contact was with Darboux and through him Monge's work on differential geometry and partial differential equations. Then they were separated by the Franco-Prussian War. Klein returned home to fight, and was invalided out with typhoid. Lie, as citizen of a neutral country was allowed to stay, but was then arrested on suspicion of being a German spy; letters from Darboux helped ensure his release after a month.

The most famous fruit of their friendship is Klein's *Erlangen Program*, the pamphlet he distributed on the occasion of his appointment as a Professor at Erlangen in 1872. Klein wrote much of it during September and October 1872, while Lie was visiting him. Lie provided Klein with important new illustrations of Klein's theory from his own work, which were incorporated in sections 7 and 9 of the Program. Later, in the preface to his book *Lectures on the Icosahedron* (1884), Klein said that the two had decided to divide group theory into two: Lie taking the theory of continuous groups, Klein the discontinuous. This much quoted remark conceals as much as it reveals. It implies that the direction of their future work was clearer than it surely was, and it masks the extent to which the *Erlangen Program* is a classification of all the then-known geometries (Euclidean and non-Euclidean) within projective geometry. There they are distinguished by the nature of the spaces they describe and the groups of allowable transformations they possess, but the emphasis in 1872 was on organising geometry, not promulgating group theory.

Lie returned to Norway at the end of 1872, and his mathematical interests began to diverge from Klein's, but over the next ten years they remained in steady contact and still managed to see each other on Lie's occasional trips to the continent. On the other hand, Lie began to feel mathematically isolated. The only foreign journal in which Lie published anything substantial during these years was the *Mathematische Annalen*, edited by Felix Klein. His expository style, and his geometric way of thinking, did not fit with the dominant Berlin mixture of algebra and analysis. Weierstrass even insisted that everything Lie did would have to be reworked completely [1]. In 1886 Lie

VORLESUNGEN

ÜBER DAS IKOSAEDER

UND DIE

AUFLÖSUNG

DER

GLEICHUNGEN VOM FÜNFTEN GRADE

VON

FELIX KLEIN,

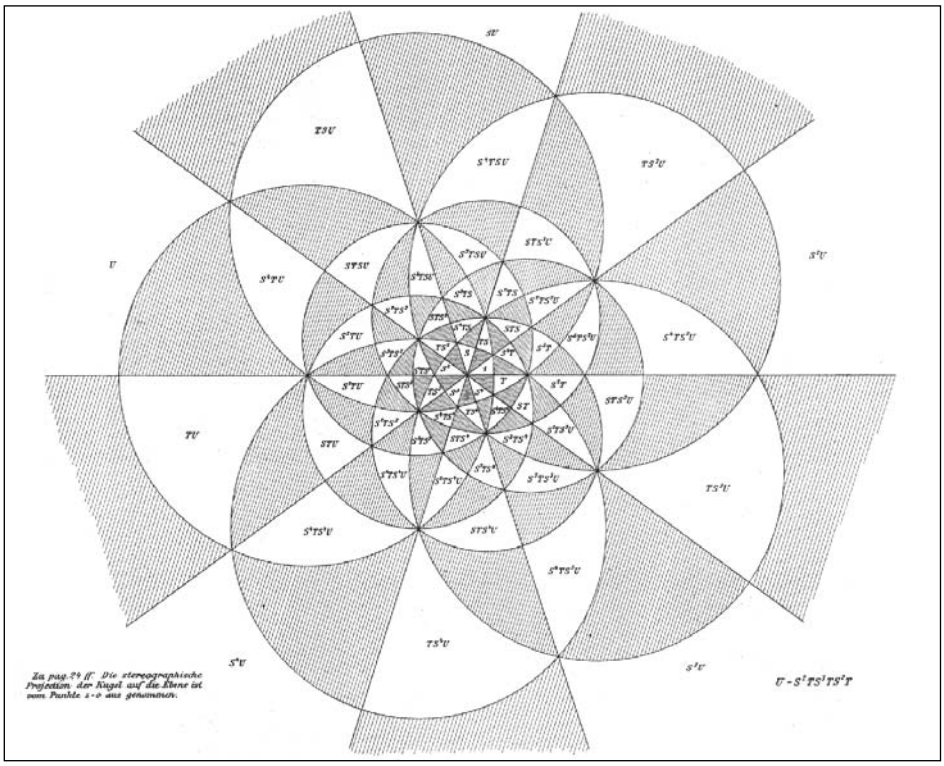
O. Ö. PROFESSOR DER GEOMETRIE A. D. UNIVERSITÄT LEIPZIG.

MIT EINER LITHOGRAPHIRTEN TAFEL.

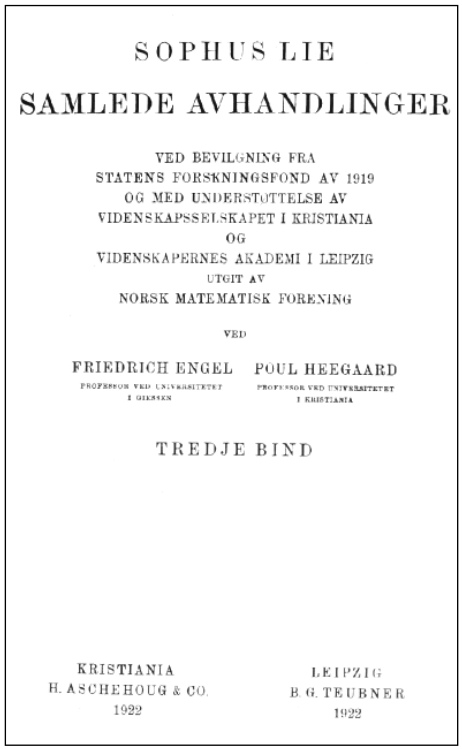
LEIPZIG,

DRUCK UND VERLAG VON B. G. TEUBNER.

1884.



Title page and diagram from Felix Klein's Lectures on the Icosahedron



SOPHUS LIE

SAMLEDE AVHANDLINGER

VED BEVILGNING FRA
STATENS FORSKNINGSFOND AV 1919
OG MED UNDERSTØTTELSE AV
VIDENSKAPSSELSKAPET I KRISTIANIA
OG
VIDENSKAPERNES AKADEMI I LEIPZIG
UTGIT AV
NORSK MATEMATISK FORENING

VED

FRIEDRICH ENGEL — PROFESSOR VED UNIVERSITETET I GIESSEN
POUL HEEGAARD — PROFESSOR VED UNIVERSITETET I KRISTIANIA

TREDJE BIND

KRISTIANIA
H. ASCHEHOUG & CO.
1922

LEIPZIG
B. G. TEUBNER
1922

Title page of Lie's Collected Works

became a Professor in Leipzig, but the move did nothing to solve his problems. Now in the mainstream he became acutely aware that other mathematicians had similar ideas to his. So, when Klein visited Lie in February 1891, he raised the idea that Lie republish his early work much of which had appeared in Norwegian journals. This would establish Lie's claims more securely, present them in their proper geometric garb (and doubtless shed a favourable light indirectly on Klein). Klein would take the opportunity to republish the *Erlangen Program*.

This was a tricky matter. Klein had also suggested, not for the first time, that Lie respond to Helmholtz's ideas on the foundations of geometry, which cried out for a group-theoretic analysis, but Lie had already commented caustically on Klein's account of the topic, not least because Klein's version neglected his (Lie's) contributions from the 1880s. Relations between the two men deteriorated and then in 1893 Lie attacked Klein in public.

In the preface to Volume 3 of his *Theorie der Transformationsgruppen*, Lie [3] wrote: 'I am not a student of Klein's nor is the reverse the case, even if it comes closer to the truth ... I value Klein's talent highly and will never forget that part he had in accompanying my scientific efforts from the beginning. I believe, however, that he does not always distinguish sufficiently between induction and proof, between the introduction of a concept and its utilization.'

Whatever personal pain Klein felt, he dealt with the matter professionally. In 1897 he wrote a report for the Kasan Scientific Society proposing that Lie be awarded the first Lobachevskii Prize [2]. He drew particular attention to Lie's treatment of the Riemann-Helmholtz problem, stressing that "this treatment appears, so to speak, as the logical consequence of Lie's long and continuous works in the area of geometry, in particular, his theory of continuous transformation groups". One notes that this was the very topic upon which Lie had attacked Klein.

In the spring of 1898 Lie returned to Oslo. According to Klein's wife, Anna, a 'reconciliation' of sorts did, in fact, take place: "One summer evening as we came home from an excursion, there, in front of our door, sat a pale sick man. 'Lie!', we cried, in joyful surprise. The two friends shook hand, looked into one another's eyes, all that had passed since their last meeting was forgotten. Lie stayed with us one day, the dear old friend, and yet changed. I cannot think of him and his tragic fate without emotion. Soon after, he died, but not before the great mathematician had been received in Norway like a king" [4].

Acknowledgement: I would like to thank David Rowe for providing me with a vast store of information and advice upon which this article is based.

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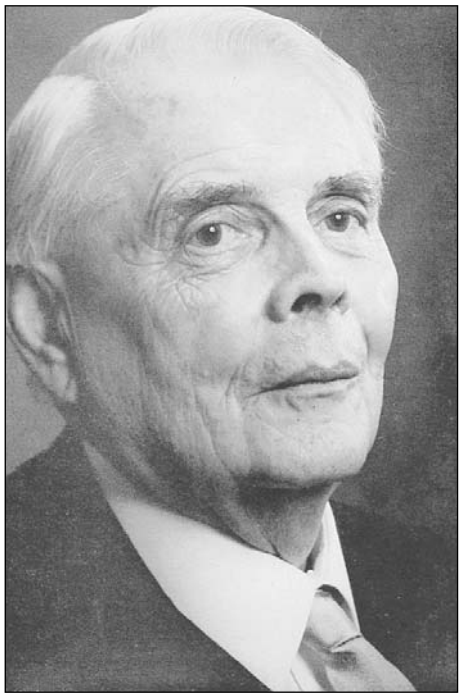
Wolfgang Krull (b. 1899)



Krull is remembered as one of the followers of Emmy Noether, but he also derived a strong desire to 'see' mathematics from Felix Klein, whose seminar he attended in 1920–21. He first worked at Freiburg, where his 1922 Habilitation Thesis introduced (among other things) a finite *Grundring* which since 1994 has been much used in algebraic coding theory under the name of *Galois-ring*. In 1925 he proved the Krull-Schmidt decomposition theorem for abelian groups of operators. In 1928 he went to Erlangen, where he showed how to extend Galois theory to infinite extensions by introducing topological ideas. Then the influence of Emmy Noether took hold.

A significant achievement in ring theory was his introduction of what today is called the *Krull dimension* of a commutative Noetherian ring, and the proof of the principal ideal theorem in this setting. This result was quickly recognised as a decisive advance in Noether's programme of emancipating abstract ring theory form the theory of polynomial rings. The Krull dimension of a Noetherian ring is the maximal length of a chain of distinct prime ideals (and in simple cases it corresponds to the chain of geometric inclusions: point, curve, surface . . .). The theorem asserts that if a local ring with unique maximal ideal $\boldsymbol{m}$ has (Krull) dimension n then n is the smallest number such that there are n distinct elements of $\boldsymbol{m}$ which are not contained in any other prime ideal of the ring. Geometrically, if $\boldsymbol{m}$ is the maximal ideal of functions that vanish at a point on a variety, this is the claim that at least n functions are needed to pick out a point.

In 1932 Krull introduced general additive valuations, now known as *Krull valuations*. In 1935 he published his book *Idealtheorie*, which was to prove an accessible source for his ideas after the war, and in 1938 he initiated the theory of local rings that was then taken up by Chevalley, Zariski and Cohen. In 1939 he moved to Bonn, and during the war he worked in the naval meteorological service. He then resumed his career as a mathematician at Bonn, and 32 of his 35 doctoral students came out of this second phase of his career.

Krull laid great store by the mathematical imagination. In his inaugural address at Erlangen he spoke of the mathematician's task as not only finding theorems and giving them valid proofs, but also arranging the theory until they become self-evident. His own work is marked by the profundity of his ideas, the rigour of his proofs, and also by a strong aesthetic sense. In this way he did indeed continue the tradition of his mentors in Göttingen, Felix Klein and Emmy Noether.

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Jeremy Gray [j.j.gray@open.ac.uk] is a senior lecturer at the Open University,UK.

An error crept into my obituary of André Weil in EMS *Newsletter* 31. Although he did write at length about the work of Fermat he never produced an edition of it. I am grateful to Prof. Dr. Klaus Barner for bringing my attention to this mistake. *Jeremy Gray*

Letters

The article by John Fauvel on the sale of the Turner Collection in EMS *Newsletter* 31 and its reponse by Allen Foster produced a lively postbag.

From John Fauvel *(j.g.fauvel@open.ac.uk) Fulbright Scholar and Visiting Professor of Mathematics, Colorado College, USA.*

Perhaps I may comment briefly on a few of the more misleading claims in Allan Foster's response to my article about the way the University of Keele has exercised its custodianship of the Turner Collection of mathematical texts?

1. There is no "campaign of vilification" but a justifiable world-wide protest about something which ought not to have happened and has variously been described as "disgusting" (a mathematics professor from Germany), "astonishing and disgusting" (a librarian from France), "unbelievable" (a professor from the US), "hasty, secretive and ill-advised" (fifty UK academics), . . .
2. The legality of Keele University's actions is not at issue, but their moral and ethical justification and the probity of their actions.
3. It is hard to see how the Keele University managers have persuaded themselves that they "acted . . . with integrity": by other people's standards there was neither moral integrity in the secretive way the decision was taken nor pragmatic integrity in destroying an academic resource for future generations.
4. Keele University's financial need is agreed and lamented on all sides. That has no bearing on the fact that the solution the managers chose was the wrong one. It deliberately confuses the issues to argue, in effect, 'we needed money, *therefore* our secret selling of the Turner Collections to a second-hand book dealer was justified.'
5. The Turner Collections *were* "relevant to teaching and research programmes", as attested by several members of Keele University's faculty – who were not even informed about, let alone consulted in, Mr Foster's "open", "extensive" debates.
6. Whatever Mr Foster may now claim, the decision was undeniably "taken in secret", with a heavy confidentiality clampdown, and furthermore this enabled the Council "debate" to be predicated on misleading information supplied by Mr Foster and his colleagues.
7. No satisfactory account has ever been offered of the nature of the "further investigation and consultation" allegedly carried out by the Vice-Chancellor and two lay folk which led to the Turner Collections being rushed off the premises within a fortnight.
8. No "private buyer" has ever been identified and it seems that the person Mr Foster refers to as "the private buyer" is a second-hand book dealer in London.
9. It is hard to believe that the students "were unanimously behind the sale", and indeed subsequent inquiries have shown this statement to be false. What students were no doubt unanimously behind was raising more money for the Library (like every sensible person), and it may well be that some were deceived into thinking that secretly selling the Turner Collections was the only or best way to achieve this.
10. In the light of evidence that has emerged subsequently, Mr Foster's claim that "the process was conducted with probity throughout" is quite unbelievable.
11. The claim that the sale followed "a very careful consideration of the issues involved" overlooks the fact that the issues involved were presented and distorted, with a range of false or misleading statements, by Mr Foster, while wider issues of ethics, public policy and the repercussions of the sale were barely considered.
12. The other book collections mentioned by Mr Foster, in Cambridge, London, Edinburgh, and Manchester, are not for the most part "much more accessible for scholars" in the West Midlands to Merseyside belt, and they are all far harder to access and make use of within the libraries concerned. Destroying the Turner Collection because other libraries exist is like closing down Keele because of the existence of the University of Luton.
13. The mathematical community's interest in the Turner Collection was (a) much greater than Mr Foster admits and (b) consisted of more than physically visiting the Collection. Well-documented use by the Open University, the British Society for the History of Mathematics, and the British Association for the Advancement of Science, along with numerous private visits, constitute a considerable body of external interest which would have increased even more in the future.
14. If Mr Foster seriously claims to have had an "earnest objective of doing nothing that would lead to the break up of the Collection" then he would hardly have gone about disposing of it secretly to a second-hand book dealer.
15. The Graves Collection (or any other) does not "replicate" items in the Turner Collection. Most early books are unique for a variety of reasons involving printing, ownership, annotations, and history.
16. We have never been told what "professional advice" about the sale was sought, nor who it was received from, nor what it consisted of. The suspicion must be raised that there was not any.
17. "Retaining" material as photocopies (very poor, few and hasty photocopies by what has been seen) is daft: as well the National Gallery sell its paintings & keep the post-card booth.
18. The reference to proceeds of the Turner sale being used to fund Keele's MBA programme comes directly from Mr Foster's own information office, so it is hard to see why he is now claiming it is "quite wrong".
19. If the decision to sell the Turner Collections was really "the collective wisdom of the University community" then God help Keele.

From Robert A. Jackson *(r.a.jackson@chem.keele.ac.uk), Senior Lecturer in Chemistry, Keele University, UK*

I was pleased to have the opportunity to read John Fauvel's article, 'Caring for the mathematical past: a recent British experience'. It describes the unfortunate events that occurred at Keele over the sale of the Turner collection very well, and I agree wholeheartedly with his conclusions.

However, as a member of Keele University's Senate, which voted against the sale of the collection, I must point out several inaccuracies in Allan Foster's reply. Most importantly, there was no "extensive debate" over the sale. Indeed, some expert users of the collection at Keele were not consulted, and scant regard was paid to the Senate vote, however good the debate may have been. It is also clear that the possibility of selling the collection to a public body like the London Mathematical Society was not properly looked into. It is also irrelevant to make capital of student opinion on this issue, since the collection was primarily for research, not teaching.

In conclusion, I agree with John Fauvel's conclusion – university administrators are no longer our natural allies. Colleagues in other universities should take note of our experience at Keele, in case something similar is proposed in their institutions.

From David Singmaster *(zingmast@sbu.ac.uk), Professor of Mathematics and Metagrobologist, South Bank University, London, UK*

Allan Foster's response is flawed and even misleading in many ways. He starts by denigrating the newspaper articles as "tabloid-style". I am sure that *The Times*, *The Guardian*, *The Daily Telegraph*, *The Times Higher Education Supplement* and

Nature would object to being compared with tabloids.

It is probable that Keele has behaved legally in that there was no written contract between Turner and Keele. However, David Ingram remembers a meeting between Turner and the Librarian of the time, when Turner asked what would happen if the University had to sell the Collection. The Librarian assured him that that would never happen and Turner said he would like the Collection to remain together. So I would say that there was a verbal understanding, though verbal agreements are difficult to verify or enforce, especially as Turner had no close relatives to object to the sale.

The beginning of Foster's second paragraph is nonsensical, though this may be due to an typographical or editing error. But then he reveals one of the most damning facts about Keele: "for many years the University has been unable to allocate sufficient funds for library resources." Indeed their Council Minutes of 26 June state: "Keele is 47th (bottom of the old universities) for library funding, spending about 75% per student FTE compared with our comparator universities; the underfunding cannot be explained by over-staffing since Keele is 77th in terms of library staff/FTE . . . There needs to be additional expenditure in the library of about £200K per year, whereas the sale would realise only £70K per year and so would not solve the problem." It is difficult to see how a University can so drastically undervalue its library as to get to such a state of affairs and how a University Librarian did not resign in protest over this. Indeed, it is reported that the University is also selling off land which has been given to it. Clearly the financial state of Keele is parlous if it is having to sell off its endowments and one can only wonder at the competence of its administrators.

When the proposal to sell was debated last May and June, the documents were not circulated to Faculty Boards and were labelled confidential. Further, staff were instructed not to convey information outside the University – e.g. the Council Minutes of 26 June say: "It was agreed that the issue was sensitive, and confidentiality within the University should be maintained at present." Several staff at Keele have informed me that they heard nothing about the sale until the books were gone. To me this seems like a *prima facie* case of secrecy and quite at odds with Foster's claim that this was the collective wisdom of the University. Foster says reports of the debates are on Keele's web site, but when we tried to access these in December, we found one needed a password.

There were also about 200 'with Turner' books which Keele had acquired to supplement the Turner Collection. These vanished with the Turner Collection, though their disposition had never been mentioned in the discussions of the Turner Collection.

Foster also says the options were weighed up carefully. However, Council's approval of the sale in principle took place on 26 June and within ten days the books were gone. This does not seem like much time to determine options, much less investigate or consider them.

Foster says the books went to a private buyer. In fact the books went to a small bookdealer in Shropshire and have since passed on to a major London dealer, and a third dealer was involved. At least Foster is no longer putting forth the blatant lie that the University issued in December and January that the books had gone to a major private collector and would remain in the UK and be available for research – though Keele couldn't say who the buyer was. However, it seems clear that Keele's Council put this story about in order to defuse protest about the sale. Indeed the Keele Council minutes state: "The private buyer has given an assurance that the collection would not leave the UK nor be broken up." This was stated despite the fact that the buyer had clearly already been selected and Keele made no attempt to formalise this verbal assurance. Keele's statements during December and January were made though the London dealer was already applying for export licenses for some of the books.

It may well be that the external usage of the Turner Collection has been small. However, I have visited it three times in the past decade, totalling about six full days of usage, and I had correspondence about having slides made from some of the books. I was thinking about taking a friend from New York to see it in early December but he didn't have time. The last time I visited, I found that the Collection had been removed from a special room in the basement to being part of the Special Collections and I was told this was because the then Vice-Chancellor wanted the room. The Special Collections Librarian asked me to sign the visitors' book because he was worried that the Vice-Chancellor would get rid of the Collection, again for reasons of room. Since the Collection only fills one room, these reasons seemed pretty petty at the time.

Since December, I have discovered that Keele has several researchers actively engaged in history of science and philosophy who had been making regular use of the Collection in their research and teaching.

There is no doubt that there are better collections on history of science and mathematics in London, Oxford, Cambridge, Edinburgh and possibly Manchester (whose library I haven't used). However, this completely loses sight of Turner's vision. He wanted his collection to go to somewhere where it would be useful, i.e. a new university some way removed from the standard centres. It is sad that Keele is so blind that it did not try to place the Collection where it would continue to be of some use.

Foster asserts that professional advice was that no other public institution was likely to buy the Collection. However, no other public institution seems to have been consulted – we have spoken to all the most likely candidates, no one else has come forward and Keele has steadfastly failed to name any such institution. So as far as we can tell, Keele's professional advice seems to consist only of advice from the dealer who was offering to buy the books, hardly the most disinterested source.

Sources at Keele tell me that the 'facsimiles' retained are mostly reprints that the University already had and that the new photocopies are few and not very helpful. Indeed a letter from the library in November states: "we retained facsimiles of some of the more important items, as well as photocopies of a small number of others." This hardly sounds like a major effort to make material available – in any case the Library only had about ten days to do this.

Professor John Rogers (*g.a.j.rogers@phil.keele.ac.uk*) has just circulated a document comparing Keele's behaviour with the published advice of the Library Association's Rare Book Group's Policy Statement on the Sale of Rare Books and Manuscripts. Keele has violated almost every relevant part of this advice.

In view of the above, I feel that Keele has behaved dishonourably, blindly, misleadingly and incompetently. Foster's claim that this was the collective wisdom of the University community seems at odds with the Senate rejecting the sale by 22 to 19. Rather it seems to be the decision of the University Council, whose administration of Keele's finances is obviously rather poor. In any case, it reminds me of Dr. Johnson's famous epigram "Patriotism is the last refuge of a scoundrel." All in all, I feel that 'philistine' is an appropriate description, though 'stupid vandals' seems more appropriate. It seems that Keele's administration is still unaware of the damage they have done to the University.

Societies Section

Finnish Mathematical Society

Aatos Lahtinen

The Finnish Mathematical Society is one of the oldest mathematical societies. It was founded in 1868, three years after the London Mathematical Society and four years before the Société Mathématique de France.

The official name of the Society is *Suomen Matemaattinen Yhdistys* (SMY). From the beginning the Society's purpose has been to encourage and maintain interest in mathematical thinking and to promote mathematical research in Finland. Later on it was specified that SMY should prepare proposals, organise seminars, arrange meetings and award grants, and it represents its membership for that purpose.

One of the major undertakings of the Finnish Mathematical Society was the organising of the 1978 International Congress of Mathematicians in Helsinki. In this picture are the main organisers: from the left, Olli Lokki, Olli Lehto, Rolf Nevanlinna and Ilppo Simo Louhivaara, all past presidents or secretaries of the Society.

In the 19th century Finland had only one university and only one chair of mathematics there. Therefore in the first years the activities of SMY for raising interest in mathematical thinking were mainly directed towards university students. At that time it was even in the statutes that students were entitled to ask and receive guidance on points on any mathematical lecture that had remained obscure to them. This article was later removed, not because students had started to understand everything, but because in the 20th century there was a considerable growth in the universities and in the number of university students. This made the old article impractical. SMY has instead enlarged the emphasis to include younger people in order to encourage them to enter mathematical studies at a university. For that purpose SMY now publishes a bulletin *Silmu* and promotes participation in mathematical competitions such as the International Mathematical Olympiad and the Nordic Mathematical Contest.

For the promotion of mathematical research there are mathematical presentations at SMY meetings. At first all the speakers were Finnish. The first foreign speaker was M. Riesz in 1926. After that the number of foreign speakers gradually increased. Finally it was taken to one of the main activities of SMY to invite eminent mathematicians to visit Finland and give talks at SMY meetings. There were about 30 such visits last year. The international ties thus formed have had a very positive effect on the development of mathematical research in Finland. On the other hand, there are also other channels nowadays for inviting visiting mathematicians; this lessens the responsibility of SMY in this context.

The stamp of the Congress

Another regular scientific activity of SMY is a conference called *Matemaatikkopäivät*, which is organised at the beginning of every second year. It aims to give an overview of current mathematical research in Finland. SMY also organises different Nordic conferences, together with other Scandinavian mathematical societies.

Together with the Finnish Physical Society (SFS) SMY publishes a journal *Arkhimedes*, which aims to publish mathematics and physics articles of general interest. The articles are usually written in Finnish with an English summary. *Arkhimedes* has five issues per year and is sent to every member of SMY and SFS free of charge. SMY, together with other Scandinavian mathematical societies, is responsible for the publication of the journals *Mathematica Scandinavica* and *Nordisk Matematisk Tidskrift*. For information of its domestic members SMY has a newsletter called *Eukleides*.

The Society has been closely linked to the European Mathematical Society since its foundation. In fact, SMY was already a member of its predecessor, the European Mathematical Council and a delegate of SMY participated also in the meeting where it was decided to create EMS legally as a Finnish scientific society with its seat in Helsinki. SMY has been active in EMS in the firm belief that via EMS mathematicians can influence the welfare of mathematics in Europe and that this benefits also all the European countries.

The Society currently has about 350 members. Its supreme authority is the General Meeting, held once a year. The general charge of all matters lies in the Board, consisting of the President, Vice-President, Secretary, Treasurer and one additional member. All of these are elected for one year at the General Meeting and may be re-elected. Currently the President is Professor Antti Kupiainen, the Vice-President is Professor Sören Illman, the Secretary is researcher Mikko Pere and the Treasurer is Professor Aatos Lahtinen.

Individuals, as well as corporate bodies, can apply for membership by sending an application to the Board of the Society, which has the power to accept members. Members pay an annual fee, which is currently 160 FIM. The Society has reciprocity agreements with some societies. Reciprocity members pay one half of the annual fee.

The address of the Society is: Department of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland.

Aatos Lahtinen is in the Department of Mathematics, University of Helsinki, Finland.

Polish Mathematical Society

Józef Piórek

From the minutes of the Mathematical Society in Cracow

In 1999 the Polish Mathematical Society celebrates its 80th anniversary, and a special jubilee Meeting of Polish mathematicians will be held in Cracow (Kraków) in September. This article contains a selection of documents from the earliest sessions of the Mathematical Society in Cracow, which later developed into the Polish Mathematical Society. It is a modified version of an article that appeared in the journal *Mathematics-Society-Teaching*, published by the Polish Centre for Mathematical Culture.

Regretfully, in English, the charm of the original documents, the now-forgotten old Polish style and expressions, and the strange grammar and spelling have all disappeared. Names, however, do not change under translation and I hope that at least some of them (such as the 'citizen' Stefan Banach) will add spice to the whole story. Some funny mistakes have remained, too.

It may also be worth reminding the foreign reader that the events related here took place almost on the morrow of Poland's regain of independence after over 100 years of absence from the maps of Europe and before the end of the wars that settled the country's borders.

The Constituting Session

Minutes of the Constituting Session, held on April 2, 1919 at 5 p.m. in the rooms of the Philosophy Seminar, 12 St. Anne Street. Present: Ob. [citizen] Stefan Banach, Julian Chmiel prof. gimn. [grammar-school professor], Leon Chwistek prof. gimn., Miros³aw Gibas prof. gimn., Dr A. Hoborski docent uniw. [university dozent], Dr L. Horodyñski prof. gimn., Ludwik Kaszycki inŸynier [engineer], Dr Fr. Leja asystent uniw. [university assistant], Otton Nikodym prof. gimn., Dr A. Rosenblatt docent uniw., Antoni Rozmus prof. gimn., Dr J. Sleszyñski prof. uniw. [university professor], Xawery Stankiewicz, Dr A. Wilk prof. gimn., Dr St. Zaremba prof. uniw., Dr K. □orawski prof. uniw.

Dr K. □orawski opened the session by saying that an all-Polish Mathematical Society is in the making in Warsaw and he proposed the motion to initiate a "Mathematical Soc. in Cracow" which might later become associated with the Warsaw society. The motion passed unanimously and Dr S. Zaremba was elected to preside over the Constituting Session.

The chairman expressed his thanks for the election, asked Dr A. Hoborski to take minutes of the meeting and allowed Dr Fr. Leja, the reporter, to read out the drafts of the statutes and regulations of the Society.

A longer discussion followed, concerning mainly the definition of the aim of the Society, admission of new members, Department members' terms of office, reelection of the president of the Society. The aim of the Soc. has been defined as follows: comprehensive stimulation of the development of pure and applied mathematics. The motion to add that popularization of mathematics is also an aim of the Soc. was rejected. Some amendments, proposed mainly by prof. Zaremba, were agreed upon. Then the statutes went through in the reading given by the reporter, and next – the regulations fixing the membership fees and dates of ordinary sessions.

The membership fees were fixed at 10K and the annual fee at 12K; also, it was agreed to make it possible for members to replace all annual payments by a single payment of 250K which transforms an ordinary membership into a life membership.

Ordinary sessions of the Society, with talks, will be held on the first and, if necessary, also on the third Wednesday of the month except for the three months of summer holidays, at 5 p.m. in the rooms of the Mathematics Seminar, ul. Œw. Anny 12.

At the Constituting Session the following members acceded to the Society on the principles as defined by the statutes and regulations:

1) Dr Stan. Zaremba prof. uniw. residing in Kraków XVIII. □ytnia 6.
2) Dr Franciszek Leja asyst. uniw. residing in Kraków ul. sw. Krzyza 16.
3) Dr Jan Sleszyñski prof. uniw. residing in Kraków Wygoda 7.
4) Dr Kazimierz □orawski prof. uniw. residing in Kraków Garbarska 7. (crossed out and corrected to Warszawa, Koszykowa 75.)
5) Xawery Stankiewicz residing in Kraków D³uga 50.
6) Julian Chmiel prof. gimn. residing in Kraków Tomasza 33.
7) Miros³aw Gibas prof. gimn. residing in Kraków Krupnicza 28.
8) Antoni Rozmus prof. gimn. residing in Kraków Gimnazyum
9) Stefan Banach residing in Kraków Grodzka 71.
10) Otton Nikodym prof. gimn. residing in Kraków Kochanowskiego 23.
11) Dr Leon Chwistek prof. gimn. residing in Kraków Szujskiego 7.
12) Dr Antoni Wilk prof. gimn. residing in Kraków XV. Józef itów 208.
13) Dr Ludwik Horodyñski prof. gimn. residing in Kraków £obzowska 12. (remark in the margin: "passed away in 1919")
14) Dr Alfred Rosenblatt docent uniw. residing in Kraków Basztowa 8.
15) Dr Antoni Hoborski docent uniw. residing in Kraków Smoleñsk 26.
16) Ludwik Kaszycki in zynier residing in Kraków Garbarska 4.

According to clause 10 of the Statutes, the assembly proceeded to the election of the president and Department members of the S-ty. 15 members took part in voting. The following were elected:

Dr St. Zaremba the president (15 votes)
Dr A. Hoborski the vice-president (14 votes)
Dr F. Leja the secretary (15 votes)
Dr L. Horodyñski the treasurer (13 votes)

The first ordinary meeting was agreed upon to be held next Wednesday, i.e. April 9. Dr A. Hoborski announced that he would give a talk on the theory of functions of real variable.

Upon this the Constituting Session was closed.

Months passed. Mathematicians from Warsaw, reluctant at first, finally started to feel the need to put the scientific movement into some organisational form. This feeling is expressed in the next text.

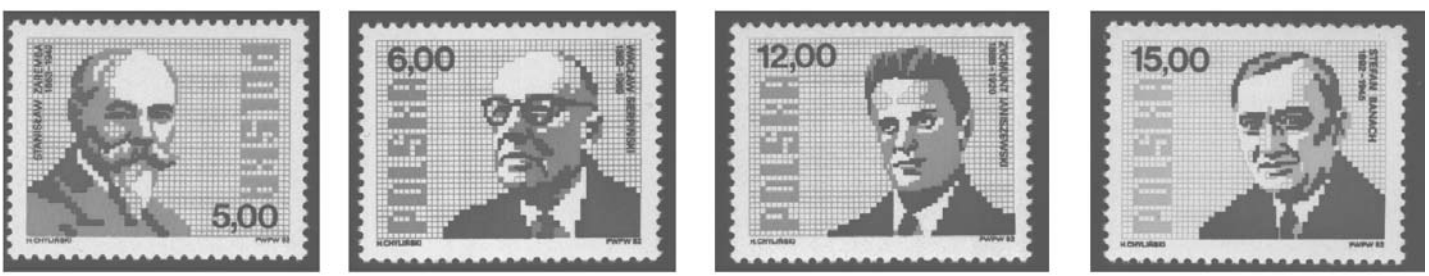
Minutes of the 9th ordinary session

held on September 19, 1919.

Dr A. Hoborski presiding. After a vote, the following were admitted as new members of the S-ty:

32) S. Dickstein prof. uniw. in Warszawa ul. Marszalkowska 117.
33) Dr Waclaw Sierpinski prof. uniw. in Warszawa ul. Marszalkowska 117.
34) Dr Z. Janiszewski prof. uniw. in Warszawa ul. Marszalkowska 117.
35) Dr Stefan Mazurkiewicz prof. uniw. in Warszawa ul. Marszalkowska 117.
36) Stanislaw Zakrocki prof. gimn. in Kraków ul.Smolensk 21.

The president passed on the information that the Extraordinary General Assembly will be held on September 29. Mathematicians from different parts of Poland have been invited to participate in it. The aim of the meeting is to organise a reporting bureau for collecting and spreading



Four stamps featuring Polish mathematicians, issued for the International Congress of Mathematicians in Warsaw. From left to right: Stanis³aw Zaremba, Wac³aw Sierpinski, Zygmunt Janiszewski, Stefan Banach.

abroad information about the scientific movement in Poland, and consider a possible reorganisation of the Society as well as a change of the Statutes, as the Society was founded mainly for assembling mathematicians working in Cracow whereas now the idea to enlarge the sphere of activities of the Society to the entire country has come up.

And now – minutes of the Extraordinary General Assembly announced by doctor Hoborski. Here we find, among others, the 'pre-history' of the organised scientific movement of Polish mathematicians.

Minutes of the Extraordinary General Assembly

held on September 29, 1919, in the Mathematics Seminar, at 5 p.m., with the following agenda:

1) *Organization of a reporting bureau for collecting and spreading abroad information about the scientific movement in Poland.*
2) *Reading out binding Statutes and regulations.*
3) *Possible motions concerning changes in Statutes and regulations.*
4) *Other motions and interpellations.*

Professor S. Zaremba, the President, greeted new members of the Society, among them Professor S. Dickstein, who arrived from Warsaw, and said that the Extraordinary General Assembly was convened for two reasons. The first is concerned with the need to organise, within the S-ty, a reporting bureau aimed at forwarding information about scientific mathematical movement in Poland to foreign journals. The second reason is that the Department wished to submit for consideration of the assembly the possible reorganisation of the Society and the change of Statutes because the Society was founded mainly to gather mathematicians from Cracow, whereas lately an opinion was expressed by Polish mathematicians from outside Cracow that the activities of the Society should be extended to the whole of Poland.

The President said that a letter had just arrived from Dr A. £omnicki, Lvov saying that two years ago a mathematical society had also come into being in Lvov but, during wartime, its activity dwindled and therefore the members plan to join the Mathematical Society in Cracow in case of an extension of the activities of the latter.

The President proposed to discuss the question of the reporting bureau organisation and allowed Professor S. Dickstein to address the meeting.

Professor Dickstein recalled that as early as in 1880 a Circle of Polish Mathematicians was founded in Petersburg and had published four volumes of transactions containing mathematical works of Polish mathematicians. Later the task was overtaken by "Prace Matematyczno-fizyczne" [Mathematical and Physical Works] established in Warsaw in 1888. Further in the discussion rose to speak: Professor Zaremba, Professor Dickstein, Mr Wilkosz, Mr Rosenblatt, Mr Chwistek, Mr Leja and Mr Ziobrowski who unanimously expressed the opinion that the bureau should be organised and the aim of the bureau is to publish accounts of works of Polish mathematicians in one of the Polish mathematical journals, e.g., in "Wiadomoœci Matematyczne" [Mathematical News] upon which Professor Dickstein expressed consent, and, moreover, to inform some foreign Italian, French and English journals about the whole mathematical movement in Poland . . .

Further, the President opened up the discussion on the question of the possible reorganisation of the Society and the change of Statutes. Here the opinions diverged a little. Professor Dickstein proposed to change the Statutes so as to allow branches of the Society in different university towns in Poland, and to call the central society "Polskie Towarzystwo Matematyczne" [The Polish Mathematical Society]. This calls for the decision whether the central society should have a fixed seat or rather a moveable one, and thus to reside some time in Cracow, and some time in Warsaw and Lvov, etc. Mr Leja pointed out the inconveniences of a moveable seat, and added that even if the decision to change the Statutes is carried it may turn out to be a void one because Circles of mathematicians from outside Cracow may well disagree with the reading of the changed Statutes which is all the more probable as the only mathematician from outside Cracow present at the meeting is Professor Dickstein. Professor Zaremba expressed the opinion that the present period seems transitional and perhaps time has not yet come to establish an all-Polish mathematical society. It would be rather advisable that local mathematical societies should first be founded in different towns which might later start to think of common Statutes. In further discussion, in which almost all members present participated, it was decided to leave the Statutes unchanged for the time being, and to postpone the decision of founding an all-Polish mathematical society.

But the question of the society reorganisation came to a head very quickly. Here are excerpts from the minutes of the Extraordinary General Assembly held on April 21, 1920.

Opening the discussion, Professor Zaremba said that the change of the Society name to "The Polish Mathematical Society", agreed upon by the mathematicians from outside Cracow, is advisable with regard to, first, future contacts with foreign mathematical societies, and, second, better chance of obtaining government grants for the Society if the change is made. Dr A. Hoborski moved that a commission be elected which would take care of preparing a proposal of new Statutes. The meeting passed Professor Zaremba's motion to change the name of "Mathematical Society" to "The Polish Mathematical Society" as well as of Dr Hoborski's motion, and Drs A. Rosenblatt, A. Wilk, and Fr. Leja were elected to the commission.

Mr F. Leja proposed that the commission be given directions and general principles of elaborating the new statutes at the present General Assembly, and that a draft version of new statutes, after having been discussed at one of the Society's sessions, be circulated among circles of mathematicians in other cities, and it is only after hearing their remarks and suggestions that the new statutes could be passed at a special meeting of the Society. Upon this Mr Leja read his own proposal of principles on which to base the new statutes. These were as follows: the seat of the Society is fixed in Cracow; ordinary members can be local or non-local; the latter are allowed to form separate branches, e.g., "the Warsaw branch of PTM", about which the Board of the Society in Cracow is to be informed. The Board of each branch has the right to admit new members, but part of its income is to be assigned for general purposes of the Society, such as, e.g., the accounts of publishers.

The members of the Board of the Society are to be chosen from amongst the Cracow members, except for the president or the vice-president, one of which can be chosen from the midst of non-local members. Non-local members, absent from a General Assembly, may participate in the voting for the Board members of the Society through sending their vote by closed mail.

A longer discussion followed which led to the conclusion that these principles can be used as guidance in drawing up the new statutes.

We are now close to the end of the first period of the Society's existence. Here are the

Minutes of the Extraordinary General Assembly

held on December 22, 1920.

Present: Professor Sleszyñski, Dr Hoborski, Dr Rosenblatt, Dr Wilkosz, Dr Irena Wilkoszowa, Dr Banach, Mr Nikodym, Mr Ziobrowski, Mr Fijol, Dr Leja.

Presiding Dr Hoborski. On the agenda: reading of the statutes and the suggestions of amendments sent in by other members of the Society.

After a long discussion the statutes passed and it was enjoined to print the new statutes and regulations. The President moved that, in the face of the change of statutes, a new Board of the Society should be chosen. On the motion from Mr Nikodym it was decided that the Board be kept unchanged until the end of term of office, i.e., May 1921. Upon this the General Assembly was closed.

The first Reporting General Assembly according to new Statutes was held on June 4, 1921 in Cracow in the presence of 10 local members. Other 16 members sent in their votes for the elections of the new Board. Dr □orawski from the Warsaw School of Technology was elected the new President of the PTM. Prof. S. Zaremba from Cracow became the first vice-president, and Dr Z. Krygowski, professor at the University of Poznañ – the second. However, as the presidential honour was not accepted by Professor □orawski, absent from the meeting, by-elections had to be called for the next General Assembly where votes were given to Dr Wiktor Stankiewicz, professor at the University of Vilna.

Józef Piórek is at the Mathematics Institute at the Jagiellonian University in Cracow, Poland.

Problem Corner : The Norwegian Niels Henrik Abel Contest

Paul Jainta

This is the first time that I've sifted through web sites before writing a Problem Corner. Our Corner has included many examples of competitions and other mathematical events around the World, but there has never been anything about contests for the talented youngsters of Scandinavia.

The first such event arose in Norway. Niels Bejlegaard, a 'problemist' from Stavanger, awakened my curiosity by writing: 'I have the unmistakable feeling that the Nordic countries lack the discipline and well-ordering that is characteristic of Central European countries. Being a member of diverse Nordic mathematical societies I try hard to alter this, but I do not seem to be very successful'. It took me less time and effort than expected to find an expert on the pre-eminent Norwegian competition, the *Niels Hendrik Abel contest*. Einar Rødland has organised this contest for many years, and his account reports on this showpiece of Norwegian contests. This young Norwegian fellow-organizer of the Abel contest has also created a web site for the contest.

The Niels Henrik Abel mathematics contest started in 1980 as a contest in mathematical problem solving for high-school pupils. However, junior pupils have also occasionally participated, and indeed qualified for the final and for the International Mathematics Olympiad (IMO). The aims of the Abel contest include the nurturing of students' interest in mathematics, both for the most talented who find little challenge at school and for those who are less interested in experiencing different types of mathematical problem. It also allows promoters of young talent to reach the most able students, but so far they have had little success in doing so. Norway simply lacks the resources to provide an adequate programme of encouragement. Until recently, there has been no corresponding contest for younger pupils, but an examination for youngsters has now been initiated so as to identify young students with the greatest talent; this venture is currently at an experimental stage.

The Abel contest was named after the mathematician who proved that there is no general formula for solving polynomial equations of degree 5. Today, the contest consists of two rounds and a final exam. In round 1 all contestants are given twenty multiple-choice problems each with five options, to be answered within 100 minutes; a correct answer is credited with five points, each unanswered question is awarded one point, and an incorrect answer is 'punished' by the deduction of one point. Thus, if answers are marked randomly, the expected score of 20 points is the same as if all questions are unanswered. The best 10% of the contestants proceed to the second round in which only ten problems are posed but which are much harder than those of the initial round; the maximum score is 50, and marking follows the same pattern. The top 20 or so scorers are invited to perform in the final, held annually at the University of Oslo; the finalists battle with four problems in four hours. The papers are then marked on the same day so that the results are ready for the prize-giving ceremony the same evening. The Abel contest is the first hurdle for talented Norwegian students who wish to qualify for membership in the Norwegian team for the following year's International Mathematics Olympiad. The six best finalists are invited to participate in the IMO. In preparation for this yearly highlight in international mathematics events, the finalists take part in the Nordic Mathematical Contest, together with teams from Denmark, Finland, Iceland and Sweden.

The Norwegian Mathematical Olympiad is arranged by the national Mathematical Society in cooperation with *Telenor AS*, the Norwegian telephone company, with support from the Norwegian Ministry of Education. The responsibility for posing and distributing problems, for collecting and processing the results, for arranging the final examination and drawing up diplomas, and finally for preparing the IMO-team, lies solely in the hands of the Abel committee. The organising committee is self-appointed and self-governed, although it is formally under the aegis of the Norwegian Mathematical Society, and at the start consisted of 4 to 8 university mathematicians and high-school teachers. Nowadays, students (mostly former contestants such as Einar Rødland) predominate. The organization of the contest is done chiefly by undergraduates. Ph.D. students with scholarships and Nils Voje Johansen, the official responsible for school affairs, have taken over the daily administrative duties. Another vital, though less visible, role is played by the teachers of the participating schools. They run the first two rounds and mark the papers and their commitment is pivotal to the success of the contest. During the final they are needed as judges, monitors and officials, and later on as facilitators to help the students prepare for the IMO. Here, teachers are supported by both university mathematicians and students of mathematics.

The Norwegian Mathematical Society was founded in 1918, and it soon decided to establish an annual national mathematics competition. The first such event was in 1921 and then took place annually until the early 1970s. Crown Prince Olav, and his successor Crown Prince Harald, endowed the 'Crown Prince's Prize'. However, participation was poor: usually ten or less contestants had the courage to match their mathematical skills against others. So, in the mid-70s the Abel contest's forerunner passed away peacefully and unnoticed. But it was not long before the contest was resuscitated. In 1979/80, on the 150th anniversary of Abel's death, a new contest for high-school students was born, and 28 courageous pupils participated in the reshaped competition. In 1981, the Abel contest became a joint action between the Norwegian Mathematical Society and *Aftenposten*, the leading Oslo daily newspaper. The problems appeared in the paper and at first the number of competitors shot up to 65. But for the next three years participation fell dramatically. This caused another reconsideration of the format of the contest.

Four years later the contest was remoulded for the third time and, achieved a breakthrough. A 100-minute test at all national schools now precedes the annual contest, and the top 20 scorers nationally enter the final. Since then, the number of participants has continually increased, culminating in about 4000 contestants in 1994. Incidentally, the Nordic Mathematics Contest has started to cooperate with other Scandinavian countries. In Autumn 1994 the contest underwent a cosmetic repair with an extra round inserted at school level. Its aim was to achieve a more reliable selection and to give the best 10% of all entrants an extra challenge. This mathematical encore was warmly accepted among the competitors, and is now an indispensable component of the contest. The contest now serves as a vehicle for modestly mathematically gifted young people to get a glimpse of a different, more enjoyable and inspiring class of mathematics problems. Einar Rødland sees several students who do well in the contest, particularly those who qualify for the IMO, with many of them taking up the study of mathematics and gaining an outstanding degree. An overview of earlier winners in the contest and its forerunners reveals a striking list of people who took up careers as mathematicians or top scientists, or became significant members of Norwegian society.

PROBLEM CORNER

The following problems exhibit the lucidity and crispness of Scandinavian questions. I hope that I have collected another set of exacting questions.

104 (*Abel contest, final round, 1992*) Choose a point P on the bisector of an angle with vertex A. A line through P meets the arms of the angle in points B and C. Show that

$$\frac{1}{AB}+\frac{1}{AC}$$

is constant as the line rotates about P.

105 (*Abel contest, final round, 1992*) Find all non-negative integers x, y, z which satisfy the equation $3(x + y + z) = xyz$.

106 (*Abel contest, final round, 1992*) Let (x, y, z) be the coordinates of a point on the surface of a sphere with centre 0 and radius 1. Find the greatest and least values of the expression $xy + xz + yz$.

107 (*The Baltic Way, 1992*) The towns in a country are connected by one-direction roads. For any two towns, one can be reached from the other. Prove that there is a town from which all the other towns can be reached.

108 (*Swedish Mathematical Olympiad, final round, 1974*) Find all polynomials $p(x)$ for which $p(x^2) = (p(x))^2$ for all x. Use the result to determine which polynomials fulfil the following condition: $p(x^2 – 2x) = (p(x – 2))^2$.

109 (*Proposed problem for The Baltic Way, 1995, from Estonia*) Find all positive real numbers c such that the sequence $a_0, a_1, a_2, \ldots$, where

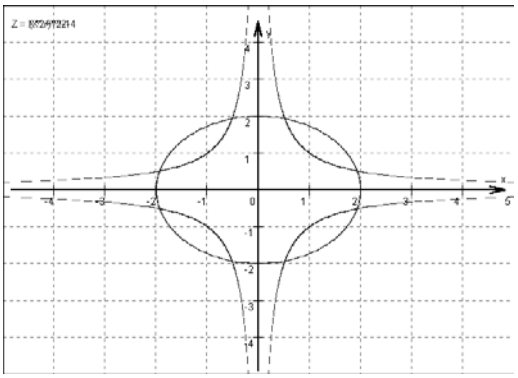
$a_0 = 1, a_i = c^{a_{i-1}}, i = 1, 2, \ldots$

is bounded (i.e. there exists a real number M such that $|a_i| \le M$, for all $i = 0, 1, 2, \ldots$).

Solutions to some earlier problems

90 With respect to an orthonormal basis we consider the curves determined by the equations $x^2 + y^2 = r^2$ ($r \ge 0$, $r^n \in \boldsymbol{R}$) and $(xy)^2 = 1$
Let $F(r)$ denote the convex polygon having the intersection points of these curves as vertices (assuming that they exist).
(a) Find an expression $f(r)$ which describes the area of the polygon $F(r)$.
(b) For which values of r is $F(r)$ a regular polygon ?

Solution *by Dr J. N. Lillington (Dorchester); also solved by Niels Bejlegaard (Stavanger) and Oren Kolman (London).*



We have $x^2 + y^2 = r^2$, $(xy)^2 = 1$, so $x^2 + (1/x^2) = r^2$ and $x + (1/x) = \pm\sqrt{(r^2 + 2)}$.
Thus, $x^2 \pm x\sqrt{(r^2 + 2)} + 1 = 0$ and $x = \pm\sqrt{(r^2 + 2)} \pm \sqrt{(r^2 – 2)} = y$, by symmetry.
Now, $f(r) = 4.\{[\sqrt{(r^2 + 2)} + \sqrt{(r^2 – 2)}]^2 – ½.[2.\sqrt{(r^2 – 2)}]^2\} = 8.[\sqrt{(r^4 – 4)} + 2]$, for $r \ge \sqrt{2}$.
For a regular polygon, this means that
$[2.\sqrt{(r^2 + 2)}]^2 + [2.\sqrt{(r^2 – 2)}]^2 = \{2.[\sqrt{(r^2 + 2)} – \sqrt{(r^2 – 2)}]\}^2$,
or $\sqrt{(r^4 – 4)} = 2$, which yields $r^4 = 8$, or $r = \sqrt{(2\sqrt{2})}$.

92 Find all polynomials $p(x) = x^5 + a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$, where the coefficients a_i are real constants which satisfy the following condition:
if a is a real or complex root of $p(x)$, then $1/a$ and $1 – a$ are also roots of $p(x)$.

Solution *by Niels Bejlegaard (Stavanger); also solved by Oren Kolman (London), Dr. J. F. Lillington (Dorchester) and Dr Z. Reut (London).*

If a is a real root of $p(x) = 0$, then $p(x)$ must be of the form
$p(x) = (x – a) . [x – (1/a)] . (x – 1 + a) . q(x)$,
where $q(x) = x^2 + rx + s$, for $r, s \in \mathbf{R}$,
giving a double infinity of polynomials.

If a is a complex number $a = c + id$, then two of the roots must be equal or conjugate to each other, by the Fundamental Theorem of Algebra.

The roots a, $1/a$, $1 - a$, $1 - (1/a)$, $1/(1 - a)$ and $a/(a - 1)$ are not all distinct.

In particular, $a = 1/a$ gives $a^2 = 1$ or $a^2 = \pm 1$.

Now if $a \neq +1$, then $a = -1$, and we get the set of solutions $\{-1, \frac{1}{2}, 2\}$.

If $a = 1 - a$, then $a = \frac{1}{2}$, and we obtain the same solutions.

If $a = a/(1 - a)$, then $a^2 - a + 1 = 0$, whose roots are $\frac{1}{2} + \frac{1}{2}i\sqrt{3}$ and $\frac{1}{2} - \frac{1}{2}i\sqrt{3}$.

In this case, the three solutions $a = 1/(1 - a) = 1 - (1/a)$ and $1/a = 1 - a = a/(a - 1)$ are identical.

If $1/a = 1 - a$, then $a^2 - a + 1 = 0$; this gives no new solutions.

Finally, $a = a/(a - 1)$ is equivalent to $a^2 - 2a = 0$, with solutions $\{-1, \frac{1}{2}, 2\}$.

Thus, we have $p(x) = (x + 1)^{\alpha}.(x - \frac{1}{2})^{\beta}.(x - 2)^{\gamma}$, with $\alpha + \beta + \gamma = 5$ and $\alpha, \beta, \gamma \geq 1$.

In the case of complex roots, we obtain the polynomial

$$p(x) = (x + 1).(x - \tfrac{1}{2}).(x - 2).(x^2 - x + 1) = x^5 - (5/2)x^4 + 2x^3 - (5/2)x + 1.$$

93 If a and b are non-negative real numbers such that $a^2 + b^2 = 4$, show that $ab/(a + b + 2) \leq \sqrt{2} - 1$.

Solution *by Dr Ranjeet Kaur Sehmi (Chandigarh, India); also solved by Niels Bejlegaard (Stavanger), Oren Kolman (London), Maurice Brémond (Avignon), Dr J. N. Lillington (Dorchester), Dr Z. Reut (London) and Claude Lamoureux (Paris).*

Since $a^2 + b^2 = 4$, where a and b are non-negative real numbers, we can write

$a = 2 \cos \theta$ and $b = 2 \sin \theta$, where $0 \leq \theta \leq \pi/2$.

Now, $ab/(a + b + 2) = 4 \sin \theta \cos \theta / (2 \sin \theta + 2 \cos \theta + 2)$

$= [(2 \sin \theta \cos \theta + \sin \theta + \cos \theta + 1)/(\sin \theta + \cos \theta + 1)] - 1$

$= [(\sin \theta + \cos \theta)(\sin \theta + \cos \theta + 1)/(\sin \theta + \cos \theta + 1)] - 1$

$= \sin \theta + \cos \theta - 1 = \sqrt{2} \sin [\theta + (\pi/4)] - 1 \leq \sqrt{2} - 1$,

since $\sin [\theta + (\pi/4)] \leq 1$.

94 Prove, that in any convex polygon of $2n$ sides, there exists at least one diagonal which is not parallel to a side.

Solution *by Oren Kolman (London); also solved by Niels Bejlegaard (Stavanger).*

Since the polygon is convex, it has $\frac{1}{2}.2n.(2n - 3) = 2n^2 - 3n$ diagonals.

Each side is parallel to at most $n - 2$ diagonals, because the polygon has $2n$ vertices.

Hence the total number of diagonals parallel to some side is at most $2n.(n - 2) = 2n^2 - 4n$.

So there are at least $(2n^2 - 3n) - (2n^2 - 4n) = n$ diagonals which are not parallel to any side.

95 Let a be a real number. For what values of a do the following simultaneous equations have real solutions?

$x^2 + y^2 + z^2 = 5$, $xy + yz + xz = 2$, $xyz = a$.

Solution *by Dr Z. Reut (London); also solved by Maurice Brémond (Avignon), Niels Bejlegaard (Stavanger) and J. F. Lillington (Dorchester).*

The given equations are (1) $x^2 + y^2 + z^2 = 5$; (2) $xy + yz + xz = 2$; (3) $xyz = a$.

Let us assume that $a > 0$ and that $x, y, z > 0$ – that is, we restrict the solutions geometrically to the first octant.

Noting that

$$(x + y + z)^2 = x^2 + y^2 + z^2 + 2(xy + yz + xz),$$

we deduce from (1) and (2) that

$(x + y + z)^2 = 9$, and $x + y + z = 3$. (4)

The elimination of z by equation (4) gives, from either (1) or (2),

$x^2 + y^2 + xy - 3x - 3y + 2 = 0$, (5)

and with equation (3), we obtain $3xy - x^2y - xy^2 - a = 0$. (6)

Multiplying (5) by x and adding to (6), we eliminate y to give the cubic equation

$x^3 - 3x^2 + 2x - a = 0$. (7)

Multiplying (5) by y and adding to (6) gives the same equation (7) for y.

Eliminating x and y from (1) or (2), equations (3) and (4) give the same equation (7) for z.

Because of the geometrical symmetry, (7) must have three real roots and the discriminant D must be positive.

Since $D = \sqrt{(4 - 27a^2)}$, it follows that $a^2 < 4/27$ and $|a| < 2/\sqrt{27}$.

96 Consider sequences of the form $x_1, x_2, \ldots, x_n$ in which each x_i is either a, b or c. Determine the number of different sequences

(i) which have length n,

(ii) which begin and end with the letter a, and

(iii) in which adjacent terms are always different letters.

Solution *by Oren Kolman, London; no other correct solutions were received.*

Let $F(n)$ be the number of sequences which satisfy conditions (i), (ii) and (iii).

Let T be the (binary) tree whose nodes are labelled in the following way:

the initial node is labelled a, and if $x \in \{a, b, c\}$ labels a node, then the labels of the two immediate successors of that node are the two elements in $\{a, b, c\} \setminus \{x\}$.

Note that $F(n)$ is the number of branches of length n with terminal nodes labelled a, which we shall call the *good* branches.

Since for each non-zero natural number k, there are 2^{k-1} nodes at level k in T, and each good branch of length $k + 1$ passes through a bad node at level k labelled b or c, it follows that

(1) $F(k + 1) = 2^{k-1} - F(k)$, and hence $F(k + 2) = 2^k - [2^{k-1} - F(k)]$,

so that

(2) $F(k + 2) - F(k) = 2^k - 2^{k-1}$.

The recursive relation (2) for even arguments yields a telescoping sum:

$[F(2(k + 1)) - F(2k)] + [F(2k) - F(2k - 2)] + \ldots + [F(4) - F(2)] = (2^{2k} - 2^{2k-1}) + (2^{2k-2} - 2^{2k-3}) + \ldots + (2^2 - 2)$

$= (1/3).\{1 - (-2)^{2k+1}\} - 1.$

Since $F(2) = 0$, it follows that

(3) $F(2k + 2) = (1/3).\{2^{2k+1} + 1\} - 1.$

Using (1), and applying (3) to the argument $2k$, we deduce that

(4) $F(2k + 1) = (1/3).\{2^{2k} - 1\} + 1.$

Putting (3) and (4) together, we find that

$F(n) = (1/3).\{2^{n-1} + (-1)^n\} + (-1)^{n+1} = (1/3).\{2^{n-1} - 2(-1)^n\}.$

Postscript

As a reaction to the last *Problems Corner* I received a letter from Prof. Pierre-Olivier Legrand, the leading organiser of mathematics competitions in French Polynesia. In his reply he sounded a bit disillusioned, comparing his situation with that offered by Europe to its mathematically talented youngsters:

'I discovered that in small countries, it is difficult to build a local structure to run a competition because I had reckoned without the intricate human factor. A one-man structure is a weak construction; each adversity or pressure of time is a nuisance to the organiser and cripples the competition. I would like to add another lesson to my former paper, 'try not to be alone'. I under-estimated this simple fact. Regarding the sponsors, Wespac is no longer the major sponsor for the Australian Mathematics Contest (AMC), neither in Australia, nor in Tahiti. In Tahiti we stopped our sponsorship with Qantas and the number of entrants decreased. The AMC is still an institution, and still carried by their users, the pupils. We now have 'second generation entrants', sons and daughters whose parents entered the AMC 16 or 17 years ago. The Australian Mathematics Trust is, in my estimation, by far the best existing structure to foster students. I tried to cooperate with the French equivalent 'Le Kangourou des Mathématiques', but the logistics never got close to what the Australian Trust is able to provide. In Europe, I think, a cooperation with Eastern countries could be more beneficial. They have accumulated a lot of experience in this field and they had a long tradition of doing good maths, but most of the time they had no means to promote, even to run their own competition locally.'

That completes the *Problems Corner* for this issue. I need suitable contests and solutions, and welcome comments, criticisms and suggestions for the future direction of this feature.

Finally, please propose problems for our readers to solve. Proposals should include a solution, references, and other insights which are likely to help the editor. They can range from elementary to advanced, from easy to difficult. Original problems are particularly sought, as are questions from problem books and contests that are not easily accessible. Other interesting problems are also acceptable, provided they are not well known and references are given as to their provenance.

Forthcoming conferences

compiled by Kathleen A S Quinn

Please e-mail announcements of European conferences, workshops and mathematical meetings of interest to EMS members, to k.a.s.quinn@open.ac.uk. Announcements should be written in a style similar to those below, and sent 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. The present issue includes conferences up to August 2000.

July 1999

2–5: VIIIth Oporto Meeting on Geometry, Topology and Physics, Portugal
[Series formerly known as 'Oporto Meetings on Knot Theory and Physics']
Aim: to bring together mathematicians and physicists interested in the interrelations between geometry, topology and physics
Speakers: Ron Donagi (Pennsylvania), *spectral curves, integrable systems, and moduli*; Jürg Fröhlich (Institut für Theoretische Physik), *Supersymmetry and non-commutative geometry*; Ezra Getzler (Northwestern)*: The Virasoro conjecture for Gromov-Witten invariants: a status report*; Igor Krichever (Columbia), *Moduli spaces of Riemann surfaces and 2D integrable systems*
Programme: short courses of about three lectures each, given by the main speakers, and a limited number of seminars
Organisers: P. Gothen, J. Mourao, R. Picken, J. N. Tavares
Sponsors: Fundacao para a Ciencia e Tecnologia, Centro de Matematica da Universidade do Porto, Centro de Matematica Aplicada, Instituto Superior Tecnico, Centro Interdisciplinar de Astrofisica, Instituto Superior Tecnico, Caixa Geral de Depositos
Site: Faculdade de Ciencias da Universidade do Porto
Information: contact Peter Gothen, Departamento de Matematica Pura, Faculdade de Ciencias, 4099-002 Porto, Portugal; *tel*: (+351)-2-3401441
e-mail: pbgothen@fc.up.pt
URL: http://fisica.ist.utl.pt/~jmourao/om/omviii/om99b.html

3–9: Computer Vision and Speech Recognition: Statistical Foundations and Applications, Anogia, Crete, Greece
Information: contact B. Gidas, Division of Applied Mathematics, Brown University, Providence, Rhode Island 02912, USA
e-mail: gidas@dam.brown.edu
[For details, see EMS *Newsletter* 31]

4–11: Paul Erdös and his Mathematics, Budapest, Hungary
Information: contact A. Sali, Mathematical Institute of HAS, Budapest, P.O. Box 127, H–1364 Hungary
e-mail: erdos99@math-inst.hu
URL: http://www.math-inst.hu/~erdos99
[For details, see EMS *Newsletter* 31]

5: CEMRACS: Centre d'été de mathématique et de recherches avancées en calcul scientifique, Orsay / Luminy, France
Information: *e-mail: cemracs@asci.fr*
URL: http://www.asci.fr/cemracs/
[For details, see EMS *Newsletter* 31]

5–9: Quadratic Forms and their Applications, Dublin, Ireland
Information: contact Prof. D. Lewis, Department of Mathematics, University College, Dublin; *tel*: (+353)-1-706-8373
e-mail: dwlewis@ollamh.ucd.ie
URL: http://mathsa.ucd.ie/TMR/quadconf.html
[For details, see EMS *Newsletter* 31]

5–9: Fourth International Conference on Industrial and Applied Mathematics (ICIAM 99), Edinburgh, Scotland
Information: *URL: http://www.ma.hw.ac.uk/iciam99/*

5–21 August: Summer Research Semester on Complex Potential Theory and its Applications, Istanbul, Turkey
Programme: this is a research-teaching semester (5 July–6 August and 16–21 August 1999) on complex potential theory (CPT) and its applications. There will be a workshop in Edirne from 9–16 August 1999, emphasising the connection between functional analysis and complex analysis
Aim: to impart the main ideas of complex potential theory to advanced graduate students and other interested mathematicians; to advance scientific discussions of results and problems in CPT
Scope: CPT is a relevant potential theory for multidimensional complex analysis; it deals with plurisubharmonic functions and maximal plurisubharmonic functions, and is strongly connected with the study of the complex Monge-Ampere equation. It has applications in approximation and interpolation theory, partial differential equations, complex dynamical systems, differential geometry and number theory
Lecturers: S. Ko³odzej (Cracow), *The main aspects of CPT and Monge Ampère equations*; D. Vogt (Germany), *CPT Phragmen-Lindelöf Principles and applications to partial differential equations*; J. Siciak (Cracow), *Pluripotentials and their applications in interpolation and approximation theory*; E. Poletsky (USA), *Plurisubharmonic currents and pluripotentials*; A. Aytuna (Turkey), *Introduction to classical potential theory*; V. Zahariuta (Russia), *Plurisubharmonic functions and analytic functions of several complex variables*
Organisers: A. Aytuna (METU), T. Terzioglu (Sabanci University), V. Zahariuta (Feza Gursey Institute)
Site: Feza Gursey Institute, Istanbul, Turkey
Deadline: 15 June 1999
Information:
URL: http://www.gursey.gov.tr/complex.html

6: IMLA'99 Intuitionistic Modal Logics and Applications, Trento, Italy
Aim: to seed a more concerted organisation of research in intuistic modal logic (IML), bringing together the method-oriented and the problem-oriented approaches, and the proof-theoretic and model-theoretic approaches
Topics: applications of intuitionistic necessity or possibility, strong monads, evaluation modalities; use of IML and modal type theory (MTT) to formalize mechanisms of abstraction and refinement; applications of IML and MTT to formal verification, abstract interpretation, program analysis and optimisation; applications of modal types to integration of inductive and co-inductive types, higher-order abstract syntax, strong functional programming; extraction of constraints or programs, non-standard information extraction techniques; Curry-Howard correspondence between computational lambda calculi and computational logics; extensions of this correspondence by other modalities or quantifiers; models of IML such as algebraic, categorical, Kripke, topological, realisability interpretations; notions of proof for IML and intermediate constructive logics; proof search in and implementations of IML
Invited speaker: Frank Pfenning (Pittsburgh)
Programme committee: Matt Fairtlough (Sheffield), Zhaohui Luo (Durham), Michael Mendler (Sheffield), Pierangelo Miglioli (Milan), Eugenio Moggi (Genova), Andy Pitts (Cambridge), Terry Stroup (Passau)
Organisers: Matt Fairtlough (Sheffield), Mauro Ferrari (Milan), Michael Mendler (Sheffield)
Information: contact Matt Fairtlough, The University of Sheffield, Department of Computer Science, Regent Court, 211 Portobello Street, Sheffield S1 4DP, UK; *tel*: (+44)-11422-21826 or (+44)-11427-80972
e-mail: m.fairtlough@dcs.shef.ac.uk
URL: http://www.dcs.shef.ac.uk/~matt/mendler/floc-ws.html

6–16: Advanced course on mathematical aspects of image processing, Centre de Recerca Matemàtica and Centre de Visió per Computador
Speakers: V. Caselles (Illes Balears) and J.M. Morel (Cachan), *Mathematical amodels in image processing*; J. Serra (Paris), *Mathematical morphology*; S. Mallat (Palaiseau) and Y. Meyer (Cachan), *Signal processing with wavelets*

Information: *URL: http://crm.es/info/acmaip/acmaip.html*

8–17: School on Singularities in Algebraic Geometry and String Theory, Lisboa, Portugal
[activity of Centro Internacional de Matematica]
Topic: the interface between singularity theory (in complex algebraic geometry) and superstring theory
Programme: six courses by leading experts on both mathematical and physical aspects of singularity theory
Lecturers: P. Aspinwall (Duke University), V. Batyrev (Tübingen), P. Candelas (Texas), Le Dung-Trang (Provence), M. S. Narasimhan (International Center for Theoretical Physics), M. Reid (Warwick)
Organisers: Carlos Florentino, Margarida Mendes Lopes, Jose Mourao, Orlando Neto, Joao Pimentel Nunes
Sponsors: Fundacao para a Ciencia e Tecnologia, Centro de Algebra da Universidade do Lisboa, Centro de Analise Matematica, Geometria e Sistemas Dinamicos, Centro de Matematica e Aplicacoes Fundamentais, Centro Interdisciplinar de Astrofisica
Site: Complexo Interdisciplinar of Universidade de Lisboa
Deadline: for registration, passed
Information: contact José Mourao, Departamento de Fisica, Av. Rovisco Pais, 1049-001, Lisboa Codex, Portugal, *tel*: (+351)-1-8419118
e-mail: jmourao@ualg.pt
URL: http://www.fisica.ist.utl.pt/~jmourao/cim/main.html

8–24: XXIXth Probability Summer School, Saint-Flour, Cantal, France
Information: contact P. Bernard, Université Blaise Pascal, Mathématiques Appliquées, F63177 Aubière Cedex, France; *tel*: 04-73-40-70-52 or 04-73-40-70-50; *fax*: 04-73-40-70-64
e-mail: bernard@ucfma.univ-bpclermont.fr
[For details, see EMS *Newsletter* 31]

9–17: Symposium on Computation in Group Theory and Geometry, Coventry, UK
Information: contact Peta McAllister, Mathematics Institute, University of Warwick, Coventry CV4 7AL, England; *tel*: (+44)-1203-524403
e-mail: peta@maths.warwick.ac.uk
URL: *http://www.maths.warwick.ac.uk/~dbae/symposium99html*
[For details, see EMS *Newsletter* 31]

12–13 Hydrodynamic instabilities, waves and geophysical fluid dynamics, Bristol, UK
[meeting to mark the retirement of Prof. Philip Drazin]
Information:
e-mail: R.R.Kerswell@bristol.ac.uk
URL: http://www.maths.bris.ac.uk/~amnag/conference.htm

12–16: 17th British Combinatorial Conference, Canterbury, UK
Information:
URL: http://speke.ukc.ac.uk/cbs/ms/bcc17/
[For details, see EMS *Newsletter* 31]

12–17: Workshop on Model Theory and Permutation Groups, Trento, Italy
Information:
URL: http://www.science.unitn.it/~puglisi/workshop.html
[For details, see EMS *Newsletter* 31]

12–18: Third International Conference on Symmetry in Nonlinear Mathematical Physics, Kiev, Ukraine
Information: contact A. Nikitin, Institute of Mathematics, National Academy of Sciences of Ukraine, 3 Tereshchenkivska Street, Kyiv 4, Ukraina; *tel*: (+38)-044-224-63-22 or (+38)-044-250-08-96; *fax*: (+38)-044-225-20-10
e-mail: nonlin@apmat.freenet.kiev.ua / appmath@imath.kiev.ua
URL: http://www.imath.kiev.ua/~appmath/first_in.html
[For details, see EMS *Newsletter* 31]

13–17: School on Category Theory and Applications, Coimbra, Portugal
Information:
e-mail: scta@mat.uc.pt
URL: http://www.mat.uc.pt/~scta/

13–22: International Conference on Biomathematics–Bioinformatics and Applications of Functional Differential Equations, Antalya, Turkey
Information:
e-mail: akca@kfupm.edu.sa, ciplak@pascal.sci.akdeniz.edu.tr or *fiskin@pascal.sci.akdeniz.edu.tr*

16–18: ESA'99: Seventh Annual European Symposium on Algorithms, Prague, Czech Republic
Information:
URL: http://www.ms.mff.cuni.cz/esa99/
[For details, see EMS *Newsletter* 31]

18–28: Foundations of Computational Mathematics (FoCM), Oxford, UK
Information:
URL: http://www.dampt.cam.ac.uk/user/na/FoCM/

19–24: Representations of Algebras (CRASP), Sao Paulo
Information: *e-mail: crasp@ime.usp.br*
URL: http://www.ime.usp.br

19–24: CT99 International Category Theory Meeting, Coimbra, Portugal
Note: satellite event: *School on Category Theory and Applications*, 13–17 July 1999, at the same site
Information:
e-mail: ct99@mat.uc.pt
URL: http://www.mat.uc.pt/~ct99/

19–29: LMS Durham Symposium on Quantum Groups, Durham, UK
Information: Prof. A. N. Pressley, Department of Mathematics, King's College, Strand, London WC2R 2LS, UK
e-mail: udah207@kcl.ac.uk
[For details, see EMS *Newsletter* 31]

19–1 August: Banach Center Symposium on Ordered Sets, Warsaw, Poland
Information:
e-mail://order@banach.impan.gov.pl

22–24: CPM '99, 10th Annual Symposium on Combinatorial Pattern Matching, Coventry, UK
Information:
URL: http://www.dcs.warwick.ac.uk/cpm/

24–30: Groups of Tree Automorphisms and Lattices, Anogia, Crete, Greece
Information: contact S. Mozes, Department of Mathematics, Hebrew University of Jerusalem, Givat Ram, 91904 Jerusalem, Israel
e-mail: mozes@math.huji.ac.il
[For details, see EMS *Newsletter* 31]

26–6 August: Structure Formation in the Universe, Isaac Newton Institute, Cambridge, UK
Information:
e-mail: h.hughes@newton.cam.ac.uk
URL: http://www.newton.cam.ac.uk/programs/sfu.html
[For details, see EMS *Newsletter* 31]

August 1999

1–6: 1999 ASL European Summer Meeting (Logic Colloquium '99), Utrecht, The Netherlands
Information: Association for Symbolic Logic, 1409 West Green Street, Urbana, IL 61801, USA; *tel*: (+1)-217-244-7902; *fax*: (+1)-217-333-9576
e-mail: asl@math.uiuc.edu
URL: http://www.math.uiuc.edu/~asl/
[For details, see EMS *Newsletter* 31]

1–7: EQUADIFF 99, Berlin, Germany
Information: contact Mrs. R. Loehr, Freie Universität Berlin, Mathematisches Institut I, Arnimallee 2–6, D–14195 Berlin, Germany
e-mail: equadiff@math.fu-berlin.de
URL: http://www.math.fu-berlin.de/~equadiff/
[For details, see EMS *Newsletter* 31]

2–6: Fifth International Conference on Finite Fields and Applications, Augsburg, Germany
Information:
URL: http://www.Math.Uni-Augsburg.DE/fq5/
[For details, see EMS *Newsletter* 31]

5–6: International Conference on the Collatz Problem and Related Topics, Germany
Topic: the $3x + 1$ problem (also known as the Syracuse algorithm, and Collatz's, Kakutani's, or Ulam's problem), and related mathematics
Programme committee: Günther Wirsching, Marc Chamberland
Organisers: Günther Wirsching, Marc Chamberland
Site: Katholische Universität Eichstaett, Germany
Deadlines: for early registration and contributed talks, passed
Information: contact Marc Chamberland, Department of Mathematics, Grinnell College, Grinnell, Iowa 50112, U. S. A., *tel*: (+1)-515-269-4207 / (+1)-515-269-4984
e-mail: chamberl@math.grin.edu
URL: http://www.math.grinnell.edu/~chamberl/conf.html

9–14: György Alexits Memorial Conference, Budapest, Hungary
Information: contact S. Fridli,

Department of Numerical Analysis, Eötvös L. University, Muzeum krt. 6–8, Budapest, H–1088 Hungary;
tel: (+36)-1-2669-833, ext. 3113
e-mail: fridli@ludens.elte.hu
[For details, see EMS *Newsletter* 31]

10–15: International Conference on Mathematical Logic, Novosibirsk, Russia
Information: *tel*: (+7)-383-2-356237;
fax: (+7)-383-2-357808
e-mail: ryaskin@math.nsc.ru
[For details, see EMS *Newsletter* 31]

16–20: International Conference on Analysis and Mathematical Physics, Lund, Sweden
[in honour of Lars Gaarding on his 80th birthday]
Theme: differential equations and their relation to mathematical physics, including spectral theory and scattering theory, both direct and inverse problems, stability of matter and related subjects.
Plenary speakers: include M. Atiyah, M. S. Birman, J. Brüning, P. Deift, G. Grubb, A. Jensen, P. D. Lax, B. M. Levitan, V. Maz'ya, J. Ph. Solovej, J. Sjöstrand, A. S. Wightman
Programme: 15 plenary lectures, 30-minute invited talks and contributed talks
Sponsor: Crafoord Fund
Deadline: for submission of abstracts, 30 June 1999
Information: contact C. Bennewitz, G. Gudmundsdottir or A. Melin, Centre for Mathematical Sciences, Lund University, Box 118, S-221 00 Lund, Sweden
e-mail: cbz@maths.lth.se
URL: http://www.maths.lth.se/garding80.html

19–25: Topology and Dynamics: Rokhlin Memorial, St Petersburg, Russia
Information: contact M. Zvagel'skii, 191011 Steklov Institute of Math. (POMI), nab. reki Fontanka 27, St Petersburg, Russia
e-mail: rokhlin@euler.pdmi.ras.ru
URL: http://www.pdmi.ras.ru/EIMI/1999/rokhlin/
[For details, see EMS *Newsletter* 31]

20–26: Eleventh International Congress of Logic, Methodology and Philosophy of Science, Kraków, Poland
Information:
URL: http://www.uj.edu.pl/Phils/congress/

22–29: Summer School on Quantum Groups, Hesselberg, Germany
Information: contact Steffen Koenig, Fakultät für Mathematik, Universität Bielefeld, D–33501 Bielefeld, Germany
e-mail: koenig@mathematik.uni-bielefeld.de
URL: http://www.mathematik.uni-bielefeld.de/~sek/summerseries.html
[For details, see EMS *Newsletter* 31]

23–29 International Conference on Nonlinear Partial Differential Equations, Lviv, Ukraine
Information:
e-mail: tedeev@iamm.ac.donetsk.ua

23–4 September: Generalized Dirac Operators and their Geometric Scattering Theory, Warsaw, Poland
Information: contact Prof. Thomas Friedrich, Institut für Mathematik, Humboldt-Universität zu Berlin, Ziegelstrasse 13a, Unter den Linden 6, D–10099 Berlin, Germany; *tel*: (+49)-30-2093-1825; *fax*: (+49)-30-2093-1824
e-mail: friedric@mathematik.hu-berlin.de
URL: http://www-irm.mathematik.hu-berlin.de/~pahlisch/Banach-99html
[For details, see EMS *Newsletter* 31]

25–28: ORDAL '99, Third International Conference on Orders, Algorithms and Applications, Montpellier, France
Information: *e-mail://ordal99@lirmm.fr*

27–29: GAMM–Workshop on Computational Plasticity, Kiel, Germany
Topics: mathematical analysis of (visco-) plasticity, well-posedness of (perfectly) plastic problems, numerical analysis of variational inequalities, computational (visco-)plasticity, numerical analysis of localisation, *a priori* error analysis, *a posteriori* error analysis, adaptive algorithms for spatial and time-step discretization, coarsening and special adaptive strategies
Programme committee: Martin Brokate and Carsten Carstensen (Kiel), B. D. Reddy (Cape Town)
Organisers: the Mathematical Seminar of the Christian-Albrechts-Universität zu Kiel in cooperation with the GAMM – Committee for Discretization Methods in Solid Mechanics
Site: Mathematisches Seminar of Christian-Albrechts-Universität Kiel
Deadlines: for abstracts, 15 June 1999
Information: contact Jan Valdman, *tel*: (+49)-431-880-1421; *fax*: (+49)-431-880-4464
e-mail: jva@numerik.uni-kiel.de
URL: http://www.numerik.uni-kiel.de/cc/work99.

27–1 September: Fourth International Conference on Geometry and Applications, St. Constantine, Bulgaria
Information:
URL: http://hopf.uoregon.edu/~gilkey/dirbulgaria/bulgariaconf.html

29–4 September: Linear series and lower dimensional varieties, Bedlewo, Poland
Information:
e-mail: workshop@im.uj.edu.pl
URL: http://www.im.uj.edu.pl/~workshop/
[For details, see EMS *Newsletter* 31]

30–1 September: Sixth International Symposium on Generalized Convexity and Monotonicity, Karlovassi, Samos, Greece
Information: contact T. Vigli-Papadaki, Department of Mathematics, University of the Aegean, Karlovassi 83200, Samos, Greece; *tel*: (+30)-273-33914/34750;
fax: (+30)-273-33896
e-mail: gc6@math.aegean.gr
URL: http://kerkis.math.aegean.gr/~gc6/GC6.htm
[For details, see EMS *Newsletter* 31]

30–3 September: International Conference in Honour of Jean Leray, Karlskrona, Sweden
Aim: to honour the memory of Jean Leray with lectures on fields related to Leray's work
Organisers: Maurice de Gosson (Karlskrona), Jean Vaillant (Paris)
Information: contact Charlyne de Gosson, University of Karlskrona-Ronneby, Mathematics Department, camus Annebo, 371 79 Karlskrona, Sweden; *tel*: (+46)-455-89-270;
fax: (+46)-455-89-377
e-mail: Charlyne. de Gosson@ihn.hk-r.se

September 1999

1–3: SOR '99, Symposium on Operations Research, Magdeburg, Germany
Information:
URL: *http://www.uni-magdeburg.de/SOR99/*

1–10 International Conference on Geometry, Integrability, and Quantization, St. Constantine, Bulgaria
Aim: to bring together experts in differential geometry, complex analysis, mathematical physics, and related fields, to assess recent developments in these areas, and to stimulate research
Scope: the geometry of real and complex manifolds, including Seiberg-Witten and minimal surface theory, integrability of complex structures and classical dynamical systems, and geometric quantization
Invited Speakers: K. Abe (Matsumoto), A. Bette (Stockholm), M. Damnjanovic (Beograd), K. Fujii (Hokkaido), K. Fukui (Kyoto), P. Holod (Kiev), M. Karasev (Moscow), M. Puta (Timisoira), M. Spera (Padova)
Programme: one-hour plenary lectures by the invited speakers; 30-minute contributed talks
Advisory Committee: P. Gilkey (Oregon), G. Marmo (Naples), J. Rawnsley (Warwick), W. Schempp (Siegen), G. Tuynman (Lille), I. Vaisman (Haifa)
Sponsors: the Bulgarian Academy of Sciences, California State University (Chico, USA), the Bulgarian National Science Fund, and the European Mathematical Society
Proceedings: to be published
Accommodation costs: approximately $30–35 full board at GUP Hotel
Site: GUP Hotel, St. Constantine
Information:
e-mail: mladenov@bgcict.acad.bg or *gnaber@csuchico.edu*
URL: http://www.csuchico.edu/math/conference/index.shtml

3–7: Summer School on Differential Geometry, Coimbra, Portugal
Information: contact Francisco J. Craveiro de Carvalho, Universidade de Coimbra, Portugal
e-mail fjcc@mat.uc.pt
[For details, see EMS *Newsletter* 31]

5–8: Conference Moshe Flato, Dijon, France
[in honour of Moshe Flato, 1937–1998]
Scope: the many domains of mathematics, mathematical physics and physics that were close to Moshe Flato's heart

Speakers: Yakir Aharonov, Louis Boutet de Monvel, Alain Connes, Ludwig Faddeev, Boris Fedosov, Sergio Ferrara, Jürg Fröhlich, Christian Fronsdal, Simone Gutt, Maxim Kontsevich, Bert Kostant, Elliott Lieb, Wilfried Schmid, Jacques Simon, Leon Takhtajan
Organisers: Daniel Sternheimer, Jacques Simon, Wilfried Schmid, Jean-Claude Cortet
Information: contact Laboratoire Gevrey de Mathématique Physique, Université de Bourgogne, BP 47870, 21078 Dijon Cede, Dijon Cedex
e-mail: cmf@u-bourgogne.fr
URL: http://www.u-bourgogne.fr/monge/cmf/

5–11: XX International Seminar on Stability Problems for Stochastic Models, Lublin-Nalêczòw, Poland
Information: K. Kubacki, Institute of Mathematics UMCS, Pl. Marii Curie-Sklodowskiej 1, 20-031 Lublin, Poland
e-mail: stabil@golem.umcs.lublin.pl
URL: http:stabil.umcs.lublin.pl/ or URL: http://bernoulli.mi.ras.ru/
[For details, see EMS *Newsletter* 30]

6–10: Second Meeting on Quaternionic Structures in Mathematics and Physics, Rome, Italy
Programme committee: D. V. Alekseevsky (Moscow), K. Galicki (New Mexico), P. Gauduchon (Palaiseau), S. Marchiafava (Rome), S. Salamon (Oxford)
Organisers: S. Marchiafava, P. Piccinni, M. Pontecorvo
Site: Università di Roma 'La Sapienza', Università 'Roma Tre', Italy
Note: Proceedings of the First Meeting can be found in the *e*-library of EMS:
URL: http://www.emis.de/proceedings/QSMP 94/index.html
Information:
URL: http://www.mat.uniroma3.it/users/max /meeting/meeting.html

6–21: EMS Summer School in Applied Mathematics: Numerical Simulation of Flows, Heidelberg and Freiburg, Germany, and Zürich, Switzerland
Information:
e-mail: wittum@iwr.uni-heidelberg.de

6–17 December: Mathematical Developments in Solid Mechanics and Materials, Cambridge, UK
Information:
URL: http://www.newton.cam.ac.uk/

14–18: International Conference on Analytic Methods of Analysis and Differential Equations (AMADE), Minsk, Belarus
Information: contact AMADE, Department of Mathematics and Mechanics, Belarusian State University, Fr. Skaryny Avenue 4, 220050 Minsk 50, Belarus
e-mail: amade99@im.bas-net or amade99@mmf.bsu.unibel.by
[For details, see EMS *Newsletter* 31]

15–19: GD'99 Seventh International Symposium on Graph Drawing, Prague, Czech Republic
Information:
e-mail: gd99@kam.ms.mff.cuni.cz
URL: http://www.ms.mff.cuni.cz/gd99/
[For details, see EMS *Newsletter* 31]

15–23: Advanced Course on Integral Geometry, Centre de Recerca Matemàtica
Speakers: R. Langevin (Dijon), *Introduction to integral geometry*; R. Schneider (Freiburg), *Integral geometry: measure theoretic approach and stochastic applications*
Information:
URL: *http://crm.es/info/acig/acig.html*

16–22: Fourth International Workshop on Differential Geometry and its Applications, Brasov, Romania
Information:
e-mail: riordan@stoilow.imar.ro, gh.pitis@info.unitbv.ro, danpapuc@info.uvt.ro or *dacu@science.sibiu.ro*
[For details, see EMS *Newsletter* 31]

20–23: EPSICODE '99: International Conference on Numerical Methods for Transport-Dominated and Related Problems, Castle of Wendgräben, near Magdeburg, Germany
Scope: discretization techniques: FDM, FEM, FVM, spectral methods, collocation methods; solution of the discrete algebraic problems: multigrid, domain decomposition, parallelization; analytical approaches: asymptotic expansions, Shishkin-type decompositions; error estimates and adaptive approaches; modelling and applications
Invited speakers: V. F. Butuzov (Moscow), C. Canuto (Torino), P. W. Hemker (Amsterdam), R. B. Kellogg (Maryland), G. Lube (Göttingen), R. Rannacher (Heidelberg), H.-G. Roos (Dresden), G. I. Shishkin (Ekaterinburg), E. Süli (Oxford), R. Verfürth (Bochum), P. Wesseling (Delft)
Organising committee: Lutz Tobiska (Magdeburg), Martin Stynes (Cork, Ireland), Lutz Angermann (Magdeburg), Volker John (Magdeburg)
Conference proceedings: to be published as a special issue of *Computing*; articles will be collected after the conference and reviewed in a standard way
Registration fee: DM 80
Accommodation fee: DM 140/165 for a double/single room per night (including full-board lodging)
Deadlines: abstracts and registration, past; submission of manuscripts, 26 November 1999
Information:
e-mail: EPSICODE99@mathematik.uni-magdeburg.de
URL: http://david.math.uni-magdeburg.de/ EPSICODE99

20–26: International Symposium on Classical Analysis, Kazimierz Dolny, Poland
Information: contact T. Mazur, Department of Mathematics, Technical University, Malczewskiego 29, 26–600 Radom, Poland;
fax: (+48)-48-26333 or (+48)-48-23969
e-mail: mazurt@kiux.man.radom.pl or krupa@alpha.sggw.waw.ps
[For details, see EMS *Newsletter* 31]

21–24: AIRO '99, Annual Conference of the Operational Research Society of Italy, Naples, Italy
Information:
URL: http://www.airo.org/airo99/

22–29: Operators on Banach spaces and Banach algebras, Mussomeli, Sicily, Italy
Scope: an instructional conference aimed at graduate students and younger colleagues, but open to anyone interested
Programme: three 7-lecture courses in English, tutorials, and written material
Lecturers: K. B. Laursen (Copenhagen) and P. Aiena (Palermo), *Local spectral theory*; J. Eschmeier (Saarbrucken), *Invariant subspaces*; H. G. Dales (Leeds), *Banach algebras and cohomology*
Organisers: Gianluigi Oliveri (Oxford), and H. G. Dales (Leeds)
Information:
e-mail: gianluigi.oliveri@wolfson.ox.ac.uk or pmt6hgd@leeds.ac.uk.
URL: http://www.wolfson.ox.ac.uk/operators/

October 1999

4–8: ParaOpt VI, 6th International Conference on Parametric Optimization and Related Topics, Dubrovnik, Croatia
Information:
URL: http://www.math.hr/dubrovnik/index.htm

5–9 Géométrie des équations diffeérentielles, Luminy, France
Scope: bifurcation theory of dynamical systems, Hilbert's 16th problem on limit cycles, finiteness properties of analytic families of functions, Bernstein inequality, centre-focus problem, Arnold-Hilbert problem on Abelian integrals, Abel equations and Pugh's problem, Lièнard equations
Organisers: J.-P. Francois (Paris), R. Roussarie (Dijon)
Site: C. I. R. M. (Centre International de Rencontres Mathématiques)
Information: contact J.-P. Francois, Equipe Géométrie différentielle, Systèmes dynamiques, applications, UFR 920, Mathématiques, B.C. 172, Tour 46, 5ème étage, Université P.-M. Curie, Paris VI 75252, Paris, France;
fax: (+33)-1-44275345
e-mail: jpf@ccr.jussieu.fr

6–9: New Trends in the Calculus of Variations, Lisbon, Portugal
Scope: calculus of variations, shape optimisation, non-convex problems, free discontinuity problems and other related areas
Programme committee: L. Mascarenhas and J. Matos (Lisbon)
Organisers: CMAF/UL and IST
Grants: some financial aid is available for selected students
Information: contact CMAF/Univ. Lisboa, Av. Prof. Gama Pinto 2, 1649-003 Lisboa, Portugal
e-mail: ntcv99@math.ist.utl.pt
URL: http://www.math.ist.utl.pt/~ntcv99/

November 1999

2–5: Workshop on Hilbert's 10th problem, relations to arithmetic and algebraic geometry
Theme: the relation between decidability problems, arithmetic and algebraic geometry
Aim: to bring together number theorists, algebraic geometers and logicians in order to provoke discussions and set directions for future research related to Hilbert's original question
Programme: selected lectures presenting recent results in the field, and three or four series of instructional lectures on topics from amongst the following: work on Hilbert's 10th problem, for various rings and fields, over the past decades; some model-theoretic aspects and related decidability problems, decidability for certain generic diophantine problems and for fragments of arithmetic; the algebraic geometric structure of Diophantine families, Mazur's conjectures on the topology of rational points; computational aspects, work of Rojas on (un)computability of bounds for integral points and the \exists\exists\forall\exists diophantine problem, complexity of diophantine geometry
Scientific committee: Jan Denef, Leonard Lipschitz, Thanases Pheidas, Jan Van Geel
Note: all who are interested are invited to apply, but the number of participants will be limited; an updated list of participants is available at the *URL* below
Information: contact Jan Van Geel or Karim Zahidi, University of Gent, Department of Pure Mathematics, Galglaan 2, B–9000 Gent, Belgium;
fax: (+32)-9-264-49-93
email: hilbrt10@cage.rug.ac.be
URL: http://cage.rug.ac.be/~hilbrt10/hilbert10.html

December 1999

20–22 Seventh IMA International Conference on Cryptography and Coding, Cirencester, UK
Theme: the future of coding and cryptography
Topics: all aspects of the theory and applications of cryptography and coding, including source coding, data compression, channel coding, error control coding, combined coding and modulation, coding for multiple-access, coding for multi-media, quantum coding, multi-functional coding, sequence design, cryptographic algorithms, public key cryptography, authentication, key management, data integrity, secure and reliable protocols, interaction between cryptography, coding and combinatorics
Confirmed speakers: S. Blake-Wilson (Canada), L. Knudsen (Norway), S. McGrath (Limerick), G. Zemor (France)
Organising committee: M. Walker (Chairman), M. Darnell (Leeds), P. G. Farrell (Lancaster), M. Ganley, J. Gordon, B. Honary (Lancaster), C. Mitchell (London), F. Piper (London)
Sponsors: Codes & Ciphers Limited, Concept Laboratories Limited, HW Communications Limited, Racal-Airtech Limited, Vodafone Limited, The Institution of Electrical Engineers
Proceedings: to be refereed and published
Site: Royal Agricultural College, Cirencester, UK
Deadlines: abstracts, 1 July 1999; full papers, 1 September 1999
Information:
e-mail: conferences@ima.org.uk
URL: http://www.ima.org.uk/mathematics/conferences.htm

January 2000

17–22: Workshop on Computational Stochastics, Aarhus, Denmark
Aim: computational stochastics is a new and expanding area of stochastics, dealing with computational methods of analysing complex mathematical and statistical models. The workshop intends to reveal and discuss the potential strength and impact of this new discipline in a variety of applications
Programme committee: Soren Asmussen (Lund), Eva B. Vedel Jensen (Aarhus)
Organisers: StocLab (Laboratory for Computational Stochastics) and MaPhySto (Centre for Mathematical Physics and Stochastics), University of Aarhus
Site: University of Aarhus
Deadlines: registration, 15 November 1999; submission of contributed papers, 1 October 1999
Information: contact Eva B. Vedel Jensen, Department of Mathematical Sciences, University of Aarhus, Ny Munkegade, DK–8000 Aarhus C, Denmark
e-mail: eva@imf.au.dk
URL: http://www.maphysto.dk/events/CompStoc2000/

June 2000

13-16 First AMS-Scandinavian International Mathematics Meeting, XXIII Scandinavian Congress of Mathematicians, Odense, Denmark
Organisers: AMS and IMADA, Odense University
Information: contact Hans J. Munkholm, Odense University, Campusvej 55, DK 5230 Odense M, Denmark,
tel: (+45)-655-72309 / (+45)-659-32691
e-mail: hjm@imada.ou.dk
URL: http://www.imada.ou.dk/~hjm/AMS.Scand.2000.html

July 2000

3–7: Functional Analysis Valencia 2000, Spain
[on the occasion of the 70th birthday of Professor Manuel Valdivia; satellite conference to the *Third European Congress of Mathematics* in Barcelona, 10–14 July]
Programme: about 15 invited plenary lectures on various topics in functional analysis; contributed 25-minute talks in parallel sessions
Programme committee: R. M. Aron (USA), K. D. Bierstedt (Paderborn), J. Bonet (Valencia), J. Cerdà (Barcelona), H. Jarchow (Zürich), M. Maestre (Valencia), J. Schmets (Liège)
Organisers: R. M. Aron (USA), K. D. Bierstedt (Paderborn), J. Bonet (Valencia), J. Cerdà (Barcelona), H. Jarchow (Zürich), M. Maestre (Valencia), J. Schmets (Liège)
Local organising committee: C. Fernàndez, A. Galbis, P. Galindo, D. Garcia, M. López Pellicer, V. Montesinos, A. Peris (all UPV or UV)
Sponsors: Technical University of Valencia (UPV), University of Valencia (UV).
Proceedings: to be published in the series *North-Holland Mathematical Studies*
Site: Technical University of Valencia, Spain
Information: contact: K. D. Bierstedt or J. Bonet, Univ. Paderborn, FB 17, Math., D-33095 Paderborn, Germany or Universidad Politècnica de Valencia, Departamento de Matemática Aplicada, E-46071 Valencia, Spain
e-mail: VLC2000@uni-paderborn.de
URL: http://math-www.uni-paderborn.de/VLC2000

10–14: Third European Congress of Mathematics, Barcelona, Spain
Theme: Shaping the 21st century
Organisers: Societat Catalana de Matemátiques, under the auspices of the European Mathematical Society
Information: contact Societat Catalana de Matemátiques, Carrer del Carme, 47, E-08001 Barcelona;
tel: (34 3) 270 16 26; fax (34 3) 270 11 80
e-mail: 3ecm@iec.es
URL: http://www.iec.es/3ecm/
[For details, including satellite conferences, see First Announcement in EMS *Newsletter* 31]

August 2000

21–25: IMACS 2000, Lausanne, Switzerland
[International Association for Mathematics and Computers World Congress]
Scope: scientific computation, applied mathematics and simulation
Scientific committee: R. Vichnevetsky (President, USA), J. Flaherty (USA), J. Butcher (New Zealand), R. Beauwens (Belgium), A. Iserles (Cambridge), N. Kuznetsov (Moscow), R. D. Russell (Canada)
Organisers: IMACS & EPFL
Site: EPFL, Lausanne, Switzerland
Deadlines: for proposals for the organised session, mini-symposia and keynote speakers, submit as soon as possible; for contributed papers, 15 September 1999
Information: contact Prof. Robert Owens, IMACS Congress 2000, DGM-IMHEF-LMF, Swiss Federal Institute of Technology, CH–1015 Lausanne, Switzerland;
tel: (+41)-21- 693-35-89;
fax: (+41)-21-693-36-46
e-mail: robert.owens@epfl.ch
URL: http://imacs2000.epfl.ch

Book Review

Prime case of numbers indivisible

Michael Atiyah

Mathematics without Borders: A History of the International Mathematical Union, *by Olli Lehto*

Springer, 399 pp, £26
ISBN 0-387-98358 9

"It makes me very happy that after a long hard time all of the mathematicians of the world are represented here. This is as it should be and as it must be for the prosperity of our beloved science ... It is a complete misunderstanding of our science to construct differences according to peoples and races, and the reasons for which this has been done are very shabby ones. Mathematics knows no races ... For mathematics, the whole cultural world is a single country." The speaker, who received a standing ovation for this forthright affirmation of the scientific ethos, was the great German mathematician David Hilbert. The occasion was the Eighth International Congress of Mathematicians at Bologna in 1928, the first postwar congress to which German mathematicians had been invited.

The tortuous politics behind this event and, more generally. the inter-relation between politics and science, is the main theme of this account by Olli Lehto of the history of the International Mathematical Union. It covers in essence the whole of the 20th century, and, by focusing on the role of key individuals, it brings to life what might otherwise be a dry academic study.

Formal international cooperation in mathematics started at the end of the 19th century and culminated in the First International Congress in Zurich in 1897. The major role of France and Germany was reflected in the fact that the second congress took place in Paris in 1900 and the third in Heidelberg in 1904. The Paris congress holds a special place in the history of mathematics because it was there that Hilbert set out his famous list of problems for the century – the possible repetition of which in the year 2000 both fascinates and intimidates the world community.

The world war of 1914-18 put an end to these four-yearly congresses, and its aftermath left a legacy of hostility that poisoned the air in political and scientific circles. The International Research Council, covering the whole of science and giving birth to specialised bodies such as the IMU. was set up in the immediate postwar years, and it specifically excluded Germany and its allies. The IMU and the closely associated international congresses were equally affected, and this continued for a whole decade.

The main opposition to German mathematicians came, as might he expected, from France. A country where intellectuals feature prominently in public life was inevitably going to find it more difficult to disentangle politics from science. It is remarkable how many eminent French mathematicians of the period also held high public office. Paul Painlevé was prime minister, Emile Borel minister for the navy, Raymond Poincaré (cousin of the mathematician Henri Poincaré) was president of the republic. The dominant figure, and the most hostile to German mathematicians, was Emile Picard. He was president of the International Research Council from 1919 to 1931, honorary president of the IMU (1929-32) and permanent secretary of the French Academy of Sciences from 1916.

The French position did not go unopposed, particularly in Britain, the United States and Scandinavia. G. H. Hardy, the leading British mathematician, was an early and outspoken opponent, as might have been expected from a staunch supporter of Bertrand Russell's pacifist stand and his subsequent troubles with Trinity College, Cambridge. The Americans, who were becoming increasingly important, had little sympathy with the French attitude. Eventually Picard had to concede defeat, and the Bologna Congress, presided over by Salvatore Pincherle, was the turning point. The IMU itself, as opposed to the congress, was not so fortunate. Its internal politics led to its demise in 1932, despite heroic efforts by its last president, the British mathematician William Henry Young.

The lessons of history are sometimes heeded. The political mistakes of 1918 were not repeated in 1945. Germany was not ostracised, and this applied also in the scientific sphere. The US was now the dominant power, and American mathematicians under Marshall Stone took the lead in organising the postwar congress at Harvard in 1950 and in setting up a new IMU. The statutes of the IMU were clear and explicit: no country was barred. Even in France, attitudes in 1945 were different from 1918. The leading French mathematician Henri Cartan (a future president of IMU), whose family had suffered grievously in the war, was one of the first to visit Germany to meet and assist his mathematical colleagues.

If the French-German problem had been resolved, the second half of the 20th century saw other political divisions, and the IMU had to struggle with these. For many years Russia proved a difficult partner. This was particularly unfortunate because Russia had a great and continuing mathematical tradition. In the early days post-1945 few Russians were allowed abroad to attend conferences and those who went were carefully selected by the political hierarchy.

Germany's East/West division also caused problems, as did the question of China and Taiwan. These mirrored similar problems at the United Nations. One might have thought that scientists could solve their problems of cooperation more easily than the politicians. For mathematicians, at least, the opposite was usually the case. The China/Taiwan issue is instructive. At the UN, realpolitik eventually won the day, but the IMU had the luxury of moral scruples. Although its statutes had been carefully drafted so as not to refer to nation states, it took nearly 30 years to devise a formula acceptable to the IMU, China and Taiwan. The combination of mathematical precision and oriental subtlety was a hard nut to crack.

A unique difficulty faced the IMU at the time of the planned Warsaw congress of 1982. Martial law had been declared and the country was in turmoil. Many in the West felt that the congress should be cancelled as a political protest. But the Polish mathematicians who had worked so hard in preparation, and who were not responsible for the actions of the communist government, were understandably keen to hold the congress. Eventually it was decided to postpone the congress by one year. It was successfully held in 1983, by which time the political situation was improving.

There are those who believe, honestly but perhaps naively, that science should and can be insulated from international politics. In reality this is not always easy, and genuine ethical dilemmas occur. For instance the Japanese were planning to host the 1990 congress at a time when UN sanctions against South Africa might have prevented South African mathematicians from attending. The problem was solved, with honour on all sides, but it was a close call.

Lehto, as secretary of the IMU for seven years and as organiser of the Helsinki congress in 1978, has recorded an eventful century of international mathematical organisation and has enlightened the official records with sensitive accounts of what went on behind the scenes. While primarily addressed to the mathematical community, who will be familiar with the main actors, the hook should attract a wider audience interested in the way in which politics and science interact.

This review first appeared in the Times Higher Educational Supplement, 12 March 1999, and is reprinted with permission.

Sir Michael Atiyah, OM, was formerly Master, Trinity College, Cambridge.

Recent books

edited by Ivan Netuka and Vladimír Souèek

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

Y. Abramovich, E. Avgerinos and N. C. Yannelis, eds., ***Functional Analysis and Economic Theory****, Springer, Berlin, 1998, 296 pp., DM 149, ISBN 3-540-64495-4*
In July of 1996, a conference on non-linear analysis and its applications in engineering and economics was held in Greece on the occasion of the birthday of Ch. Aliprantis. This book contains contributions in both mathematics and economics. In the first part, there are mathematical papers concerning disjointness-preserving operators, positive isotropic random vectors, a topological approach to fuzzy measures, the ranges of additive correspondences, a characterisation of the behaviour of backward minimal vectors, non-linear orthomorphisms and central operators, finitely generated vector sublattices, the second dual of the space of all compact operators on a Banach space, topological transitivity and recurrence, regular and order bounded operators. The second part contains seven papers in economics. (jl)

G. E. Andrews, ***The Theory of Partitions****, Cambridge Mathematical Library, Cambridge University Press, Cambridge, 1998, 255 pp., £19.95, ISBN 0-521-63766-X*
This is a paperback edition of the 1976 classical treatise on the theory of number partitions, a topic lying on the borderline between number theory and combinatorics that was founded by Euler and cultivated by Ramanujan, Hardy and many others. Its content is characterised best by the titles of the chapters: the elementary theory of partitions, infinite series generating functions, restricted partitions and permutations, compositions and Simon Newcomb's problem, the Hardy-Ramanujan-Rademacher expansion of $p(n)$, the asymptotics of infinite-product generating functions, identities of the Rogers-Ramanujan type, a general theory of partition identities, sieve methods related to partitions, congruence properties of partition functions, higher-dimensional partitions, vector and multipartite partitions, partitions in combinatorics, and computations for partitions.
Almost all of these areas have seen new discoveries and developments in the last twenty years. To identify some of them, the author has added an introduction and a list of recent references (each chapter has its own list of references). There is no doubt that this book will continue to serve as a basic and indispensable source of information for everyone interested in this fascinating subject. (jnes)

N. K. Artémiadis and N. K. Stephanidis (eds.), ***Proceedings of the 4th International Congress of Geometry, Thessaloniki 1996,*** *Aristotle University of Thessaloniki, Thessaloniki, 1997, 440 pp., ISBN 9-607-42511-1*
This book contains the proceedings of the 4th International Congress of Geometry held in May 1996 at Thessaloniki, Greece. It includes versions of the six invited plenary lectures, together with fifty contributions to the programme of the congress. The topics of the plenary lectures (by N. K. Artémiadis, W. Benz, P. M. Gruber, N. Kapoileas, R. Osserman and I. R. Shafarevic) were taken from hyperbolic geometry, convex geometry, minimal surface theory and the theory of algebraic varieties. Individual contributions cover a broad spectrum of geometrical problems taken from different areas of geometry. Some of the contributions are written in German and French. (vs)

M. Artin, ***Algebra****, Birkhäuser Advanced Texts. Basler Lehrbücher, Birkhäuser, Basel, 1998, 705 pp., DM 88, ISBN 3-764-32927-0*
This is a reprint of the 1993 German translation of the original English version (1991). The book is a systematic treatment of classical parts of algebra (matrices, groups, vector spaces, linear mappings, bilinear forms, representations of groups, rings, modules, fields, and Galois theory). These parts and some others (such as the axioms of Peano or solutions to the exercises), and especially the manner of the exposition, give a special flavour to the text, making it a very popular and favourite textbook. Moreover, some years ago, I had the pleasure of listening to a lecture of Professor Artin in Paris. Comparing my impressions of the lecture and the book, I have the feeling that both book and lecture were made with the same vivid colours streaming from the complex personality of the author. (lbe)

R. A. Bailey (ed.), ***Surveys in Combinatorics, 1997,*** *London Mathematical Society Lecture Note Series* ***241****, Cambridge University Press, Cambridge, 1997, 338 pp., £24.95, ISBN 0-521-59840-0*
This book presents the proceedings of a British Combinatorial Conference. It contains nine contributions that cover some of the main advances in contemporary combinatorics: J. H. Conway, M_{13} (this includes a new construction of this Mathieu group), K. Edwards, *The harmonious chromatic number and the achromatic number*, C. Lam, *Computer construction of block designs*, C. E. Praeger, *Finite quasiprimitive graphs*, B. A. Reed, *Tree width and tangles: a new connectivity measure and some applications* (this is one of the best introductions to Robertson-Seymour-Thomas theory), A. Schrijver, *Minor-monotone graph invariants* (centred about Colin de Verdier variations, as developed by Lovász, Schrijver and his students), T. Szönyi, *Some applications of algebraic curves in finite geometry and combinatorics*, W. T. Trotter, *New perspectives on interval orders and interval graphs*, and D. Welsh, *Approximate counting*. Each article is of substantial length and presents useful information and a collection of problems directed not only at specialists. Congratulations to the editor and organisers for the meeting and its proceedings. (jnes)

A. Belleni-Morante and A. C. McBride, ***Applied Nonlinear Semigroups****, Mathematical Methods in Practice, John Wiley & Sons, Ltd., Chichester, 1998, 273 pp., £50, ISBN 0-471-97867-1*
The aim of this book is to introduce to a non-expert the method of solving abstract Cauchy problems (ACP) via (linear and non-linear) semigroup theory. It can serve to students as a first introduction to the theory. The prerequisities needed are just a basic knowledge of real analysis and vector spaces; any necessary functional analysis and Lebesgue integration is summarised in the book. Chapters 2-5 present the theory of strongly continuous semigroups of linear operators and its relation to strong solutions of ACPs, mild solutions of semilinear ACPs, dissipative and m-dissipative (non-linear) operators and semigroups of contractions generated by them, relations to strong solutions, perturbations and weak solutions. Included are a number of examples. The last chapter (34 pages) contains three (more sophisticated) equations that model particle transport (a semilinear inhomogeneous problem, mild solution), the diffusion of a contaminant (an affine operator describing inhomogeneous boundary conditions, strong solution), and the combustion of a solid fuel (m-dissipative operator, strong solution).

Each chapter is accompanied by a list of exercises (hints are added to more difficult ones). Some of the fundamental theorems (such as Hille-Yosida) are stated without proof but with references; nevertheless, all proofs in the book are worked out in detail. The book contains one page of references. (ef)

K. Bichteler, ***Integration – A Functional Approach****, Birkhäuser Advanced Texts, Birkhäuser, Basel, 1998, 193 pp., DM 78, ISBN 3-7643-5936-6, ISBN 3-8176-5936-6*
This book presents Lebesgue integration theory based on a modified Daniell's approach. The first chapter is devoted to a review of basic notions, such as the Riemann integral and the theorem of Stone-Weierstrass. The theory starts in Chapters 2 and 3 with an elementary integral (a linear map defined on a lattice ring of bounded functions on some set). Using a Daniell mean seminorm, this elementary integral has a straightforward extension to the extended integral. The notion of measurability is then motivated by Littlewood's principles. The fourth chapter contains the study of classical Banach L_p-spaces and the last chapter deals with products and images of measures, signed measures, dis-

tributions of measurable functions and maps, convolution and interpolation. The text includes exercises and an appendix where answers and hints to the majority of them can be found.

This book is intended for beginning graduate students with a basic knowledge of real analysis. It might also be useful to advanced mathematicians and everybody who wish to become acquainted with this approach to the theory of the Lebesgue integral. (jl)

R. Bix, *Conics and Cubics*, *Undergraduate Texts in Mathematics, Springer, New York, 1998, 289 pp., DM 98, ISBN 0-387-98401-1*
This is an elementary textbook containing the theory of real conics and cubics in the real projective plane. It is addressed mainly at prospective and current teachers at secondary schools. Each chapter begins with historical remarks on the topics it contains and a discussion of related geometrical problems. For a study of real conics and cubics, the author uses homogeneous coordinates and applies the Bezout theorem to intersections of curves. Some classical results, such as Pascal's theorem and the dual correspondence introducing envelopes of conics, are presented. An interesting part of the book is the theory of cubics, giving most known results. (jbu)

S. D. Chatterji, *Cours d'Analyse*, *Vol. 3, Equations différentielles ordinaires et aux dérivés partielles, Presses Polytechniques et Universitaires Romandes, Lausanne, 1998, 755 pp., sFr 108, ISBN 2-880-74350-8*
This third volume of the *Cours d'Analyse* gives a detailed introduction to ordinary and partial differential equations, as well as to other parts of analysis useful in physics. It arose from a course delivered by the author for 'future ingénieurs, mathématiciens et physiciens' at the Ecole polytechnique fédérale de Lausanne.

In 160 pages, the fundamentals of ordinary differential equations are presented (the general existence and uniqueness theorems and linear equations). About 400 pages are then devoted to Hilbert space theory, orthogonal expansions, and operators on Hilbert spaces, including unbounded operators, spectral theory, language of quantum mechanics, Fourier and Laplace transforms and distributions. The last part (about 170 pages) deals with partial differential equations. Physical motivation is given and basic problems for elliptic, parabolic and hyperbolic equations are studied. Harmonic function theory, the Dirichlet problem and eigenvalues of laplacians are also treated in detail, and special chapters treat the heat equation and the wave equation. There are plenty of well-chosen exercises, mainly of a computational character. Historical comments and bibliographical remarks form another nice feature of the book.

The three volumes of *Cours d'Analyse* represent an important addition to the existing textbooks on mathematical analysis and will be appreciated by students of mathematics and physics, as well as university teachers interested in mathematical analysis. (in)

D. M. Clark and B. A. Davey, *Natural Dualities for the Working Algebraist*, *Cambridge Studies in Advanced Mathematics 57, Cambridge University Press, Cambridge, 1998, 356 pp., £40, ISBN 0-521-45415-8*
The natural dualities between the concrete categories K and H are created by a 'schizophrenic object', an object carrying two structures, the first making it an object of K and the second an object of H – for example, the two-point Boolean algebra and the two-point Boolean space in the case of Stone duality, or the two-point distributive lattice and the two-point Priestley space in the case of Priestley duality. In the monograph, only natural dualities with *finite* schizophrenic objects are examined; Pontryagin duality remains beyond the scope of the monograph, although its restricted variant is mentioned.

The authors present a general theory which, besides its beauty, is of use when examining varieties and quasivarieties of universal algebra determined (by means of products, subalgebras and isomorphic copies) by a *finite* universal algebra M. They create a category of structured Boolean spaces – the category obtained by non-empty powers and closed subobjects of the underlying set of M, endowed with the discrete topology and some additional structure consisting of operations (total and partial) and relations; M is then a schizophrenic object of these two categories. In this approach, the first category, the quasivariety of universal algebras and their homomorphisms, is the centre of interest, and the second category, the category of the structured Boolean spaces, is created in order to get dualities with 'nice properties'. In the 'dual category' of the structured Boolean spaces, it is often easier to solve some problems that are of interest in the original category. The authors show the fruitfulness of this idea in some examples.

The theory itself offers nice and sophisticated procedures on how to create an additional structure on the discrete space on the underlying set of a given finite algebra M to get a nice connection between the corresponding categories. Starting from 'pre-dualities' which can *always* be obtained by laying *all* the algebraic relations on the discrete space, the authors present some necessary and/or sufficient conditions to improve it and to diminish the number of operations and relations in the additional structure of the Boolean spaces without destroying an already existing duality, and obstacles for these procedures for some finite algebras M. Nice dualities are obtained for the varieties of Heyting algebras, Kleene algebras, De Morgan algebras, Stone algebras, Post algebras, proper subvarieties of the variety of Abelian groups, and many others.

Although this monograph is very comprehensive, it is written in a readable clear style and can be recommended to researchers and to students of advanced courses. (vt)

P. A. Clarkson and F. W. Nijhoff (eds.), *Symmetries and Integrability of Difference Equations*, *London Mathematical Society, Lecture Note Series **255**, Cambridge University Press, Cambridge, 1999, 424 pp., £27.95, ISBN 0-521-59699-8*
This volume is based on lectures presented at the second international conference on symmetries and integrability of difference equations (SIDE II) at the University of Kent at Canterbury in July 1996. It contains 33 articles and a list of conference participants.

The contributions cover the following topics: special functions and difference equations (discrete Painlevé equations, difference– and q-difference orthogonal polynomials, separation of variables), algebraic aspects (quantum algebras and representation theory, associated special functions), computational and numerical aspects (formal theory of orthogonal polynomials, soliton cellular automata, symplectic and volume-preserving integrators, integrable versus non-integrable discretisations in computation), symmetry aspects (symmetries of difference equations, similarly reductions, integration techniques through symmetries), analytic aspects (analysis of difference equations, isomonodromic deformation theory for discrete systems, asymptotics of orthogonal polynomials), geometry (discrete curves and surfaces, connections with discrete soliton systems, visualisation techniques) and applications (neural networks, coding theory and cryptology, data compression, mathematical biology and economics, integrable algorithms). All these subjects are highly interconnected.

The contributions are written in such a way as to give a brief overview of the state of the art whilst reporting some original research in the subject area. The reviewer is convinced that this book will form an inspiration for further research and so help to establish the links between the various communities working on discrete systems. (kn)

G. A. Edgar, *Integral, Probability, and Fractal Measures*, *Springer, New York, 1998, 286 pp., 36 fig., DM 69, ISBN 0-387-98205-1*
This book is a loose continuation of the author's text *Measure, Topology, and Fractal Geometry*.

The first chapter summarises basic facts from measure theory, with an emphasis on outer measures. Hausdorff and packing measures are studied in detail and various notions of dimension are introduced. Also, local fractal measures are considered and the geometry of fractals is investigated, frequently using suitable densities.

The second chapter discusses the theory of integration. The approach to the integral of a non-negative function with respect to a measure is based on the idea of the 'area' under the graph (formally introduced, of course, by means of a product of the measure in question and one-dimensional Lebesgue measure). The integration theory developed covers the standard material on the abstract Lebesgue integral as well as Radon-Nikodym derivatives, the Riesz Representative Theorem, narrow

convergence of measures, and properties of the space of Borel probability measure on a metric space.

Chapter 3 deals with topological and fractal dimension, the M. Riesz capacity approach to fractal dimension, fractal measure, pointwise dimension, iterated function systems, self-affine graphs and self-similar measures.

The next chapter is an introduction to probability theory (including the law of large numbers) needed in the final chapter on probability and fractals. The chaos game is described and the dimension of self-similar measures is investigated. Special attention is paid to random Cantor sets, and further statistical self-similarity and statistically self-affine graphs are discussed. The dimension of paths of Brownian motion is evaluated and a multifractal decomposition is briefly mentioned.

Each chapter is accompanied by a 'Remarks' section with further relevant information and bibliographical indications (there are 273 references). This book is recommended for anybody who wants to learn the mathematics of fractals. (in)

P. Engel and H. Syta (eds.), ***Voronoï's Impact on Modern Science I, II,*** *Proceedings of the Institute of Mathematics* ***21****, Institute of Mathematics, Acad. Sci. Ukraine, Kyiv, 1998, 274 pp. and 225 pp., US$50, ISBN 966-02-0643-7 and 966-02-0644-5*

G. Voronoï is one of the most cited mathematicians. These volumes are the proceedings of the second conference devoted to the various aspects of mathematical work of G.Voronoï. The conference was held in Kyiv in 1998 (the first one was held in 1993).

The first volume consists of two parts. The first (historical) part contains two mathematically oriented contributions: a description of the mathematical contributions of Voronoï during his Warsaw period (1894-1908) and the connections between Voronoï's summation formula and the geometry of quasicrystals. The remaining contributions of this part are formed by a short (14 pp.) illustrated biography of Voronoï. Of interest are fragments of Voronoï's diary, in its Russian original and an English translation. The second part, entitled *Development of Voronoï's research in modern mathematics*, contains surveys on various aspects of such classical results as Voronoï's congruence on Bernoulli numbers and its summation formula in analytic number theory.

The second volume also has two parts. The first part, entitled *Investigations in parallelohedra and Voronoï domains*, contains ten contributions in these areas. The last part, *Applications in the natural sciences*, includes contributions on application of Voronoï's tessellation to detect a crystalline nucleus in the analysis of computer simulation of crystallization process, on computational porosimetry, on Voronoï's polyhedron analyses for characterizing the local environments of atoms in the supercooled metal liquids and glasses, a geometrical method of analysis of the statistical ensembles of the trapping sites for electrons in disordered media, or on curve detection in 3D dot patterns using Voronoï neighbourhoods.

The proceedings will be certainly useful for mathematicians in pure or applied mathematics, or with orientations towards computer science (as computer graphics, image recognition, artificial intelligence), physics, biology, astronomy, geography, molecular biology, radiation physics, cosmology, chemical engineering or physical chemistry. It can also be recommended to post-doctoral students with the above interests. (spor)

A. Facchini, ***Module Theory****, Progress in Mathematics* ***167****, Birkhäuser, Basel, 1998, 285 pp., DM 138, ISBN 3-7643-5908-0 and 0-8176-5908-0*

The main result of the book is a presentation of a negative answer to the Krull and Warfield problems, that the Krull-Schmidt Theorem does not hold for finite direct sums of artinian and uniserial modules. On the other hand, a weaker form of the Krull-Schmidt Theorem for finite sums of biuniform modules is proved. This applies to uniserial modules, since each uniserial module is biuniform. In general, finitely generated serial modules are determined, not up to one permutation of isomorphic summands, but up to two permutations of monogeny and epigeny equivalent summands. Moreover, the author presents certain results for the case of infinite direct sums of uniserial modules.

The author gives his attention to the class of serial rings, especially to the subclass of serial rings that have Krull dimension. He presents a detailed description of quotient rings of serial rings and he studies also the class of serial rings that are isomorphic to endomorphism rings of artinian modules.

This book is written in an attractive and fresh mathematical style. Each topic is arranged well and lucidly. The author has made important contributions to the study of direct sum decompositions and many of the main results in this book include his own work. (jze)

H. Fetter and B. Gamboa de Buen, ***The James Forest****, London Mathematical Society Lecture Note Series* ***236****, Cambridge University Press, Cambridge, 1997, 255 pp., £27.95, ISBN 0-521-58760-3*

The *James space* J consists of all sequences of real numbers $\mathbf{x} = \{a_i\}$ for which $\|\mathbf{x}\| = \sup 1/\sqrt{2}\left|(a_{p_1} - a_{p_2})^2 + (a_{p_1} - a_{p_3})^2 + \ldots + (a_{p_{m-1}} - a_{p_m})^2 + (a_{p_m} - a_{p_1})^2\right|^{1/2} < \infty$ with $\lim a_n = 0$, where the supremum is taken over all choices of m and $p_1 < p_2 < \ldots < p_m$. The *James tree space* JT is then obtained from the space J by replacing the index set (the integers) by an infinite tree. Both spaces are very important in Banach space theory, separable and non-separable, linear and non-linear. For example, J is non-reflexive, J^{**} is isometric to J, the codimension of J in J^{**} is 1, and $J \times J$ is not isomorphic to J. The space JT is a separable Banach space with non-separable dual, such that JT contains no isomorphic copy of l_1.

The book contains a comprehensive study on the classical, as well as on some recently discovered, properties of these spaces – for example, the results on complemented subspaces of the space J, the result on dentability in JT^*, the results on fixed points, isometries, etc. The presentation makes the text accessible to graduate students, and the text is a good reference book for researchers in Banach spaces and related fields. (vz)

R. Friedman, ***Algebraic Surfaces and Holomorphic Vector Bundles****, Universitext, Springer, New York, 1998, 328 pp., DM 88, ISBN 0-387-98361-9*

This book presents a comprehensive and contemporary overview of the theory of complex surfaces and vector bundles on them. Complex surfaces can also be considered as interesting examples of 4-dimensional real manifolds, important in mathematical physics. Their theory has also been intensively developed in recent years, in connection with the Donaldson theory and the Seiberg-Witten theory.

In the first part, a brief and nice introduction to the theory of algebraic surfaces is given, including curves on surfaces, coherent sheaves and the birational geometry of surfaces.

The stability of bundles and their elementary properties are studied in the next part. Ruled and elliptic surfaces are studied in detail, and vector bundles and their geometrical properties are described. Special attention is paid to the structure of moduli space of bundles on a surface and their local and global properties. For ruled surfaces and elliptic surfaces X, it is possible to present the given surface as a fibration over a base curve. Such a fibration allows us to study bundles over X by studying their restriction to fibres of the fibration. In particular, a description of the singular fibres of this fibration and a classification of stable bundles on them are used for understanding stable rank 2 vector bundles over elliptic surfaces.

Results from the earlier parts of the book are used for an alternative proof of Bogomolov's inequality for stable bundles and also for a discussion of the classification of algebraic surfaces using moduli spaces of stable bundles.

Each chapter ends with a number of exercises containing further results of the theory. The book can be recommended to everybody interested in the topic. (jbu)

M. Giaquinta, G. Modica and J. Soucek, ***Cartesian Currents in the Calculus of Variations: I, Cartesian Currents, II, Variational Integrals,*** *Ergebnisse der Mathematik und ihrer Grenzgebiete, A Series of Modern Surveys in Mathematics, Vols. 37/38, Springer, Berlin, 1998, 711 and 697 pp., DM 229 each volume, ISBN 3-540-64009-6 and 3-540-64010-X*

Any graph of a smooth function $u: \Omega \to R^N$, where Ω is an open subset of R^n, is an n-dimensional surface in $R^n \times R^N$ which can be endowed with a natural orientation. The oriented graph induces an n-dimensional current in $R^n \times R^N$ which we identify with the graph. Limit currents of smooth

graphs are currents in the 'weak closure' of smooth graphs. A list of basic properties of limit currents is used to define Cartesian currents. The spaces of Cartesian currents in the calculus of variations lead us to hope that they may serve when the usual function spaces are not effective enough. The authors devoted about ten years of their intensive and systematic research to develop the theory of Cartesian currents. This book contains the result of their investigations, as well as all the background needed and many related topics.

The monograph is divided into two thick volumes. The first volume contains a self-contained introduction to geometric measure theory, starting from general measure theory and including the topics of area and co-area, fine properties of $W^{1,p}$-functions, BV spaces and sets of finite perimeter, general and integer multiplicity rectifiable currents, deformation and closure theorems, degree theory, and continuity of gradient minors and their approximation properties. The main aim of the volume is to study the class of Cartesian currents. Deep closure, compactness and structure theorems are established, and particular interest is paid to Cartesian currents between manifolds, which naturally carry induced homology and cohomology maps. Among the main topics let us mention flat chains, the Hodge-Kodaira-Morrey decomposition theorem, Poincaré-Lefschetz and de Rham dualities, intersection and indices.

In the second volume, the theory of Cartesian currents is applied to problems in the calculus of variations. Minimisation of the energy functional in non-linear (finite) elasticity leads to investigation of polyconvex and quasiconvex integrands. Existence theorems for minimisers are obtained in the classes of weak diffeomorphisms. These are Cartesian currents which are 'well invertible' in the class of Cartesian currents. The spaces of weak diffeomorphisms are also studied as topics of independent interest. Minimisation of the Dirichlet integral among functions with values in manifolds leads to (weakly) harmonic maps; some results are specific to the sphere-valued maps. The energy functional of liquid crystals is investigated with the Oseen-Frank density. The minimal surface problem is studied with an emphasis on the non-parametric problem – that is, minimisation among 'graphs'.

These volumes represent a comprehensive treatment of an important direction in modern calculus of variations. Updated systematic presentation of a large part of geometric measure theory is also valuable. Some parts are of particular interest to specialists in Sobolev spaces, BV-spaces and applied real analysis. The book is indispensable for mathematicians in the field and for mathematical libraries. (jama)

C. G. Gibson, *Elementary Geometry of Algebraic Curves. An Undergraduate Introduction*, *Cambridge University Press, Cambridge, 1998, 250 pp., £15.95, ISBN 0-521-64140-3 and 0-521-64641-3*

This textbook is an elementary introduction to geometry of plane algebraic curves. It is designed as a first text for undergraduates in mathematics, as well as a text for postgraduate students in engineering and physical sciences. The material contained is standard, the only exception being that real curves are studied first (for motivation) and an extension of the theory to the case of a general follows later. There is also a section that shows the relation between the theory of algebraic curves and planar kinematics (e.g., special planar motions). Only a small part of the book is devoted to general polynomial algebra theory.

The theory of affine conics, especially the affine classification and their affine invariants, is studied in more detail. For a general affine curve of arbitrary order, tangents at a point, the multiplicity of the point and intersection numbers for the pair of curves are defined and discussed. In relation to rational curves, Diophantine equations are mentioned. This enables the author to present some applications of algebraic geometry in number theory.

In the second part, a natural extension of the theory to projective algebraic curves is given. All standard questions (properties of singularities, tangents and intersection numbers) are also discussed for projective curves. One of the global results, Bezout's theorem for curves in complex projective plane, is presented. Some special types of complex projective algebraic curves are mentioned – for example, cubics together with their natural group structure. There are many examples illustrating the theory and many exercises at the end of each chapter. (jbu)

M. Grey, M. Mezzino and M. A. Pinsky, *Introduction to Ordinary Differential Equations with Mathematica. An Integrated Multimedia Approach*, *The Electronic Library of Science, Springer-Verlag, New York, 1997, 890 pp., DM 128, ISBN 0-387-94481-8*

This book deals with traditional methods of solving ordinary differential equations. Its advantage is that it includes an introduction to the software package *Mathematica* which is used here to avoid routine and time-consuming calculations. The book is not only a guide to solving ODEs, but the theory of ODEs is followed by many examples. *Mathematica* can be used without extra knowledge – all the reader needs is found in the book.

The book is divided into 21 chapters and two appendices. These chapters discuss first-order differential equations (existence and uniqueness of solution), second-order linear differential equations, in particular with constant coefficients, numerical solutions of differential equations, the Laplace transform, systems of linear differential equations, the stability of non-linear systems, Frobenius and power series solution of second-order equations, and applications of ODEs.

This book is suitable for students specialising in mathematics and other disciplines. As a bonus, the reader gets a 'Multimedia resource kit for Introduction to ODE with *Mathematica*' on CD-ROM. (mb)

K. Grove and P. Petersen (eds.), *Comparison Geometry*, *Mathematical Sciences Research Institute Publications* ***30**, Cambridge University Press, Cambridge, 1997, 262 pp., £30, ISBN 0-521-59222-4**

This volume is a beautiful, comprehensive and up-to-date collection of expository and research articles, written by leading experts in the field. The survey articles are written by U. Abresch, W. T. Meyer (*Injectivity radius estimates and sphere theorems*), M. T. Anderson (*Scalar curvature and geometrization conjecture for 3-manifolds*), T. H. Colding (*Aspects of Ricci curvature*), R. E. Greene (*A genealogy of noncompact manifolds of nonpositive curvature*), Y. Otsu (*Differential geometric aspects of Alexandrov spaces*), P. Petersen (*Convergence theorems in Riemannian geometry*) and S. Zhu (*The comparison geometry of Ricci curvature*). The research articles are witten by G. Perelman and A. Petrunin. (ok)

H.-C. Hege and K.Polthier, *Visualization and Mathematics. Experiments, Simulations and Environments*, *Springer-Verlag, Berlin, 1997, 386 pp., 230 fig., DM 138, ISBN 3-540-61269-6*

This book is a collection of contributions which were presented at the international workshop 'Visualization and Mathematics', held in June 1995 in Berlin. The aim of the workshop was to show how mathematics is important and helpful for visualisation and computer graphics, and *vice versa*. The book contains several parts that cover main topics of current research interest in this area: visualising mathematics, geometric algorithms and experiments, visualisation algorithms and data structures, visualisation environments, and visualization and simulation techniques. This book gives a very nice and interesting overview on this interdisciplinary area, and it is recommended to everybody. (ml)

P. C. Hemmer, H. Holden and S. K. Ratkje (eds.), *The Collected Works of Lars Onsager (with commentary)*, *World Scientific Series in 20th Century Physics* ***17**, World Scientific, Singapore, 1996, 1075 pp., GBP 68, ISBN 9-810-22563-3, ISBN 9-810-22718-3**

This is a complete edition of papers, short communications, and printed discussion remarks (from conferences, etc.) by Lars Onsager, a physicist about whom Lev D. Landau said that "while the work of other theorists of his (Landau) generation presented no real challenge to him, he could not envisage himself accomplishing Onsager's solution of the Ising model".

The book starts with a bibliographical memoir by H. Christopher Longuet-Higgins and M. E. Fisher, followed by autobiographical commentary and the Nobel Lecture by Lars Onsager (*The motion of ions; principles and concepts*). The rest of the book is divided into sections reflecting various scientific interests of Onsager. Each section is accompanied by a commentary written by a leading present specialist in the field.

The sections of the book are: irreversible processes (commentary by P. Mazur), the Ising model (commentary by C. Domb and C. N. Yang), electrolytes (commentary by W. Ebeling and J.-C. Justice), electrons in metal (commentary by A. B. Pipard), colloids (H. N. W. Lekkerkerker and T. Odijk), dielectrics (G. Stell), helium II and vortex quantization (R. J. Donelly), off-diagonal long range order and flux quantization (P. W. Anderson), turbulence (A. Chorin), ion recombination (G. Weiss), fluctuation theory (H. MacKean), ice and water (J. F. Nagle), biology (J. F. Nagle), and Mathieu functions – L. Onsager's thesis (R. Askey). Three of the articles appear in German, and the rest are in English (or an English translation of the original text).

The variety of subjects covered by the book is really impressive, and most of the articles represent a seminal contribution of the author to the corresponding field of physics. They are still extremely relevant for the contemporary researchers working in these fields. (mz)

J. Hilgert, J. D. Lawson, K.-H. Neeb and E. B. Vinberg (eds.), ***Positivity in Lie Theory: Open Problems****, de Gruyter Expositions in Mathematics* ***26****, Walter de Gruyter, Berlin, 1998, 290 pp., DM 258, ISBN 3-11-016112-5*

This series of 15 papers is based on the conference 'Positivity in Lie theory', which was held in December 1996 at the Mathematical Research Institute in Oberwolfach. This conference was a meeting of mathematicians working in various branches of mathematics but applying similar ideas – namely, the ideas of distinguishing positive elements. The papers presented in this collection are divided into four overlapping groups: harmonic analysis, representation theory, control theory, and a fourth group of various topics such as probability theory and algebraic semigroups. The main aim of this collection is to present a a compact text introducing contemporary research in fields where positivity methods are applied. All articles are organised so as to introduce the main definitions, give the necessary references, and present open problems. We agree with the editors that 'the level of presentation is chosen in such a way that a graduate student with a sound knowledge of basic Lie theory should be able to grasp the gist of the problem'. In order to present information about new developments, they have set up a website: *http://lie.math.tu-clausthal.de/\~{}Hilbert/Problembook.*

In general, all the articles in this collection are carefully and clearly written, and the results presented are very attractive. I can imagine that many mathematicians will read at least one article from this interesting collection. (jiva)

K. H. Hofmann and S. A. Morris, ***The Structure of Compact Groups****, de Gruyter Studies in Mathematics* ***25****, Walter de Gruyter, Berlin, 1998, 835 pp., DM 278, ISBN 3-11-015268-1*

This is, from several points of view, a very impressive book which aspires to become an important monograph, a reference book as well as a textbook for more advanced students. 615 pages of the main text, plus 220 pages devoted to four appendices (the index takes 37 pages), show the extent of the material that the book covers. Further, it is clear from the organisation of the book that the authors have much experience in presenting the subject. They have found ways of making a reader quickly familiar with parts of the theory, without requiring a lot of preliminaries. This will doubtless stimulate further, more difficult, readings in the book. There are many interesting examples and exercises (with hints if necessary) which will substantially improve the knowledge of a reader and which make the text more attractive.

At the beginning of each chapter the reader is told which prerequisites are needed and where to find them, and at the end there are references for additional reading. The authors have included many remarks, comments, and postscripts at the end of each chapter to clarify the main text, and have tried to make the book as self-contained as possible. For this purpose they have included appendices on abelian groups, covering spaces and groups, a primer of category theory, and selected results in topology and topological groups.

The book deals with compact topological groups, written more from the point of view of general topology than from that of algebraic topology. Nevertheless, much information about algebraic topology and homological properties of compact groups can be found. The representation theory of compact groups is presented from a general point of view, so we cannot expect to find lists of representations of all the classical groups. Lie groups play a very important role in the whole book, but this is not a textbook on Lie groups. Not only does the book present a lot of material, but there are many results that have previously appeared only in articles. The book will probably also be useful to non-specialists in the field. If one is looking for a notion or a result, one can find and understand it without reading the book systematically from the very beginning. We expect that the book will be on the shelves of many mathematicians, as well as many students of mathematics. (jiva)

S. Janson, ***Gaussian Hilbert Spaces****, Cambridge Tracts in Mathematics* ***129****, Cambridge University Press, Cambridge, 1997, 340 pp., £40, ISBN 0-521-56128-0*

A Gaussian Hilbert space is a linear space of random variables. It involves both probability theory and Hilbert space theory, and thus has many applications ranging from stochastic processes, quantum field theory and partial differential equations to Banach space theory. The book contains a well-written study on some of these topics.

The book contains chapters on Gaussian spaces, Wiener chaos, Gaussian stochastic processes, limit theorems, Malliavin calculus and transforms. The text provides a good orientation in the field. Many examples make the presentation more accessible to newcomers to this area. (vz)

N. L. Johnson and S. Kotz (eds.), ***Leading Personalities in Statistical Sciences. From the Seventeenth Century to the Present****, Wiley Series in Probability and Statistics, J. Wiley & Sons, Inc., New York, 1997, 399 pp., £39.95, ISBN 0-471-16381-3*

.Johnson and Kotz co-edited the internationally acclaimed ten-volume *Encyclopedia of Statistical Science*, published by Wiley. Their work inspired them to publish a chronicle of lives and achievements of the most influential personalities in the field, spanning nearly four centuries. This book includes more than 110 names, with texts partially written by 75 experts from around the world, and contains many authentic photos and illustrations. I find the book extremely useful for students, who can find when, and in which situations, famous results connected with names of individual persons were originally found. It is interesting that many persons now considered as Americans were of European origin and that many of them had a wide range of scientific interests, being originally educated as pure mathematicians, physicists, astronomers, economists, biologists and geneticists. This again illustrates that statistics has deep roots in other sciences.

The statistical personalities are classified into seven sections: forerunners (23 people), statistical inference (24), statistical theory (19), probability theory (17), government and economic statistics (17), applications in medicine and agriculture (8), and applications in science and engineering (6); the interests of some persons lay in several of these categories. The individual entries are more concerned with lives of persons than with the technical details of their work that can be found more easily in the literature. Only four women are included, some of them doing pioneering work (such as Florence Nightingale). I find the book fascinating and recommend it to every statistician and probabilist. As Karl Pearson is quoted in the preface: "It is impossible to understand a man's work unless you understand something of his environment." (jju)

Editor's note. This review appeared in the last number of the *Newsletter* with the wrong heading. We apologise for this error.

L. P. Kadanoff, ***From Order to Chaos. Essays: Critical, Chaotic and Otherwise****, World Scientific Series on Nonlinear Science (A)* ***1****, World Scientific, Singapore, 1994, 555 pp., £45, ISBN 9-810-21197-X and 9-810-21198-8*

This is a collection of selected papers and essays by the author. The book is divided into four parts, with a new foreword and introductory essay to each part of the book, written by the author especially for this volume. After a general introduction (essay: the worlds of science), there are four main topics in the book: *Fundamental issues in hydrodynamics, condensed matter and field the-*

ory (essay: from level to level); *Scaling and phase transitions* (essay: on the joys of creation), *Simulations, urban studies, and social systems* (essay: models and arguments) and *Turbulence and chaos* (essay: questions without answers)

This book includes both the famous seminal papers of Kadanoff (often shaping the above disciplines in recent decades, such as the papers from the 1960s on the renormalisation group, and a number of articles from recent years. The newly added introductory essays are also extremely interesting. The book is an invaluable source of information and inspiration on a variety of important problems in modern physics. (mz)

L. Manivel, *Fonctions symmétriques, polynômes de Schubert et lieux de dégénérescence*, *Cours Spécialisés* 3, *Société Mathématique de France, Paris, 1998, 179 pp., ISBN 2-85629-066-3*

This book is divided into three parts. In the first two parts, the theory of symmetric functions, Schur polynomials and Schubert polynomials are developed; Schubert polynomials were defined by A. Lascoux and M.-P. Schützenberger in 1982. Some ideas of S. Fomin and A. Kirillov in the mid-1990s led to an interesting approach to the subject. The third part is devoted to Schubert varieties inside Grassmannians and flag manifolds. One of its culminating points is the theorem of Fulton.

The book is carefully written; however, we think that the presentation deserves a more detailed treatment of the classical results of M. Demazure. The reader will surely appreciate the 'rhythm' of the text: 'exercise – definition – example – exercise – example – proposition'. The appendix on singular homology makes the book more accessible for a less prepared reader. (lbe)

R. E. Megginson, *An Introduction to Banach Space Theory*, *Graduate Texts in Mathematics* 183, *Springer, New York, 1998, 596 pp., DM 134, ISBN 0-387-98431-3*

The book is an extensive graduate text devoted to basic notions of Banach space theory. The first chapter presents the basic concepts of the theory (normed linear and Banach spaces, linear operators, dual spaces and reflexivity, quotient spaces, direct sums, separability) as well as Hahn-Banach extension theorems (including Helly's theorem) and other fundamental principles of functional analysis (the proofs are based on Zabreiko's lemma). This chapter culminates with a proof of James's sequential characterisation of reflexivity.

The second chapter deals with weak topologies and includes such topics as vector topologies (also metrisability conditions), primers of locally convex spaces, weak topology, weak* and bounded weak* topologies, James's weak compactness theorem, the Krein-Milman theorem, Bishop-Phelps theorems and subreflexivity.

The next chapter is devoted to a deeper study of bounded linear operators (properties of adjoint operators, projections and complemented subspaces, elements of Banach algebras, compact operators and their Riesz-Schauder theory and weakly compact operators). Then follows a chapter on Schauder bases (unconditional bases, equivalent bases, the Orlicz-Pettis theorem, bases and duality and James's space J).

The last chapter deals with basic notions of the geometry of Banach spaces (rotundity and smoothness, uniform rotundity, uniform smoothness and their generalisations). There are four appendices, including the basic properties of metric spaces, l_p spaces and ultranets.

The book is sprinkled with examples, historical notes and citations of original sources. There are over 450 exercises that provide the reader with some practice, present supplementary examples and counter-examples, and extend the theory presented in the text.

This book can be warmly recommended to graduate students and to anybody who wishes to become acquainted with the basic elements and deeper properties of Banach space theory. (jl)

M. Mezard, G. Parisi and M. A. Virasoro, *Spin Glass Theory and Beyond*, *World Scientific Lecture Notes in Physics* 9, *World Scientific, Singapore, 1988, 461 pp., £20, ISBN 9-971-50115-5 and 9-971-50116-3*

This book provides a self-contained treatment of the physical theory of spin glasses. The main body of this theory was developed between 1977 and 1985, in a considerable part due to the efforts of the authors of this book.

The volume is divided into three parts. Each part starts with a general introduction and a more detailed exposition of the main ideas. A collection of related reprints of original papers then follows, so that the reader can find more detailed information and more calculations. Part 1 (*Spin glasses*) develops the essence of the replica method and the TAP approach and explains the breaking of the replica symmetry; appplications to the study of the spin glass phase and the cavity method are also treated in detail. Twenty-four of the original important articles are then reprinted. Part 2 (*Optimization*) deals with combinatorial optimisation problems, simulated annealing, and some analytical results, followed by four reprints of original articles. Part 3 is devoted to biological applications, in particular to brain modelling, learning and a study of the Hopfield model. The book concludes with seven reprints related to these subjects.

The fact that the book is a 1993 reprint of the original 1987 edition confirms that the subject is still important, and this volume remains a very useful source of relevant information on the progress achieved by theoretical physicists in the field. It can be helpful also to mathematicians trying to develop a mathematically rigorous counterpart of this theory. (mz)

P. Petersen, *Riemannian Geometry*, *Graduate Texts in Mathematics* 171, *Springer-Verlag, New York, 1998, 432 pp., DM 89, ISBN 0-387-98212-4*

The book is a nice introduction to Riemannian geometry, containing basic theory as well as several advanced topics. The basic notions and results from Riemannian geometry (covariant derivatives and Riemann and Ricci curvature tensors) are introduced at the beginning; these quantities are computed for several interesting Riemanian manifolds.

A chapter is devoted to the theory of hypersurfaces in Euclidean space, where classical results, such as the fundamental theorem of hypersurface theory and the Gauss-Bonnet theorem, are presented. A remarkable part of the book describes the Bochner technique and its extension to forms using the Clifford multiplication.

In the next chapter, these results are used for a classification of compact manifolds with non-negative curvature operator. There is also a brief introduction to the theory and classification of symmetric spaces, together with a discussion of Grassmanians and complex projective spaces). For these spaces, the curvature and holonomy of connections are computed.

There are also three appendices containing the Stokes theorem and related de Rham and Cech cohomology, Cartan formalism for the connection and curvature and spinor calculus on Riemannian spin manifolds. Each chapter ends with discussions and suggestions for further study, together with corresponding references. This book can be recommended to anybody interested in modern Riemannian geometry. (jbu)

H. A. Priestley, *Introduction to Integration*, *Clarendon Press, Oxford, 1997, 306 pp., £40, ISBN 0-198-50124-2*

This book is designed primarily as an undergraduate or introductory graduate textbook. It offers a unified account of integration theory, the stress being on functions on $\mathbf{R}$ or $\mathbf{R}^k$, rather than on set functions. The theory is accompanied by a wealth of well-chosen examples and exercises illustrating the use of Lebesgue integration. There are also brief chapters on L^p spaces, on Fourier series (convergence questions, in particular), on orthogonal systems and on Fourier transforms. The final chapter is an invitation to the use of integration in probability theory.

The exposition starts with a simplified Lebesgue-style integral for continuous functions on a compact interval in $\mathbf{R}$ based on step functions (no null sets). This replaces the more traditional Riemann integral. Then the one-dimensional Lebesgue integral is introduced via monotonic sequences of step functions. Integration on $\mathbf{R}^k$ is sketched as an extension of the theory explained in great detail in $\mathbf{R}$. The two-dimensional Fubini and Tonelli theorems are proved, but the proof of the change of variables theorem is sketched only for $\mathbf{R}^2$.

The book nicely illustrates the power of the Lebesgue theory and provides a rigorous practical guide to the use of integrals. It can be recommended to mathematics students and teachers of mathematical

analysis. (in)

V. Maz'ya and T. Shaposhnikova, *Jacques Hadamard, A Universal Mathematician*, *American Mathematical Society, Providence, 1998, 574 pp., £52, ISBN 0-821-80841-9*
This is a fascinating book on the life and work of J. Hadamard (1865–1963). In fact, it is also a book on mathematics and mathematicians from the last quarter of the 19th century until today –extremely rich material collected, ordered and presented in an interesting, attractive and readable form.

The first half of the book is devoted to Hadamard's life. Childhood, school-years, education, marriage, first results in mathematics, colleagues, friends, international contacts, teaching, *le séminaire Hadamard*, hobbies, activities during the war, political commitments, travelling, emigration, family tragedies – all are offered with much documentation: interviews, correspondence, recollections, jokes, myths, over 300 photographs and illustrations, all creating an authentic and colourful picture. The account of Hadamard's life is intelligible to a wide readership, and only a necessary minimum of Hadamard's mathematical achievements is included in the first part of the book.

The second half deals with a detailed analysis of Hadamard's contribution to mathematics – namely to function theory, number theory, geometry, analytical mechanics, calculus of variations, functional analysis, mathematical physics, PDEs and other areas of analysis, algebra, set theory, topology, and also to the psychology of invention. Most of the more than 30 sections (divided into eight chapters) is in the form of essays (or short survey papers) on individual mathematical topics. The exposition is clear, accessible and nicely written, connecting Hadamard's mathematics with further developments, frequently up to results of current research interest.

At the end of the book, there is a list of 62 mathematical objects in which Hadamard's name appears and an extensive bibliography: 406 of Hadamard's publications, 62 publications about Hadamard and his work, and 430 references related to the text. An incredible amount of work has had to be undertaken in order to produce such a book. The authors have done an excellent job and the result deserves much attention from professional mathematicians and historians of science, as well as from students with an interest in mathematics. This book is warmly recommended to everybody who likes mathematics. (in)

Y. Motohashi (ed.), *Analytic Number Theory*, *London Mathematical Society Lecture Note Series* 247, *Cambridge University Press, Cambridge, 1997, 382 pp., £27.95, ISBN 0-521-62512-2*
This volume arose from the 39th Taniguchi International Symposium on Mathematics which, under the title *Analytic Number Theory* was held in May 1996, organised by N. Hirata-Kohno, L. Murata and Y. Motohashi as a conference at the Research Institute for Mathematical Sciences at Kyoto University. Plenary lectures were given by E. Bombieri, P. D. T. A. Elliott, J.-H. Evertse, J. Friedlander, A. Granville, K. Hashimoto, A.Ivic, H. Iwaniec, M. Jutila, Y. Kitaoka, Y. Motohashi, M. R. Murty, P. Sarnak, H.-P. Schlickewei, R. Tijdeman, M. Walschmidt, and T. D. Wooley. Speakers in parallel sessions were A. Akiyama, M. Amou, R. C. Baker, R. Balasubramanian, J. Brüdern, H. Diamond, S. Egami, S, Gonek, G. Greaves, M. Hata, A. J. Hildebrand, M. Hindry, N. Hirata-Kohno, M. N. Huxley, S. Kanemitu, M. Katsurada, K. Kawada, A. Laurinikas, E. Manstavius, K. Matsumoto, H. Mikawa, L. Murata, V. K. Murty, M. Nagata, A. Perelli, J. Pintz, B. Ramakrishman, W. Schwarz, T. N. Shorey, C. L. Stewart, K.-M. Sang, C. Viola, D. Wolke, E. Yoshida, J. Yu and T. Zhan.

J. R. Norris, *Markov Chains*, *Cambridge Series in Statistical and Probabilistic Mathematics, Cambridge University Press, Cambridge, 1998, 237 pp., £16.95, ISBN 0-521-63396-6*
This is a paperback edition of the book published in 1997 (for a review, see EMS *Newsletter* 26, December 1997, p. 33). (in)

H. L. Resnikoff and R. O. Wells, Jr., *Wavelet Analysis*. *The Scalable Structure of Information, Springer, New York, 1998, 435 pp., DM 120, ISBN 0-387-98383-X*
This book introduces the reader to the ideas and methods that lie behind the theory of compactly supported wavelets. The authors relate them to previously known methods in mathematics and engineering, show how they can be practically used in a digital signal processing and computing environment, and illustrate their potential for mathematical engineering by describing several successful applications in bandwidth management.

The book consists of four parts. Part I, *The scalable structure of information*, describes the multi-scale nature of information in many aspects of the real world. Part II, *Wavelet theory*, presents the algebraic and analytic theories of wavelet matrices, scaling and wavelet functions, wavelets systems, and the corresponding multi-resolution analysis of square-integrable functions on a given space. Turning from the continuous to the discrete, Part III, *Wavelet approximation and algorithms*, shows how a properly selected set of wavelets can be used to represent a wide variety of signals efficiently and effectively by means of a variety of algorithms useful for implementation of wavelet methods in the discrete world. A theory of wavelet-based differentiation is developed and the wavelet-Galerkin method is used to formulate and develop single-scale and multi-scale numerical algorithms for solving elliptic boundary value problems. Part IV, *Wavelet applications*, presents a variety of applications of wavelets to problems in data compression and telecommunications.

This book contains very rich material concerning the analysis of wavelets and is useful for anybody interested in the subject. It is beautifully written and can be warmly recommended to students in engineering or mathematics. (kn)

C. A. Rogers, *Hausdorff Measures*, *Cambridge Mathematical Library, Cambridge University Press, Cambridge, 1998, 195 pp., £17.95, ISBN 0-521-62491-6*
The first edition of this well-known and beautiful book appeared in 1970.

Chapter 1 gives a nice account of basic (outer) measure theory with special attention to the study of non-σ-finite measures. Chapter 2 develops the most general aspects of the theory of Hausdorff measures. In particular, it is proved that in some metric spaces each Souslin set of positive Hausdorff measure μ_h contains a compact set of finite positive μ_h-measure. Chapter 3 contains a general survey of applications of Hausdorff measures and detailed accounts of two special topics. The first is devoted to applications to the theory of continuous fractions and the second one to a study of general non-decreasing continuous functions (and corresponding Lebesgue-Stieltjes measures).

The book is almost self-contained and is written with notable clarity and precision, so that bright students can read it by themselves. Mathematicians who need to know about Hausdorff measures can find clear statements, clear proofs and a good guide to the basic literature.

This second edition contains a new appendix (16 pp.) on 'dimension prints' - a notion introduced by the author in 1988 to distinguish between different sets with the same Hausdorff dimension. Very useful is a new foreword (21 pp.) written by K. J. Falconer containing a survey of recent developments of the subject and new applications of Hausdorff measures with a long list of references. (lz)

A. J. Scholl and R. L. Taylor (eds.), *Galois Representations in Arithmetic Algebraic Geometry*, *London Mathematical Society Lecture Note Series* 254, *Cambridge University Press, Cambridge, 1998, 493 pp., £29.95, ISBN 0-521-64419-4*
This volume is based on the symposium *Galois representation in arithmetic algebraic geometry* held in Durham in July 1996. There were six expository courses at the symposium on the following topics: Galois module structure, Shimura varieties in mixed characteristic, p-adic comparison theorems, the work of Kato on the Birch-Swinnerton-Dyer conjecture, polylogarithms, rigid analysis and modular forms. There were also fourteen research seminars.

As the title indicates, the contents are devoted to topics of interplay between algebraic number theory and arithmetic algebraic geometry. There are ten contributions to the volume – both expository and research articles. Readers can find here carefully written reports on subjects which have recently attracted a lot of attention; for example, expositions by B. Erez on *Geometric trends in Galois modules theory* (32 pp.), B. Mazur on *Open problems regard-*

ing rational points on curves and varieties (28 pp.), B. Moonen on *Models of Shimura varieties in mixed characteristics* (84 pp.) and P. Schneider on *Basic notions of rigid analytic geometry* (11 pp.) provide carefully written reports on these topics. From the rest, let us mention a long paper *The eigenvalues* (115 pp.) by R. Coleman and B. Mazur, A. Goncharov's *Mixed elliptic motives* (76 pp.), J.-P. Serre's *La distribution d'Euler—Poincaré d'un groupe profini* (33 pp.) and A. J. Scholl's *Introduction to Kato's Euler systems* (82 pp). The volume can be recommended to those interested in recent trends in arithmetic algebraic number theory and geometry. (šp)

M. Šilhavý, *The Mechanics and Thermodynamics of Continuous Media*, *Texts and Monographs in Physics, Springer-Verlag, Berlin, 1997, 504 pp., 24 fig., DM 128, ISBN 3-540-58378-5*

This book covers a broad range of mathematical theories and techniques used in the field of rational mechanics. The main topics are balance equations, basic laws of thermodynamics, constitutive theory, thermodynamic equilibrium and thermodynamics. It also contains an explanation of basic principles of geometry and kinematics, together with necessary parts of algebra and analysis.

The first part formulates the basic balance equations for various quantities. This part presents a lot of material formerly accessible only in research papers. In the second part, the author introduces axioms for the foundations of thermodynamics, which are based on his results (together with J. Serrin). A detailed mathematical analysis of entropy and the second law of thermodynamics is presented in a way which is free from the usual ambiguities. The third part covers constitutive equations, and includes a discussion of irreversible linear thermodynamics. The fourth part is, in a sense, the central part of the book. Standard topics in non-linear continuum mechanics are discussed in an understandable and comprehensive way. The last part is devoted to dynamics.

The book is excellent, and covers a very broad area (usually treated as separate topics) from a unified perspective. The author has clearly tried to reduce the mathematical tools to a minimum so as to make the book accessible to readers from the physics community (a more mathematical treatment can be found in his papers). It will be very useful for both mathematicians and physicists. (jsou).

N. P. Smart, *The Algorithmic Resolution of Diophantine Equations*, *London Mathematical Society Student Texts* 41, *Cambridge University Press, Cambridge, 1998, 243 pp., £16.95, ISBN 0-521-64156-X and 0-521-64633-2*

This book presents an up-to-date summary of the latest developments in the so-called constructive theory of Diophantine equations, an area of number theory that has recently undergone very important developments.

After an introductory chapter, the remaining thirteen chapters divide into three parts. The first part, *Basic solution techniques*, is devoted to classical techniques, as local methods, Skolem one, etc. The reader finds here a description of various tools (ternary quadratic forms, continued fractions and the basis reduction algorithm) that play an important role in the development of the subject.

Part 2, *Methods using linear forms in logarithms*, deals with Thue-Mahler-type equations; and the recent algorithms of Bilu and Hanrot or Tzakanis and de Weger are described here. The effective theory of S-unit equations and unit equations follows ideas first developed by K. Gyory, combined with other methods (such as sieve methods). The author's own algorithm for unit equations and discriminant-form equations of Mahler type are also presented here.

In part 3, *Integral and rational points on curves*, the author surveys the most important methods from the theory of rational and integral points on elliptic curves. Curves of genus greater than 1 are also taken into consideration.

Besides the description of the modern methods in this rapidly developing theory, many historical notes and exercises for solutions accompany the text. All this together predestines the book to be recommended not only to interested students but also to active researchers in the subject. (spor)

H. F. Spirer, L. Spirer and A. J. Jaffe, *Misused Statistics*, *Second Edition, Revised and Expanded, Popular Statistics 7, Marcel Dekker, Inc., New York, 1998, 263 pp., ISBN 0-8247-0211-5*

Statistics is a science of collecting, analysing, and interpreting data. There are many reasons why the results may not be presented correctly. The most important categories of statistical misuses are: lack of knowledge of the subject matter, poor quality of the basic data, incorrect or incorrectly applied statistical methodology, misleading presentation of results, incorrect conclusions from statistical results, and deliberate suppression of data.

The authors illustrate statistical misuses on a number of real examples taken from newspapers and scientific journals. A considerable deal of the material is devoted to problems connected to surveys and pools, because such topics appear in newspapers very frequently. Teachers will read with interest the part of the book about how to predict which of several applicants will be a good student. It is shown that typical scores of standardised tests used as one of the criteria for admission have small correlation with the grade point average which the student will earn in the admitting institution. The reason may be applicants with low scores are not admitted, and so there are no data to verify the hypothesis that their study would not be successful.

The first edition of the book became very popular. The authors updated the examples and added many new ones, so that more that 50% of the second edition is new or revised material. The book can be recommended to readers who do not want to be cheated by misused statistics, as well as to researchers who wish to publish results of their statistical analysis correctly. The fresh style of the book make it suitable as a supplement to classical statistical textbooks. (ja)

S. M. Srivastava, *A Course on Borel Sets*, *Graduate Texts in Mathematics* 180, *Springer, New York, 1998, 261 pp., DM 98, ISBN 0-387-98412-7*

The main objects of the exposition are the essential parts of classical descriptive set theory, the theory of Borel sets and measurable selections. The book is intended to be introductory, and it is possible to use it to study even at undergraduate level. It is self contained, and the needed prerequisites on set theory and theory of metric spaces are thoroughly explained in the early chapters. Only an understanding of the possible applications, indicated often in the form of remarks, requires knowledge from topology, algebra, measure theory, etc. Methods like universal sets, prewell-ordering, and scales are explained. Methods that use games, recursive functions and forcing are not included.

The presentation is systematic, and the theory of Borel sets is split into two parts: one that does not need the theory of analytic and co-analytic sets, and another that depends deeply on these crucial notions. The part on selections and uniformisations that concludes the book contains many known results in the subject, and so for this topic, as well as for the Borel set theory, the monograph can serve also as a good reference book. (ph)

R. F. Streater, *Statistical Dynamics: A Stochastic Approach to Nonequilibrium Thermodynamics*, *Imperial College Press, World Scientific, Singapore, 1995, 275 pp., £17, ISBN 1-860-94002-1 and 1-860-94004-8*

This is a book on stochastic dynamics, of models of statistical mechanics. It consists of two parts of roughly equal size and parallel organisation (275 pages in total). The first part develops the dynamics of classical statistical models, using the 'field point of view', while the second part is devoted to C^*-algebras and quantum probability. The material is given in a self-contained form, and the student is not assumed to have a prior knowledge of probability theory.

The first part consists of six chapters: Introduction, Probability theory, Linear dynamics (reversible and random dynamics and Markov chains), Isolated dynamics (the Boltzmann map and the 'heat particle'), Isothermal dynamics (the Legendre Transform), and Driven (open) systems.
The second part starts with an introduction to C^*-algebras and quantum probability. The contents of subsequent chapters are roughly parallel to the first part of the book, with a return to some harder problems of classical dynamics in the last chapter.

This book contains a wealth of useful information. Many interesting applications (such as activity-led reactions and chemical

kinetics) are discussed. Basic concepts, such as entropy, are thoroughly explained, with an emphasis on useful technical details, lemmas and sharp bounds instead of aiming for the maximum possible generality for each result. Interesting historical and other remarks are scattered throughout the text. The results are presented in a way that minimises the requirements on the mathematical preparation of the reader. This makes the book attractive for a wide range of physicists and mathematicians. (mz)

A. N. Whitehead and B. Russell, *Principia Mathematica to *56*, *2nd edn., Cambridge Mathematical Library, Cambridge, 1997, 410 pp., £ 32.50, ISBN 0-521-62606-4*

This book contains the abridged text of Volume 1 of *Principia Mathematica* (the famous work on the foundations of mathematics). Here one finds material for an introductory study of logic and the philosophy of mathematics. It is a paperback edition, suitable for students.

Nowadays there are modern books on mathematical logic that use more 'efficient' axiomatic systems. But it may happen that after finishing such a course, one does not have an understanding of both the historical background and the circumstances connected with the development of the branch and possible different ways of reasoning. To avoid such a situation, a study of this book can be recommended because it also describes the foundations of mathematics as it was at the beginning of the century. Because of that, the book may also be interesting for a wider group of mathematicians and philosophers. (kcu)

M. Willem, *Minimax Theorems*, *Progress in Nonlinear Differential Equations and its Applications* ***24****, Birkhäuser, Boston, 1998, 159 pp., DM94, ISBN 0-8176-3913-6 and 3-7643-3913-6*

As the title indicates, the book is devoted to basic minimax theorems. These theorems are explained in a unified manner starting in each case from a quantitative deformation lemma. In each chapter, the theory is used as a tool for many applications (the semilinear Dirichlet problem, the semilinear Schrödinger equation, a treatment of the generalised Kadomtsev-Petviashvili equation, etc.)

In Chapter 1, the mountain pass theorem and its applications are studied. A linking theorem is explained and applied to the semilinear Dirichlet problem in Chapter 2. Invariant functionals with infinitely many critical values are considered in Chapter 3 (the Fountain theorem). The notion of a Nehari manifold, developed in Chapter 4, is then used to prove the existence of nodal solutions. A minimax theorem proved in Chapter 5 (Relative category) is applied to the problem with critical non-linearities. degree theory by Kryszewski and Szulkin and generalised linking theory is considered in Chapter 6. The application to the semilinear Schrödinger equation is given. The existence of solitary waves of the generalised Kadomtsev-Petviashvili equation is established in Chapter 7, and the last chapter (Representation of Palais-Smale sequences) describes the loss of compactness in some variational problems. Material used in the previous text is briefly and transparently explained in four appendices (the superposition operator, variational identities, symmetry of minimisers and topological degree).

The reader is supposed to have a basic knowledge of partial differential equations, Sobolev spaces technique and linear functional analysis. Being very nicely written, the book will certainly be of use as a textbook for advanced graduate students. It will be extremely useful to researchers in partial differential equations and non-linear functional analysis. (oj)

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4. 'Letter of intent'.
5. Photocopies of relevant graduation diplomas.
6. Research publications of the candidate's own choice, numbered according to the bibliography. (Please observe, however, that only one copy of each research publication referred to should be sent to the University administration. Three additional copies of item 6 are to be sent later, upon notification from the University, to the Expert Members of the Appointments Board.)