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NOTICE FOR MATHEMATICAL SOCIETIES

Please note labels are prepared during the second half of the month before the next issue. Would you please send your updated lists before this time.

Many thanks. Ms T Mäkelainen

WORLD MATHEMATICAL YEAR 2000

The work in the EMS committee

Vagn Lundsgaard Hansen

The following notes are based on a report to the Executive Committee of the European Mathematical Society in Vienna, April 5–6, 1997.

Members of the WMY 2000 committee appointed by the EMS:

- **Mireille Chaleyat-Maurel**, 7 rue des Wallons, F-75013 Paris, France
  e-mail: mcm@ccr.jussieu.fr
- **Alberto Conte**, Corso Francia 17, I-10138 Torino, Italy
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- **José Francisco Rodrigues**, C.M.A.F., Universidade de Lisboa, Av. Prof. Gama Pinto 2, 1699 Lisboa, Portugal
  e-mail: rodrigue@lmc.fc.ul.pt

One further member is under appointment.

Chairman of the committee: Vagn Lundsgaard Hansen

Date of creation and purposes of the WMY 2000 committee:

The committee was appointed by the Executive Committee of the European Mathematical Society in its meeting in Hamburg June 30-July 2, 1995. The chairman was appointed in a letter of October 31, 1995.

The committee works on the following tasks:

1) Find, coordinate and initiate suitable mathematical activities supported by the European Mathematical Society to take place in the year 2000. The activities should be common to several European countries, hopefully all and, best of all, related to the rest of the world.
2) Help with possible ideas to organise suitable mathematical activities in the individual European countries. Some of these should be carried out in the year 2000 but could also prove useful independently of the World Mathematical Year 2000.

Current actions undertaken:

With respect to 1), the committee is investigating the possibility of organising a joint European-Arab Congress of Mathematics in Granada, Spain, in the year 2000. The project is called ALHAMBRA 2000.

With respect to 2), the committee hopes to produce a catalogue of good ideas.

Status of various projects and proposals:

ALHAMBRA 2000

It has been approved by the Executive Committee of the EMS that this project should be pursued. Spanish mathematicians must be involved in the local arrangements and this is being investigated at the moment. There are very good possibilities for establishing a prominent scientific committee for such a joint European-Arab Congress of Mathematics.

It should also be mentioned that CIMPA (Centre International de Mathématiques Pures et Appliquées), might like to join in on the project.

Mathematics and EXPO 2000
sub-project: Symposium in relation to Hilbert's problems

(A project proposed by Professor Klaus Hulek in Hannover.)

Obviously such a symposium should take place and Germany would be a natural place. However, there might be rival projects in relation to the Hilbert problems. The Executive Committee of the EMS wants this to be clarified before a final conclusion about EMS involvement in this project can be made.

Mathematics Posters in the subways of large cities in Europe in the year 2000 as a WMY 2000 project

This project could be a joint venture of EMS (for the coordination) and the corresponding national societies.

In France, the process is beginning with EMS in collaboration with Palais de la Decouverte and the French Mathematical Society.

Mathematics Posters at public places in the year 2000 as a WMY 2000 project

Obviously, the idea of posters can be extended to include all kinds of places where a large part of the public comes regularly. Petrol stations have been mentioned as one possibility. The committee welcomes other suggestions.

Stamps as a WMY 2000 project

It would be fine idea if as many national mathematical societies as possible contacted their Postal Services in order to have issued stamps with a mathematical content in the year 2000. In France the process has already been started. It is clearly advisable to react very soon since the postal services plan several years ahead.

MACAO 2000 - Mathematics and Civilization

In the meeting of our committee on July 25, 1996, during the congress in Budapest, a suggestion was brought up for a joint "Orient-Occident Encounters of Mathematical Cultures". Such a meeting would surely be within the spirit of the work in the EMS committee on the WMY 2000.

Contacts have now been made unofficially by José Francisco Rodrigues with the Chinese Mathematical Society and with mathematicians at the University of Macao. These first contacts are very encouraging.

EUROPEAN MATHEMATICAL SOCIETY

Meeting of the Executive Committee

Vienna (Austria) April 5-6, 1997

SCIENTIFIC ACTIVITIES

Third European Congress of Mathematics (3ECM)
July 10-14, 2000, Barcelona (Spain)
The motto of 3ECM is: *"Shaping the 21st Century"*.

The chairpersons appointed to the Committees are: Sir Michael Atiyah (UK) (Scientific Committee), Jacques-Louis Lions (France) (Prize Committee) and Miguel de Guzman (Spain) (Round Tables Committee). The recommendations of the Executive Committee are: a nontechnical lecture should be held during the opening ceremony; the satellite conferences could be held also outside of Spain; the reduction of fees for EMS members should be effected; a link to the web address will be on the server and the national committees should be contacted asking for a link with the Congress.

Second Diderot Mathematical Forum "Mathematics and Environment"
On December 19-20, 1997, the Forum on Mathematics and Environment will be held in Amsterdam, Madrid and Venice. It will concentrate on problems related to water. (For informations: mcm@ccr.jussieu.fr).

Summer Schools
In 1997, there are two Summer Schools, one in Portugal (Non-commutative Geometry) and another in France (Modelling of industrial problems).
The Summer Schools are aimed at advanced graduate students, with 4-5 courses, lasting about two weeks. The expected number of participants is 50-100. The level should be clearly defined in advance. People interested in organising such a School can contact G. Monegato (e-mail: monegato@itopoli.bitnet).

INFORMATION SERVICES

Server (EMIS)
The number of mirrors is growing rapidly: at the moment there are 22 mirrors plus 3-4 more in preparation and there are now 20 journals in EMIS.

The Newsletter
It was noted that the book reviews, the problem corner (very popular) and the Euronews need little editing so no major changes are planned. There have been relatively few general articles and those are what is needed.
Improvements are needed for the format and an editorial board is necessary. There should be a lead article and 3-4 regular columns.

Mathematical Press Agency (EMPRESSA)
The Mathematical Press Agency, to be called EMPRESSA, is now being formed in Strasbourg, aimed at mathematicians and press. A strategy for spreading information on mathematics through mathematicians to the press should be formed.

WMY 2000 COMMITTEE

V.L. Hansen presented the plans of the committee (see the article in this issue).
The plans to have a joint European-Arab meeting in Alhambra in the year 2000 found general approval but local interest must be ensured.
Another project, Mathematics and EXPO 2000, proposed by K. Hulek, with a symposium in relation to Hilbert's problems, also met with favourable discussion.
Young people should be contacted, for instance by asking research mathematicians to give speeches at schools on unsolved problems.
Interest was also given to idea of having posters in the subways or filling stations in large European cities, in collaboration with other bodies. A team of people should be appointed circulating ideas, basic designs, concentrating on large cities.
Stamps with a common symbol could be suggested in various countries. In this case, quick action is needed: in many countries it is already too late. It was noted that the member societies were contacted already three years ago.

RELATIONS WITH EUROPEAN INSTITUTIONS

The Fifth Framework Programme of the EU
First versions in French and English for the declaration by the EMS on the preparation of the Fifth Framework Programme have been written and distributed widely, among others to ESTA and Academia Europea. It is important to stress that mathematics needs a longer perspective than industry. The document should be distributed still wider in all countries, to government representatives etc. One can get the document by asking at mcm@ccr.jussieu.fr.

Reference Goals for Mathematical Education
EMS was asked by the Commission to set up reference levels for students in EU countries at three different ages and different levels (age 16 is a priority). The Education Committee agreed to undertake the project. In order to study the situation in the 15 EU countries, the Committee has to be enlarged. The project will be managed by EMS at no extra cost. The study should be completed and recommendations made by June 1998.

LIFE OF THE SOCIETY

The number of individual members has reached a record of 1800.
There are several corporate members whose fees have been unpaid for several years and there are some who have not even contacted EMS for an extended period of time. A special effort is made to reach these societies.

PEOPLE NEEDED!!

EMS is willing to run a job advertisement, which is very important for young mathematicians, on EMIS. A person is doing preliminary work but EMS needs more people who have time to devote to this task. Please contact the Publicity Officer (mcm@ccr.jussieu.fr).

NEXT MEETING

◇ Isola di Capri (Italy), October 10-12 1997

Mireille Chaleyat-Maurel

Meeting of the Council

Berlin, August 28 and 29, 1998

The Council meets every second year. The next meeting will be held in Berlin, August 28 and 29, 1998, immediately after the International Congress of Mathematicians, in the 'Senatssaal der Humboldt-Universität', Unter den Linden 6, D-10099 Berlin.

Delegates to the Council will be elected by the following categories of members.

(a) Full Members

Full Members are national mathematical societies which elect 1, 2 or 3 delegates according to size and resources. A society is responsible for the election of its delegates. Each society should notify the Secretariat of the EMS in Helsinki of the names and addresses of its delegate(s) no later than 20th March 1998. As of 1st July 97, there were 44 societies which could designate a maximum of 66 delegates.

(b) Associate Members

There are two associate members, namely the Gesellschaft für Mathematische Forschung and the European Mathematical Trust. Their delegate is elected until 1999.

(c) Institutional Members

There are two institutional members, Institut Non Lineare de Nice and Moldovian Academy of Sciences. Arrangements will be made for election of their common delegate.

(d) Individual Members

A person becomes an individual member either through a corporate member, by paying an extra fee, or by direct membership. On 30th June 1997 there were some 1700 individual members and, according to our statutes, these members will be represented by 17–18 delegates. The final count of individual members for these elections will be made on November 1, 1997. The mandates of 6 of the present 17 delegates end on 31st December 1997 and so elections must be held for their positions. Nomination papers for these elections will appear in a later issue of the Newsletter. 11 delegates were elected for the term 1996–1999, so they will continue unless they inform the Secretariat to the contrary by 31st December 1997.

The Executive Committee is responsible for preparing the matters to be discussed at Council meetings. Items for the agenda of this meeting of the Council should be sent as soon as possible, and no later than 27th April 1998, to the Secretariat of the EMS in Helsinki.

The Council is responsible for electing the President, Vice-Presidents, Secretary, Treasurer and other members of the Executive Committee. The present membership of the Executive Committee, together with terms of office, is as follows.

President	1995–1998	Professor J.-P. Bourguignon
Vice-Presidents	1995–1998	Professor D. Wallace
	1997–2000	Professor A. Pelczar
Secretary	1995–1998	Professor P. Michor
Treasurer	1991–1998	Professor A. Lahtinen
Other members	1997–2000	Professor B. Branner
	1995–1998	Professor A. Conte
	1997–2000	Professor R. Jeltsch
	1997–2000	Professor M. Sanz Sole
	1997–2000	Professor A. Vershik

Under Article 7 of the Statutes, members of the Executive Committee shall be elected for a period of 4 years. Committee members may be re-elected provided that consecutive service shall not exceed 8 years. The President may not serve as President for more than one period, accordingly Professor J.-P. Bourguignon

will demit office in December 1998. By Rule 16 of the By-Laws, the incoming President must be elected from among the members of the Council. No such stipulations apply to the other members of the Executive Committee. Professor A. Lahtinen is not eligible for another period.

It would be convenient if potential nominations for office in the Executive Committee, duly signed and seconded, could reach the Secretariat by 27th April 1998. It is strongly recommended that a statement of intention or policy is enclosed with each nomination. If the nomination comes from the floor during the council meeting there must be a written declaration of the willingness of the person to serve, or his/her oral statement must be secured by the chair of the Nominating Committee (if there is such) or by the President. It is recommended that a statement of policy of the candidates nominated from the floor should be available.

The Council may, at its meeting, add to the nominations received and set up a Nominations Committee, disjoint from the Executive Committee, to consider all candidates. After hearing the report by the chaiman of the Nominations Committee (if one has been set up), the Council proceeds to the elections to the Executive Committee posts.

Delegates to the Council meeting, who are to attend the ICM, are advised that their accommodation arrangements can be made through the ICM. For delegates to the Council, who are not attending the ICM, an address for accommodation arrangements will be provided later.

Peter Michor
Secretary of the EMS

Secretariat: Mrs. Tuulikki Mäkeläinen
Department of Mathematics
P.O. Box 4
FIN-00014 University of Helsinki
Finland

P.S. Timetable for the Council Meeting

September 1997: Letter to full and associate members and delegates about the council meeting, dates, place, elections.

November 1, 1997: The number of individual members is fixed.

December Newsletter: All the previous information about Council meeting, nominating slip for the delegates of the individual members, and suggestions for EC members.

January 31, 1998: Nominations for delegates for individual members received by the Secretariat in Helsinki by February 10, 1998.

February 1998: Ballot papers sent to individual members.

March Newsletter: Candidates for delegates of individual members, venue and times of Council meeting

March 31, 1998: Deadline for ballot papers, to Secretariat.

April 1998: Letter to delegates, containing also the agenda of the council meeting.

June Newsletter: Result of elections for delegates of individual members, venue, times, and agenda of Council meeting.

June-July, 1998: Council material sent to delegates.

International Congress of Mathematicians
Berlin, Germany
August 18-27, 1998

First Announcement

The Organising Committee is pleased to announce that the next International Congress of Mathematicians will take place in Berlin, Germany, from Tuesday, August 18, to Thursday, August 27, 1998.
It will be held under the auspices of the International Mathematical Union (IMU) and sponsored by many other institutions.

Mathematical Programme

Responsibility for the scientific programme lies with the Programme Committee appointed by IMU. There will be about twenty one-hour Plenary Lectures covering recent developments in the major areas of mathematics and about 170 forty-five-minute Invited Lectures in nineteen sections. The sections are as follows:

1. Logic
2. Algebra
3. Number Theory and Arithmetic Algebraic Geometry
4. Algebraic Geometry
5. Differential Geometry and Global Analysis
6. Topology
7. Lie Groups and Lie Algebras
8. Analysis
9. Ordinary Differential Equations and Dynamical Systems
10. Partial Differential Equations
11. Mathematical Physics
12. Probability and Statistics
13. Combinatorics
14. Mathematical Aspects of Computer Science
15. Numerical Analysis and Scientific Computing
16. Applications
17. Control Theory and Optimisation
18. Teaching and Popularisation of Mathematics
19. History of Mathematics

Every registered participant (traditionally called Ordinary Member) of the Congress will have the opportunity to give a short presentation, either during a poster session or in the form of a fifteen-minute lecture. A formal call for such presentations will be issued in the Second Announcement. Informal mathematical seminars may be organized at the initiative of groups of participants. English, French, German, and Russian are the official languages of the Congress.
All Plenary and Invited Lectures will be published in the Proceedings of ICM; after the Congress, a complimentary copy of these Proceedings will be sent to each Ordinary Member. Abstracts of all lectures and of all short presentations will be distributed free of charge to Ordinary Members at Congress check-in.
The Fields Medals and the Nevanlinna Prize will be awarded during the Opening Ceremony on the first day of the Congress. This will take place in the International Congress Center Berlin (ICC); all other scientific events will be held at Technische Universität Berlin. No scientific activities are scheduled for Sunday, August 23.
In an effort to reach out to a wider audience, the ICM organisers have initiated several cultural activities related to mathematics that are attractive to the general public. In particular, there will be a VideoMath Festival, software demonstrations, talks about mathematics and its relations to other subjects, several exhibitions (*Mathematics in the Arts*, etc.), and other events (*Mathematics and Music*, etc.).
Special consideration will be given to the impact of the Nazi regime on mathematics in Berlin and Germany.

Social Events

On August 18, a buffet-banquet for all registered participants will be held at noon directly after the Opening Ceremony in the ICC. During the Congress, a number of guided tours of Berlin, visits to museums, and walking tours will be offered. On Sunday, August 23, it will be possible to choose from several excursions. For that evening, tickets have been reserved for the opera *The Magic Flute* at the Deutsche Oper. Registered participants may purchase tickets in advance for these events as well as for many day trips and pre- or post-congress tours to places of interest in the vicinity of Berlin.

Organisation

Up-to-date information about all aspects of ICM is available on the following website:

`http://elib.zib.de/ICM98`

This includes information about registration, abstract submission, etc. Correspondence should be directed to

icm98@zib.de

It will be forwarded to an appropriate member of the Organising Committee. If electronic communication is not available you may also write to

ICM
c/o Prof. Dr. J. Winkler
TU Berlin, MA 8–2
Straße des 17. Juni 135
D-10623 Berlin, Germany
FAX: +49/30/314–21604

Registration and Accommodation

DER- Congress, a professional congress and tour organiser, has been appointed by the Organising Committee to handle all non-scientific matters for individual participants: registration to the Congress and the social events, hotel reservation, tourist programme, collection of registration fees, etc. The formal registration procedure for the Congress will be described in the Second Announcement (see below).
Participants will be housed in a variety of hotels in Berlin; the necessary reservations have already been made by DER- Congress. In addition, DER- Congress will make student residences available and will provide a certain amount of private accommodation at a cheap rate for participants willing to accept less comfort. Detailed information on locations and rates will be provided in the Second Announcement.
Forms for registration and accomodation requests will be made available on the ICM server in January 1998.

Second Announcement

The Second Announcement of ICM will describe the activities of the Congress in more detail and give instructions on how to complete the registration process and obtain accommodation. It will provide more, although not complete, information on the scientific programme, contain a call for contributed short presentations, and give instructions regarding the submission of abstracts.
The Second Announcement will also include advice on how to proceed upon arrival at airports and train stations, and it will be accompanied by a brochure describing the day trips and tours organised by DER-Congress.
Several conferences of a more specialised nature are scheduled immediately before or after ICM. The Second Announcement will also contain a list of such "satellite conferences".
To receive the Second Announcement, fill out the form on the ICM server (`http://elib.zib.de/ICM98`). Alternatively, send an empty e-mail to `icm98@zib.de` with `Second Announcement` in the `SUBJECT` line to receive an e-mail form. If this is not possible for you, please fill out the form below and send it to the ICM Secretary Prof. Winkler (see address above).
The Second Announcement will be mailed from Berlin at the beginning of 1998.

I would like to receive the Second Announcement of ICM. **Please print**

Name:
last name first name middle name/initial

Address:
institution

street and number

postal code city country

E-mail:

International Conference on Industrial and Applied Mathematics
Edinburgh, 1999

The Fourth International Congress on Industrial and Applied Mathematics (ICIAM) will be held in Edinburgh from 5th to 9th of July 1999. More than 2000 delegates are expected to attend. Previous ICIAM congresses were held in Paris 1987, Washington 1991, and Hamburg 1995 and this event is now firmly established as the premier international conference in applied mathematics. The last mathematical congress of comparable importance and size to be held in the UK was the International Congress of Mathematicians held in 1958. This, too, was held in Edinburgh. The success of that congress bodes well for ICIAM 99.
The congress will focus worldwide attention on the importance of mathematical and computational methods in the solution of real world problems. The main features of the programme will be:

(1) 25 general lectures by leading international experts on current developments of industrial, computational and applied mathematics. Mathematical methods for the qualitative and quantitative analysis of models will be presented and important practical applications will be discussed extensively. Particular themes will include:
- Mathematical Modelling in Industry
- Mathematics of Medicine
- Financial Mathematics, Insurance, Investment and Banking
- Geophysical and Oil Sciences
- Large Scale Computation
- Environmental and Climate Science
- Cryptography, Coding and Computer Security

(2) 300 mini-symposia and organised discussion sessions to provide integrated presentations and discussion by international panels on the latest mathematical and computational techniques. Research on industrial, commercial and environmental applications will be discussed as well as other issues including applied mathematics education, public perception of mathematics, and the organisation of applied mathematics societies.

(3) Special all-day sessions will be run in conjunction with learned societies and other organisations discussing new research in the mathematical and computational sciences and outlining novel applications.

(4) End of Conference Session with a panel presenting overviews and perspectives, drawing conclusions from lectures and mini-symposia, and looking foward to the challenges and problems of the next century.

Organisation of the Congress
The Joint Patrons of the Congress are H.R.H. The Prince Philip, Duke of Edinburgh, K.G., K.T. and The Right Hon. The Lord Mackay of Clashfern.
The Committee for International Conferences on Industrial and Applied Mathematics (CICIAM) is an international association of societies involved in applied mathematics and its applications. The main activity of CICIAM is to hold a four-yearly international congress. The present chair of CICIAM is Professor R. Mennicken (Regensburg University).
A company, ICIAM 99 Ltd, has been formed and is responsible for all legal and financial aspects of the congress. The Chairman of the company is Sir Michael Atiyah.
The scientific programme and, in particular, the selection of invited speakers lies in the hands of an international Scientific Programme Committee chaired by Professor J.C.R. Hunt, Honorary Professor at University of Cambridge and, until recently, Chief Executive of the Meteorological Office. The committee has 30 members from 16 different countries.
Chairman of the Programme Management Committee is Professor Jack Carr (Heriot Watt University).
A UK Action Group co-ordinates the involvement and support of the UK scientific community. Organisations involved include the British Computer Society, Royal Statistical Society, Institute of Mathematics and its Applications, International Centre for Mathematical Sciences, London Mathematical Society, Operational Research Society, Royal Society, Royal Society of Edinburgh, Engineering and Physical Sciences Research Council.

Information about Edinburgh
Edinburgh, one of the world's most beautiful cities, is renowned for its unique history, architectural grandeur, and cultural vibrance. Built on a series of spectacular hills and valleys, the city provides a superb background

to any conference; over six million visitors and delegates are attracted each year. Edinburgh is the UK's most important financial centre after London and its residents enjoy a quality of life unrivalled throughout the UK. Within the city boundaries are 23 golf courses, an internationally-acclaimed zoo, Royal Botanic Gardens, and Holyrood Park, dominated by an extinct volcano. Edinburgh has a distinguished scientific and mathematical heritage. James Clerk Maxwell was born in the city; his birthplace now houses the headquarters of the ICMS. The Congress will take part on the George Square campus of the University of Edinburgh which is close to the city centre.

Information about ICIAM 99
Further information on the Congress can be found on the World Wide Web under the address

http://www.maths.ed.ac.uk/conferences/iciam99/

where the current information is constantly brought up to date and you can preregister for the meeting following the easy instructions.
If you do not have access to the World Wide Web, further information can be obtained by writing/telephoning/faxing/emailing

ICIAM '99 Congress Secretariat
c/o Meeting Makers
50 George Street
Glasgow G1 1QE
UK
telephone +44 (0)141 553 1930, Fax: +44 (0)141 552 0511,
email geninfo.iciam@meetingmakers.co.uk

Highly Structured Stochastic Systems

A New Initiative in European Statistics

The European Science Foundation (ESF) is funding a Scientific Programme on Highly Structured Stochastic Systems. This follows the earlier, very successful, ESF Scientific Network with the same title. The Programme will run from 1997 to 2000.
Highly Structured Stochastic Systems (HSSS) combine simple local relations to build — via conditional independence — stochastic models that exhibit great complexity. Such complex stochastic models have found applications in areas as diverse as expert systems, genetics, and statistical mechanics. The needs of these areas have in turn stimulated important theoretical developments. By emphasising common ideas and structures, such as graphical, hierarchical and spatial models, and techniques, such as Markov chain Monte Carlo methods and local exact computation, the Network has already succeeded in stimulating cross-disciplinary work in stochastic systems. The new Scientific Programme is funded at a higher level to build on this success.

New challenges for research include developing diagnostic and analytic tools for model criticism; understanding sensitivity of models to local specifications; designing new MCMC algorithms, identifying limits of causal interpretation in networks representing observational studies; introducing nonparametric elements into graphical models; extending the theory and methodology to systems that develop over time.
To help meet these and other challenges, the programme will arrange focused workshops, summer schools, open conferences, and support for research visits.
Anyone interested in HSSS and in the new ESF Scientific Programme may join the HSSS email discussion list. Simply send a message to `mailbase@mailbase.ac.uk` and put in the body of your message the words "join hsss" followed by your name. You will then receive information about how to use the list. The list is open for any discussion of matters relating to Highly Structured Stochastic Systems, and will be a major vehicle for providing HSSS activities.
There is also the Programme's web page: `http://www.maths.nott.ac.uk/hsss/` which contains a growing amount of information about the Programme, its activities and how interested researchers might participate.

Second EMS Lectures

The European Mathematical Society chose as its EMS-lecturer of the year 1997 Professor Nigel Cutland from Hull, UK. Professor Cutland gave his lectures in Helsinki at the end of May. A related visit with the same theme was paid to Gothenburg during the annual meeting of the Swedish Mathematical Society.
In Helsinki, he gave a series of four lectures with an interesting survey of modern Loeb measure theory and its applications in fluid dynamics, Malliavin calculus and mathematical finance theory.
Cutland's work is related to Abraham Robinson's nonstandard analysis. This is a way to give exact meaning to infinitesimals and to use them in several areas of mathematics. Nonstandard analysis dates back to the early 60's. Before Robinson, logicians were long aware of the existence of nonstandard models but Robinson realised that such models yield not only metamathematical information but also a new way to do mathematics.
The term 'Loeb measure' refers to one of the most interesting and fruitful ideas in nonstandard analysis. It is actually a method for constructing measure spaces with several interesting properties. In his own work Professor Cutland has applied this method widely and successfully. Besides several original research papers Cutland has written, together with Marek Capinski, a monograph on the use of nonstandard techniques in fluid dynamics.
Nigel Cutland's visit to Helsinki was profitable. Several Finnish mathematicians followed his enjoyable lectures and had fruitful discussions with him. Plans for a future joint research project were also made.
Besides mathematics there was also some time for social programme. The University of Helsinki gave a reception in honour of Cutland.

The exact titles and abstracts of Cutland's lectures are below.

(1) Loeb Measures
After a brief introduction to nonstandard analysis, we will describe the Loeb measure construction, and give a few elementary and, by now, classical, applications.

(2) Stochastic Fluid Mechanics
We will begin with a careful exposition of the solution to the Navier–Stokes equations using nonstandard ideas. Then we will show how the basic idea can be extended to tackle a range of more advanced problems—including stochastic Navier–Stokes and stochastic Euler equations, statistical solutions, and attractors for stochastic Navier–Stokes equations (both measure attractors and stochastic attractors).

(3) Malliavin Calculus and Related Topics
Malliavin calculus is a generic name for a large body of ideas and results, sometimes known as stochastic calculus of variations. Many of the ideas have intuitive descriptions using the power of nonstandard analysis and Loeb spaces. We will present a story beginning with Wiener's "Differential Space" ($S^{\infty}(\sqrt{\infty})$), and discussing a precise formulation of it using nonstandard analysis, which we call the Wiener sphere. From there we will discuss the basics of Malliavin calculus as classical calculus in a nonstandard Euclidean space, the infinite dimensional Ornstein–Uhlenbeck process and its connections with Brownian motion on the Wiener sphere.

(4) Mathematical Finance Theory
Loeb space methods allow a unified treatment of discrete (Cox–Ross–Rubinstein type) pricing models and continuous (Black–Scholes type) pricing models—the latter being based on Ito calculus. The continuous theory comes from the discrete theory with infinitesimal time steps. A new mode of convergence is very naturally formulated in nonstandard terms, and for this it can be claimed that the whole discrete theory converges to the continuous one—we will discuss particular examples of this.

Call for the EMS Lectureship 1999

Bids for the EMS Lectureship 1999 are invited, following the rules outlined below, and should be sent to the secretary of the EMS, at the following address, not later than January 1, 1998.

Professor Peter Michor
Institut für Mathematik
Universität Wien
Strudlhofgasse 4
A-1090 Wien
Austria
Peter.Michor@esi.ac.at

The possibility to give the same lecture on two sites is welcome. See also the report on the EMS lectureship 1997 above.

About the EMS Lectureship

1. Nature and purpose
The idea of the EMS lectureship is, in each odd-numbered year, to invite a distinguished mathematician to visit an institution within the area covered by the EMS, to give a series of from three to five lectures of an advanced expository nature on a topic of current research interest. The lecturer should subsequently provide a written version, which should be submitted for publication, normally to the 'Journal of the European Mathematical Society', when it becomes established. In the selection of the venue for the lectures, preference should be given to institutions which might not otherwise be able to host such a meeting. If the lecturer agrees, the lectures should be repeated at one other location, also within the area covered by the EMS but remote from the first.

2. Financial arrangements
The EMS will pay travel expenses for the lecturer, and will also pay a lecture fee upon receipt of the manuscript. The host institution will be responsible for the lecturer's accomodation and living expenses, and for insuring appropriate hospitality.

3. Timing and selection
For the lecturer in year n, there will be an announcement in the September issue of the Newsletter in year $n-2$, inviting members to bid for a visit to their department by a named lecturer. At its first meeting in year $n-1$, the Executive Committe will agree on an ordered list of the top three choices for the combination lecturer+location. The President of the EMS will invite the lecturer to be the EMS Lecturer for year n. If the lecturer declines the invitation, then the second (and if necessary the third) choice will be approached. The host institution will then become responsible for making the detailed arrangements for the lectures and for arranging appropriate publicity for the event.

4. Previous EMS-lecturers: H. Lenstra, June 12-15, 1995 in Besancon, France. N. Cutland, May 23 and 26, 1997, in Gothenburg, Sweden, and May 27-June 2, 1997, in Helsinki, Finland.

Phil Davis Receives Danish Honorary Doctorate

Philip J. Davis of Brown University (Providence, R.I., U.S.A.) has received an honorary doctorate from Roskilde University (Denmark). The degree will be conferred on Davis in ceremonies to be held in September 17-19, 1997 in Roskilde on the occasion of the 25th anniversary of the university, an institution which over the years, at both faculty and student level, has paid considerable attention to the relationship between science and society.

From the citation:
Philip J. Davis is an international figure who has looked at mathematics and mathematical activity from a number of points of view: philosophical, societal and cultural. For years he has described, analysed, and offered critical discussion of important features of mathematical research, applications, and education. In this endeavour, his goals have been quite parallel to the main goals of the practice of mathematics at IMFUFA, where we have studied mathematics itself as well as the manner in which it functions in research, in applications and in education.

In recent years, Phil Davis has been occupied largely with pointing out and discussing the serious problem (due to overspecialization) of the cooperation between mathematicians in different fields. He has also discussed the conflicts that have arisen between mathematicians, constructors of mathematical models, users of such models, and the entire non-mathematical world which is nonetheless exposed to a high degree of mathematization and to its consequences. His concem has embraced such questions as the role of "expertocracy", the exaggerated confidence in mathematical modelling, as well as the blind rejection of decisions and actions based on mathematical models.

Prior to his interest in such problems, Phil Davis worked for years with technically intricate but basic problems in the mathematical field of numerical analysis; first at the National Bureau of Standards of the U.S.A., where he became Chief of the Numerical Analysis Section, and since 1963, at Brown University, Providence, R.I., as Professor of Applied Mathematics.

In 1981, Davis (together with Prof. Reuben Hersh) published a most influential and widely read book "The Mathematical Experience" which later was updated and translated and published in many languages. This book presents traditional but basic questions in a new way and provides new insights into the relation between modem science-based technology and societal development. In this book, Davis and Hersh address problems brought up, for example, at an international IMFUFA workshop "Mathematics and The Real World" (1978). This workshop was the occasion of the first contact between Davis and IMFUFA.

Over the years, Davis has elaborated his views in a series of monographs and articles, as well as in his monthly columns in SIAM NEWS, the bulletin of the international Society for Industrial and Applied Mathematics. He has presented his views in lectures and seminars at RUC; in 1989, he was the main lecturer at the 4th International Conference on the Teaching of Mathematical Modelling and Applications. More importantly, in 1992, when he was visiting professor at IMFUFA, he conducted a well-attended 3-months course on "Mathematics and Society" for Danish PhD students and other interested scholars.

Philip Davis' books and articles have become a constant, often provocative, source of inspiration and have provided material for mathematics education at RUC both in project work and in classroom teaching.

In designating Phil Davis as doctor honoris causa at RUC we desire to honour a unique combination of deep professional insight, a wide overview, societal and cultural understanding, moral integrity and, not least, an unremitting and charming — often even entertaining — dissemination of mathematics and its problems to broad circles within and outside the bounds of the profession.

Professor Philip J. Davis, Brown University, Providence, R.I. (U.S.A.)

Biographical Note

Philip Davis was born in 1923. He received his PhD from Harvard University in 1950 tor a thesis on "Uniqueness Theorems for Sets of Linear Functionals".

1944-1946 Aerodynamicist at the National Advisory Committee for Aeronautics, Langley Field, Virginia.
1949-1951 Post-Doctoral Research Assistant at Harvard University, School of Engineering.
1951-1952 Staff Member of the Lincoln Laboratories, M.I.T.
1952-1963 Applied Mathematics Division, National Bureau of Standards, Washington, D.C.

1959-1963 Chief, Numerical Analysis, National Bureau of Standards.
1963-1993 Professor, Division of Applied Mathematics, Brown University, Providence, R.I.
1993- Professor Emeritus and scientific writer.

Selected Books by Philip. J. Davis

1961 The Lore of Large Numbers, Random House and Yale.
1963 Interpolation and Approximation, Blaisdell Publishing Co., New York, Dover Publications, 1975.
1964 The Mathematics of Matrices, Blaisdell Publishing Co., New York, Wiley, 1975, Krieger Pub. Co., 1984.
1967 Numerical Integration, Blaisdell Publishing Co., Waltham, Mass., Academic Press, New York, 1975, 1985 (with Philip Rabinowitz).
1979 Circulant Matrices, John Wiley, New York.
1981 The Mathematical Experience, Birkhäuser, Boston-Basel, Paperback, Penguin Books, 1982 (with Reuben Hersh).
1986 Descartes' Dream: The World According to Mathematics, Harcourt Brace Jovanovich, Cambridge-Orlando, Paperback, Pelican Books, 1988 (with Reuben Hersh).
1987 No Way: The Nature of the Impossible, W.H. Freeman, New York (with David Park).
1993 Spirals: From Theodorus to Chaos, AKPeters, Boston.
1997 Mathematical Encounters of the Second Kind, Birkhäuser, Boston-Basel.

Prizes and Awards

1960 Award in Mathematics, Washington Academy of Sciences.
1963 Chauvenet Prize, Mathematical Association of America.
1983 Lester R. Ford Award, Mathematical Association of America.
1983 American Book Award for "The Mathematical Experience".
1987 George Pólya Award, Mathematical Association of America.
1997 Communications Award, Joint Policy Board for Mathematics

Compiled by IMFUFA, Roskilde University

EUROPEAN NEWS: Country by Country

DENMARK

History and Philosophy of Mathematics

Second Announcement

Proof Theor y:History and Philosophical Significance

University of Roskilde
October 31 - November 1 1997

Proof Theory: Motivation
Proof theory was developed as part of Hilbert's Programme. According to Hilbert's Programme one could provide mathematics with a firm and secure foundation by formalising all of mathematics and subsequently prove consistency of these formal systems by finitistic means. Hence proof theory was developed as a formal tool through which this goal should be fulfilled.
It is well known that Hilbert's Programme in its original form was unfeasible mainly due to Gödel's incompleteness theorems. Additionally it proved impossible to formalise all of mathematics and impossible to even prove the consistency of relatively simple formalised fragments of mathematics by finitistic methods. In spite of these problems, Gentzen showed that by extending Hilbert's proof theory it would be possible to prove the consistency of interesting formal systems, perhaps not by finitistic methods but still by methods of minimal strength. This generalisation of Hilbert's original programme has fuelled modern proof theory which is a rich part of mathematical logic with many significant implications for the philosophy of mathematics.

Although a completely secure justification of mathematics is impossible it is, however, possible to achieve many fundamental partial results concerning relative consistency of theories, concerning the strength of axiomatic systems and finally concerning the relationship between constructive, predicative and classical systems of analysis.

The purpose of this meeting is to survey the history of proof theory and its role in the analysis of the philosophical foundations of mathematics from its first primitive form in Hilbert's original Programme to its modern highly articulated form. Accordingly, **the emphasis will be on historically and epistemologically important episodes in the development of proof theory, not on technical aspects**. All lectures will be of such a nature that they can be followed by mathematicians and philosophers without any professional training in proof theory but possessing a general knowledge of fundamental studies.

List of Invited Speakers and Talks

Prof. Solomon Feferman, Csli, Stanford University, CA, USA.

Proof Theory and Studies of the Foundations of Analysis
1. Highlights in proof theory since Hilbert's first formulation.
2. The significance of Herman Weyl's "Das Kontinuum".
3. Reflections on the relationship between constructive, predicative and classical systems of analysis.

Prof. Wilfried Sieg, Dept. of Philosophy, Carnegie Mellon University, PA, USA.

4. Hilbert's Programmes: 1917-1922.
5. Natural Reasoning Mechanised.

Prof. Dirk van Dalen, Dept. of Mathematics, University of Utrecht, The Netherlands.

6. Herman Weyl's Conception of Intuitionistic Mathematics.
7. The Development of Intuitionistic Mathematics.

Prof. David Rowe, AG Geschichte der Mathematik, Universitaet Mainz, Germany.

8. On the Structure and Strategy of the Argument in Hilbert's *Grundlagen der Geometrie.*
9. On Hilbert and the Göttingen Mathematical Community

Prof. Leo Corry, Dept. of History and Philosophy of Science, Tel Aviv University, Israel.

10. The Empiricist Origins of Hilbert's Axiomatic Approach.

Prof. Erhard Scholz, Dept. of Mathematics, Universität Wuppertal, Germany.

11. Herman Weyl on the concept of continuum and the construction of mathematical symbol systems.

Prof. Moritz Epple, AG Geschichte der Mathematik, Universität Mainz, Germany.

12. Did Brouwer's intuitionistic analysis meet its own epistemological standards?

Time and Location
All presentations will take place at the University of Roskilde in the auditorium in building 46.

	Friday, October 31	Saturday, November 1
09.30 - 10.30	Prof. S. Feferman (1)	Prof. W. Sieg (5)
10.30 - 11.30	Prof. W. Sieg (4)	Prof. D. Rowe (8)
11.30 - 12.00	**Coffee Break**	**Coffee Break**
12.00 - 13.00	Prof. D. van Dalen (6)	Prof. D. van Dalen (7)
13.00 - 14.00	**Lunch**	**Lunch**
14.00 - 15.00	Prof. S. Feferman (2)	Prof. E. Scholz (11)
15.00 - 16.00	Prof. L. Corry (10)	Prof. M. Epple (12)
16.00 - 16.30	**Coffee Break**	Prof. S. Feferman (3)
16.30 - 17.30	Prof. D. Rowe (9)	**End**

Abstracts

Prof. Wilfried Sieg, Dept. of Philosophy, Carnegie Mellon University, PA, USA.

"Hilbert's Programmes: 1917-1922"
Hilbert's finitist programme was not created at the beginning of the twenties solely to counteract Brouwer's Intuitionism, but rather emerged out of broad philosophical reflections on the foundations of mathematics and out of detailed logical work; that is evident from notes of lectures that were given by Hilbert and prepared in collaboration with Bernays, in the period from 1917 to 1922. These notes reveal a dialectic progression from a critical logicism through a radical constructivism towards finitism; the progression has to be seen against the background of the stunning presentation of mathematical logic in the lectures given during the winter term 1917/18. In this talk, I sketch the connection of Hilbert's considerations to issues in the foundations of mathematics during the second half of the 19th century, describe the work that laid the basis of modern mathematical logic, and analyze the first steps in the new subject of proof theory.

"Natural Reasoning Mechanised"

The presentation of mathematical logic in the lectures from the winter term of 1917/18 includes a careful formulation of a logical calculus for first order logic. The issue of its (empirical) completeness to recapture mathematical arguments is central, so is that of the algorithmic decidability of validity, i.e., the decision problem. The background of these issues is described together with the negative solution of the decision problem by Turing and Church. Then the focus shifts to formulations of logical calculi by Hertz and Hilbert that led to the sequent, respectively natural deduction calculi of Gentzen. The latter calculi make somewhat plausible Hilbert's claim that "The fundamental idea of my proof theory is none other than to describe the activity of our understanding, to make a protocol of the rules according to which our thinking actually proceeds." The set-up of natural deduction invites strategic considerations that, in turn, inform particularly direct ways of constructing proofs – through suitable computer programs. Such programs have been used both for logical and psychological experimentation.

Prof. Dirk van Dalen, Dept. of Mathematics, University of Utrecht, The Netherlands.

"The Development of Intuitionistic Mathematics".
Brouwer's foundational views originated from his mystical-philosophical ideas. Already in 1898 he formulated a highly idealistic view of the world. In 1905 he more or less repeated his ideas in a mystical setting (Life, Art and Mysticism). The subsequent dissertation (1907) cannot be properly appreciated without keeping these facts in mind. The constructivism of the dissertation went further than both Kronecker's and the French brand. The first Brouwerian constructivism (called neo-intuitionism in 1912) wavers between a constructive universe and a "non-lawlike" one. E.g. he accepts an immediately given continuum which is not lawlike. In

the war years he worked out a new approach in his lectures on point set theory. In these lectures the choice sequences are accepted as fully legitimate and the basic continuity principle is formulated. The new version of intuitionism appears in print in 1918. The big step forward, i.e. the continuity theorem, fan theorem etc., is made in 1924. In the following years the creating subject is introduced; in his Berlin lectures it is used (without explicit mention). The publication follows only in 1948. The various notions of intuitionism are refined and revised in the course of time by Brouwer. In the lecture the development of the various notions and ideas will be sketched.

"Herman Weyl's Conception of Intuitionistic Mathematics".

Right after the Great War in 1919, Brouwer made a trip to Switzerland where he met Weyl, to whom he explained his new intuitionism. Weyl was immediately convinced that Brouwer's rendering of the continuum was more faithful than his own approach of "Das Kontinuum". Weyl elaborated Brouwer's ideas in a seminar at Zürich and published the results in his revolutionary paper "Über die neue Grundlagenkrise der Mathematik". The paper contains Weyl's version of Brouwer's intuitonism. It differs from Brouwer's version in a number of ways. E.g. Weyl's choice sequences seem to be a kind of continuous images of "lawless sequences". Furthermore, Weyl reviewed the role of logic and the excluded third. By declaring existential and universal statements be "judgement abstracts" instead of real statements, he gave an explanation of the failure of the principle of the excluded third. In subsequent expositions he further explained the intuitionistic views. He soon abandoned his intuitionistic activities, although he remained convinced that intuitionism held the proper conceptual views of the universe. Weyl's New Crisis-paper opened the Grundlagenstreit. Where Brouwer avoided any provocation by publishing dry, scholarly expositions, Weyl's evocative language provoked Hilbert's sharp reactions.

David E. Rowe, AG Geschichte der Mathematik, Universität Mainz, Germany.

"On the Structure and Strategy of the Argument in Hilbert's *Grundlagen der Geometrie*".

Hilbert's interest in axiomatics first became evident in 1899 with the appearance of his *Grundlagen der Geometrie*, a work that established a new research paradigm for the foundations of geometry. Indeed, this famous text underwent twelve editions, many of which reflect ongoing efforts to refine and improve its concepts and arguments (including those prepared by Paul Bernays after Hilbert's death). Although this famous study has often been portrayed as having emerged like a bolt of lightning from Hilbert's fertile brain, Michael Toepell has shown that it actually represents the culminating phase in a much longer intellectual process that also involved important contributions by several other lesser-known figures. In this talk, I will discuss certain parts of this longer Hilbertian journey in an effort to dispel some of the by now deeply ingrained myths that surround his early work. By examining the overall structure of the argument in *Grundlagen der Geometrie* and some of the more significant emendations that appear in subsequent editions, I hope to show that a clearer picture of Hilbert's approach to foundations of geometry, in particular, as well as with regard to axiomatics, in general, can be formed.

"On Hilbert and the Göttingen Mathematical Community."

Following the publication of his *Grundlagen der Geometrie* in 1899 and his Paris lecture on *Mathematische Probleme* of 1900, Hilbert soon emerged, alongside Poincare, as one of the two leading mathematicians of the new era. Having worked in splendid isolation in Koenigsberg until 1895, he arrived in Goettingen where he exerted an unparalleled influence over the next twenty years. As benefactors of major support from both industry and the Prussian state, Hilbert, Klein, and their Göttingen colleagues could thoroughly dominate German mathematical affairs. During the Weimar era, a period of widespread discontent in German academic quarters, Göttingen could no longer maintain its dominant position. Thus, it was in an atmosphere filled with tension and a sense of looming fragmentation that Hilbert launched his proof theory, and he did so in a polemical fashion that aimed to fend off the critical foundational views of both Brouwer and Weyl. In this presentation, I will suggest how some of the larger issues connected with this shift in scientific atmosphere at Göttingen from the pre- to post- war period shaped and intensified this famous crisis in the foundations of mathematics.

Prof. Leo Corry, Dept. of History and Philosophy of Science, Tel Aviv University, Israel.

"The Empiricist Origins of Hilbert's Axiomatic Approach."

"Hilbert's Programme", "Proof Theory", "The Formalist Philosophy of Mathematics", "Grundlagen der Geometrie", "Hilbert's Axiomatic Approach": It is often the case that all these terms are presented-either

implicitly or explicitly-as closely interrelated with one another, and even as different sides of one and the same phenomena. In particular, the name of Hilbert has usually been associated, in one way or another, with the formalist interpretation of the essence of mathematics. However, a careful examination of Hilbert's published works, but especially of his unpublished Göttingen lectures, brings to the fore a completely different picture of the historical Hilbert, and of his conceptions about the nature of mathematical knowledge, about the foundations of geometry, and about the relationship between mathematics and the sciences.
Hilbert's formalistic position in the debate on the foundations of arithmetic of the 1920s was very clearly delimited in time and in subject matter. Thus, amidst many changes that affected his conceptions over the years, Hilbert always took an outright empiricist stance concerning the question of the foundations of geometry; for Hilbert, geometry was one among the natural sciences. The axiomatic approach he adopted for his discussion of geometry in *Die Grundlagen der Geometrie* was an outgrowth of this empricist conception, and among the main sources from which he took inspiration for elaborating his axiomatic approach one finds works in the foundations of mechanics, such as Heinrich Hertz's. Understanding the empiricist roots (in fact, the empiricist essence) underlying Hilbert's axiomatic approach is essential for understanding the historical import of his work in geometry, in physics and in the foundations of mathematics in general.

Prof. Moritz Epple, AG Geschichte der Mathematik, Universität Mainz, Germany.

"Did Brouwer's intuitionistic analysis meet its own epistemological standards?"

While the basic ideas of intuitionistic analysis were quite well received by a small group of mathematicians during the first decades of this century, hardly anybody except Brouwer's immediate students seems to have followed the technical development of intuitionistic analysis very far. In particular, the mathematics based on Brouwer's fundamental theorem on finitary spreads found little or no reception at all for quite some time. In this talk, I will argue that one reason for this missing reception was an intrinsic difficulty of Brouwer's original intuitionistic program. While much of the attractiveness of the latter derived from its strong epistemological claims - every mathematical truth must be verifiable in a finite number of cognitive steps - it was indeed unclear whether these claims were respected in Brouwer's own revision of analysis. In particular, the proof of the basic "fan theorem" involved an argument that had a rather unclear epistemological status.Only much later, Kleene's metamathematical investigations made clear that at this point, intuitionistic analysis, now understood as a formal theory, had to invoke a new proof principle - bar induction - or some equivalent axiom. This metamathematical clarification, however, left the fundamental epistemological issue unanswered: Is the introduction of the new proof principle justifiable on the basis of the original epistemological views? Whatever the final answer to this question may be, it is understandable that in the 1920's and 1930's, mathematicians had great difficulties in following Brouwer's technical arguments on intuitionistic analysis.

Prof. Erhard Scholz, Dept. of Mathematics, Universität Wuppertal, Germany.

"Herman Weyl on the concept of continuum and the production of mathematical symbol systems".

Herman Weyl's contribution to the elaboration of mathematical concepts of the continuum took place on different methodological levels (mathematical objects in the literal sense, enunciation of philosophically motivated basic conditions for such productions, and speculations or reflections on physical references for the same). Moreover we find at least three different approaches to a mathematical elaboration of the continuum concept only during the years 1917 to 1925:

(1) Arithmetical construction of a (restricted) continuum (1917/1918).
(2) Arguments in favour of an intuitionistic continuum concept following Brouwer's proposals of free choice sequences (mainly during 1920/1921).
(3) Philosophically inspired continuum concept as constituted from infintesimal neighbourhoods with strong consequences for a conceptual refinement of differential geometry ("purely infinitesimal geometry") with first daring steps into the theory of connections in the differential geometric sense and of gauge geometry (1918 – 1923).

Approaches (2) and (3) had certain links but turned out not to be completely compatible, as Weyl apparently hoped in 1920/1921. His aspirations for physical semantics gave him the conviction that in cases of doubt approach (3) should be taken as more fundamental than a pure approach of type (2) (intuitionistic continuum concept). The same reason, Weyl's shifting perception of what kind of mathematics might be proper for a deeper understanding of (physical) nature, was apparently essential for his shifting evaluation of the balance

of pros and contras with respect to Hilbert's emphasis of the axiomatic method in modern mathematics and his programme for a foundation of classical analysis and set theory.

Additionally, abstracts for the scheduled presentations are also available on the following homepage:

http://mmf.ruc.dk/conf/pfab.htm

Registration Registration is free and does not include any housing, transportation, etc. Please write (or fax)

Klaus Frovin Jørgensen
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DK-4000 Roskilde, Denmark
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and include the following infomation:

(1) Name.
(2) Institution.
(3) Country and Zip Code.
(4) Phone.
(5) Email.

If email is used be sure to include "Proof Theory Registration" in the subject entry. *All questions* pertaining to *registration only* should be directed to Klaus Frovin Jørgensen.
No individual notification upon registration will be forwarded to individual participants. However, the conference's www-homepage

http://mmf.ruc.dk/conf/proofthe.htm

will be updated regularly including a list of registered participants.

Organising Committee The organising commitee consists of the following members:

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DK-2300 Copenhagen S, Denmark
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All questions pertaining the conference (*not registration*) should be brought to the attention of Vincent F. Hendricks.

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FRANCE

Symposium on trends in Applications of Mathematics to Mechanics (STAMM 98)

See Web page http://www.inln.cnrs.fr/stamm98

HUNGARY

Colloquium on Topology, Gyula, Hungary, 1998
9 to 15 August, 1998

PRELIMINARY ANNOUNCEMENT

The Janos Bolyai Mathematical Society is organizing a Colloquium on Topology in the period of August 9-15, 1998 in Gyula. The aim of the Colloquium is to provide ground for the exchange of information on new achivements and on the recent problems of General, Algebraic and Differential Topology.

Organising Committee:
M. Bognar, A. Csaszar (chairman), J. Gerlits, I. Juhasz, E. Makai, G. Moussong, R. Rimanyi, A. Stipsicz, J. Szenthe, L. Soukup, A. Szucs (secretary)

Location: Gyula is a beautiful city at the Eastern part of Hungary with a medieval castle and a thermal bath.
The Colloquium is held right after the ICM Berlin meeting.
The papers submitted to the Colloquium are planned to be published in a special volume of the journal "Topology and Its Applications".
If you are interested, please send an e-mail to gyula@math-inst.hu

SPAIN

Number Theory and Arithmetical Geometry
Arithmetical Applications of Modular Forms

San Feliu de Guixols, Spain, 24-29 October 1997

In association with the European Mathematical Society

Chairman: G Frey (Essen)
Vice-Chairman: J B Bost (Bures)

SPEAKERS WILL PROVISIONALLY INCLUDE:

V Abrashkin (Moscow) E Bayer-Fluckiger (Besancon) G Bockle (Essen) N Boston (Urbana) J Cremona (Exeter) H Darmon (Montreal) F Diamond (Cambridge, USA) E de Shalit (Jerusalem) E Kani (Kingston) G van der Geer (Amsterdam) M Hindry (Paris) A Kraus (Paris) I Kiming (Copenhagen) R Murty (Kingston) P Parent (Rennes) R Pink (Mannheim) J Quer (Barcelona) H G Ruck (Essen) R Schoof (Amsterdam) R Sujatha (Bombay) S Vladuts (Moscow)

SCOPE OF THE CONFERENCE

The conference will focus on:
Galois representations and applications to diophantine problems. Arithmetic of modular curves, conjectures of Birch and Swinnerton-Dyer type, the theory over function fields.
Applications to coding theory and cryptography.

A crucial goal of the conference is to give young researchers the opportunity to learn about the state of art, interesting questions and possible future developments. The conference is open to researchers world-wide, whether from industry or academia. Participation will be limited to 100. The emphasis will be on discussion about new developments. The Registration Fee covers full board and lodging. Grants will be available for younger scientists, in particular those from less favoured regions in Europe.

Deadline for applications: 3 months before the conference

For information and application forms, contact the Head of the EURESCO Unit: Dr Josif Hendekovic, European Science Foundation, 1 quai Lezay-Mernesia, 67080 Strasbourg Cedex, France. Tel + 33 3 88 76 71 35 Fax + 33 3 88 36 69 87 E-mail:euresco@esf.org on-line information and application on WWW at: `http://www.esf.org/euresco`

SWITZERLAND

Hyperbolic Problems – Theory, Numerics, Applications
ETH Zurich, February 9-13, 1998

Objectives
The aim of the conference is to bring together scientists with interests in the theoretical, applied and computational aspects of hyperbolic partial differential equations. There will be an emphasis on nonlinear problems and applications in different fields. As has been done in the past, a special effort will be made to make it possible for young scientists to attend to promote their interaction with more senior researchers.

Plenary Speakers
P. Lax, USA, J.A. Sethian, USA, T.P. Liu, USA, B. Perthame, France, K.W. Morton, UK, E. Priest, UK, R. Rannacher, Germany, G. Metivier, France, E. Tadmor, USA, M. Pulvirenti, Italy, Z. Xin, USA, A. Kazhikhov, Russia, J.-Y. Chemin, France, D. Marchesin, Brasilien

The speakers include:
R. Winther, Norway, D. Serre, France, T. Yang, Hong Kong, M. Fey, Switzerland, B. Gustafsson, Sweden, A. Schroll, Germany, M. Feistauer, Czech Republik, S.M. Deshpande, India, P. Le Floch, France, A. Kluwick, Austria, J. Ballmann, Germany, G.Q. Chen, USA, K. Powel, USA, S. Nishibata, Japan, B. Engquist, USA, J. Masso, Germany, B. Temple, USA, E. Mueller, Germany, H.-O. Kreiss, USA, C. J. Van Duijn, Netherlands, R. LeVeque, USA, R. Klein, Germany

For more information see `http://www.sam.math.ethz.ch/ hyp98/index.html` or contact the Conference Office

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INTERNATIONAL NEWS

USA

The Third International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing is to be held in Claremont, California at The Claremont Colleges on June 22-26,1998.
The conference web page, which includes the preliminary announcement, can be found at http://www.cgu.edu/math/mcqmc98.

Problem Corner

Paul Jainta, Werkvolkstr. 10, D-91126 Schwabach, Germany

Global Players in Mathematics
The Tournament of the Towns

This summer the German Institute of German-French friendship and a great French cheese factory started a joint advertising campaign in national journals with a view to establishing new friendships between the people of each country. The slogan was: *One flavour joins up nations!* At long last this push is meant to bring together new foreign friends. It's not often that a soft cheese acts as a catalyst to set off such a process! Here, the way to amity is through one's stomach. World-wide, there is heavier fare to spark off friendships amongst young people and the name of this global player is *Tournament of the Towns*. In this case, the way to a man's heart is through his brain. This mathematical tournament adroitly exploits the attraction to the young of all kinds of sporting events. Complete forms from schools, mixed teams or individuals are drawn from towns dotted about the globe to compete with their rivals in scoring points and yet becoming bosom pals without leaving the comfort of their home towns. The slogan perhaps should now read: *Many distinct towns, but one taste!*

Introduction

The International Mathematics Tournament of the Towns is an international problem-solving competition, originating in the (then) USSR, in which small and large towns throughout the world are able to participate on an equal footing owing to a democratic formula which takes into account the town's population. Thus, for example, in 1996, *Ljubljana* fared much better than *Moscow*, in spite of its smaller headcount. Students participate in their own town which involves minimal transport and administrative costs.

Format

The Tournament is conducted annually, in two rounds. The timing is meant to coincide with a northern academic year, although this is not a problem for students in the southern hemisphere. The two stages are held in Autumn (usually October) and Spring (usually March). Owing to distances between participating towns and the consequent difficulties with communication, and when local juries have been satisfied with the security of the question paper, the Tournament has been allowed to run up to about 4 weeks late in some towns.

Each town may enter either round, or both, within the Tournament. The town's score is the based on the average of the scores of the town's best N students, from either round. In the case of a town with a population greater than 500 000, N is the population divided by 100 000. In the case of a town with smaller populations, 5 students are still necessary, but as compensation their score is boosted by a factor which ranges from 1 (population equals 500 000) to 1.625 (population equals 0).

The Tournament consists of two levels of paper within each round. Students are eligible if they still attend secondary school, in a year whose average age is about 17. In many countries, this would be the year immediately prior to University admission. There are two versions of each paper known as Senior and Junior Papers. Students in Years 10 and 11/12 (equivalent of final year in high school) are classified as Senior participants and therefore attempt the Senior Paper. So that Year 10 students are not disadvantaged their scores are multiplied by the factor $\frac{5}{4}$. The other paper is designated as the Junior Paper, for students in Years 8, 9 and 10. To ensure that the scoring is fair to all levels of students, Year 9 students have their scores multiplied by $\frac{4}{3}$ while students in Year 8 and below have their scores multiplied by $\frac{3}{2}$.

Within each round, there have generally been two papers, an O Level, and an A Level, spaced about a week apart. Students are awarded points based on their best responses to three questions. They may attempt both the O Level and A Level within each round, and be awarded the larger of their two scores. The A Level paper is more difficult, but offers more points. Note that the O Level and A Level papers were formerly known as the *training* and *main* versions of the paper.

The Tournament is not only a team event but also an individual one. Students with a sufficiently high score, typically about 13, are awarded a Diploma of the Russian Academy of Sciences while many local committees also award prizes of their own. The Tournament is managed by the Central Committee in Moscow, which is a subcommittee of the Russian Academy of Sciences. The International Mathematics Tournament of the Towns is sponsored by the Institute of New Technologies, whose director, *Alexei Semenov*, is a strong advocate of such international endeavours. For the superb organisation of this wonderful competition, much of the credit belongs to the excellent Russian mathematician, *Nikolai Konstantinov*.

History

This competition commenced in the USSR in the late 1970s and has since become truly international. The National (All Union) Olympiad of the USSR previously used a system which gave relatively little academic opportunity to the many capable students of the larger cities such as Moscow or Leningrad.

The first Tournament known as the *Olympiad of Three Towns* was held in 1979/80. Participation quickly grew and the Tournament changed its name to *Tournament of the Towns* in the next year. The newborn competition had difficulty in obtaining political recognition in its early years, but the Tournament's popularity in 1984, when it became a subcommittee of the USSR Academy of Sciences, allowed it to be opened up to foreign countries. This attracted entries from numerous towns in Eastern Europe, in particular Bulgaria where a national committee was formed. In 1988 the city of Canberra entered the 10th Tournament becoming the first Western (in outlook) and English-speaking city to participate. The Tournament has continued to grow strongly with many towns partipating in it. Countries participating outside Eastern Europe now include Argentina, Australia, Austria, Canada, Columbia, Germany, Great Britain, Greece, Israel, New Zealand, Serbia, Slovenia, Spain, and USA. Thus presently there are 92 towns with a total population of 78 million people in the Tournament. I will give a more detailed history of the Tournament in one of the next issues of the Corner.

How To Enter

The Tournament is open to towns throughout the world. A town is defined as its greater area. For example, London may consist of a number of smaller cities, such as Westminster, however Westminster could not enter alone as it belongs to 'greater' London. Smaller sections of a large city combine their marks with the city as a whole, and the best marks are counted towards the city score.

A town anticipating entry should contact one of the two addresses below for general enquiries. These contacts will also supply the rules of conduct, and question papers. Local organisers should then schedule the paper into their timetable in accordance with the rules. They are authorised to make their own assessments and choose the highest scores for final assessment in Moscow (i.e., at least one for each hundred thousand of population with a minimum of five).

These scripts should be sent to Professor Konstantinov in Moscow (address listed above) together with a declaration that proper examination procedures will be used; a list of names; schools; school years; and locally assessed scores for all the students who attempted the paper. This has to be posted by air-mail within a week reckoning from the date of the A Level paper.

Entry Fees

The Central Committee in Moscow faces some costs in organising the Tournament including postage, printing and employing University students to assess submitted scripts. The charge each year is \$US 50 per city, plus an additional \$US $3.N$ where N is the population in hundreds of thousands with a minimum of 5.

Further Information

Further information can be obtained from either:

Prof N Konstantinov, 'Turnir Gorodov', *Kvant* I Tverskaya-Yamskaya 2/1, MOSCOW 103 006, RUSSIA, Fax: 7-095-2515557 or E-mail: nsknkonst@glas.apc.org OR

Dr P J Taylor, Faculty of Information Sciences and Engineering, University of Canberra, PO Box 1, Belconnen, ACT 2616, AUSTRALIA, Fax: *International* 61-6-201-5096 or E-mail: pjt@ise.canberra.edu.du.

Everyone in the western part of our earth who has been actively involved in mathematics contests for years should be grateful to **Peter Taylor** for bringing the Tournament from the (then) Soviet block to the rest of the world. He spared no effort in getting this competition established here. He also learned the Russian language and so he is just the right man to help local and national organising committees for the Tournament to get further established.

The problems set in the individual rounds are downright engrossing from the masters of the craft. A few are technical in nature, but the vast majority are phrased in soothing everyday language, often with amusing settings. I hope I have made your mouth water and the questions below should be an appetiser leading to joy and excitement. I hope that you may become a supporter of the Tournament too, and take pleasure from problems like these; they're teasers one wants to solve.

Q. 74 At the beginning of a month a shop has 10 different products for sale, each with equal prices. Every day the price of each product is either doubled or trebled. By the beginning of the following month all the prices have become different. Prove that the ratio *maximal price/minimal price* is greater than 27. (Spring 1992, Junior, O Level)

Q.75 A sequence a_n is determined by the rules $a_0 = 9$ and for any nonnegative k,

$$a_{k+1} = 3{a_k}^4 + 4{a_k}^3.$$

Prove that a_{10} contains more than 1000 nines in decimal notation. **(Autumn 1991, Junior A Level)**

Q.76 Find the maximum number of parts into which the 0xy-plane can be divided by 100 graphs of different quadratic functions of the form $y = ax^2 + bx + c$. **(Spring 1990, Junior, A Level)**

Q.77 Fifteen elephants stand in a row. Their weights are expressed by integer numbers of kilograms. The sum of the weight of each elephant (except the one on the extreme right) and the doubled weight of its right neighbour is exactly 15 tonnes. Determine the weight of each elephant. **(Spring 1990, Junior, A Level)**

Q.78 Three piles of stones are given. One may add to, or remove from one of the piles in one operation the number of stones in the other two piles. For example [12, 3, 5] can become [12, 20, 5] by adding $17 = 12+5$ stones to pile 2 or [4, 3, 5] by removing $8 = 3+5$ stones from pile 1. Is it possible starting from the piles with 1993, 199 and 19 stones to get one empty heap after several operations? **(Spring 1993, Senior, O Level)**

Q.79 A square is constructed on the side AB of triangle ABC (outside the triangle). O is the centre of the square. M and N are the midpoints of the sides BC and AC. The lengths of these sides are a and b respectively. Find the maximal possible value of the sum $OM + ON$ (when the angle at C changes). **(Spring 1993, Senior, A Level)**

Next we look back to some further solutions to problems given in Newsletter No. 23 and for which some answers were submitted. Three questions (Q.63, Q.65 and Q.66) are waiting for resolution. Who will take pity on them? I warmly welcome proposals for solution. Our today tour through answers will lead us into the world of touting at first. Let's have a short sojourn at it.

Q.64 *The Quality Food Supermarket sells its own brand of frozen pizza. It has been discovered that when it places special advertising in the local newspaper, pizza profits rise to \$300 on the following day, declining \$5 per day thereafter, until profits become \$200 per day. The store manager decides to advertise more frequently to keep profits above \$200 per day.*
How often should newspaper advertising be done to maximize profit if the cost of advertising is \$40 each time it is done? Assume that initially the store realises \$300 profit.

Solution (Dr J N Lillington, Winfrith Technology Centre, Dorchester)

Suppose the advertising is done on the N^{th} day ($N \geq 1$). Consider the mean profit per day from day 1 to N (≤ 21). We can write the sum of daily profits as follows:

$$P(N) = \sum_{n=1}^{N} [300 - (n-1)\cdot 5] - 40.$$

The mean profit per day is $M(N) = \frac{1}{N} \cdot P(N) = \frac{1}{N}(300N - 5\sum_{n=1}^{N}(n-1) - 40)$

$$= \frac{1}{N}(300N - \frac{5}{2}(N-1)N - 40)$$

$$= 300 - \frac{5}{2}(N-1) - \frac{40}{N}.$$

Then $\frac{dM}{dN} = -\frac{5}{2} + \frac{40}{N^2} = 0 \Rightarrow N = \sqrt{\frac{1680}{105}} = 4$ and $\frac{d^2M}{dN^2} = -\frac{80}{N^3} < 0$ at $N = 4$, so that $M(N)$ is a maximum at $N = 4$.

Therefore it pays to place advertising every four days. ■

Q. 67 *The side lengths x, y, z of a triangle are integers, and one of its altitudes is equal to the sum of the other two. Prove that $x^2 + y^2 + z^2$ is the square of an integer.*

Solution (Dr J N Lillington)

Let a, b, c be the altitudes from the vertex opposite the sides x, y, z respectively.

We are given, say $a = b + c$ (1)

Since the area of the triangle, A, satisfies $A = \frac{1}{2}ax = \frac{1}{2}by = \frac{1}{2}cz$, it follows that by (1) $\frac{2A}{x} = \frac{2A}{y} = \frac{2A}{z}$ and $xy + xz = yz$ (2), by means of a little agebra.

Then $x^2 + y^2 + z^2 = x^2 + y^2 + z^2 - 2(xy + xz - yz) = (x - y - z)^2$ q.e.d. ■

Q. 68 *A function f satisfies the equation $f(x+1) + f(x-1) = \sqrt{2} \cdot f(x)$ for all real x. Prove that this function is periodic.*

First Solution (Raymond Mortini, Luxembourg, Université de Metz, Département de Mathématiques)

–Ed. *It is the first time that I received a submission in German language, and astoundingly it came to me from France. The overtures of friendship between Germans and Frenchmen aforementioned appear to work. So, it is fortunate that Mathematics can amplify such advances; hence this solution is presented true to the original.*

Behauptung. Es sei f eine Funktion auf $\mathbb{R}$ welche der Bedeinung genügt:

$$f(x+1) + f(x-1) = \sqrt{2} f(x)$$

Dann hat f die Periode 8.

Beweis. Es sei $x \in \mathbb{R}$ beliebig aber fest gewählt. Dan ergeben sich aus der Voraussetzung die folgenden Gleichungen:

$$f(x+8) = \sqrt{2}f(x+7) - f(x+6) = \sqrt{2}[-f(x+5) + \sqrt{2}f(x+6)] - f(x+6) = -\sqrt{2}f(x+5) + f(x+6) = -f(x+4).$$

Damit ergibt sich sofort die Behauptung $f(x+8) = -f(x+4) = -(-f(x)) = f(x)$.

Bemerkung. Alle Lösungen der obigen Funktionalgleichung haben die Form

$$f(x+n) = r(x) \cdot sin(\theta(x) + n \cdot \tfrac{\pi}{4}) \text{ für } x \in [0,1[, \quad n \in \mathbb{Z},$$

wobei $r(x) > 0$ und $\theta(x)$ beliebige Funktionen sind. ■

Also solved by Dr. J N Lillington.

Maurice Brémond, *Avignon, points out a gap in reasoning to Q. 61 (see Newsletter No. 24, page 22). In his opinion the validity of the following identity has not been verified:*

$$(3 + \sqrt{11})^{2n+1} = x^{2n+1} - \left(\frac{2}{x}\right)^{2n+1}$$

He advocates a third variant to this question, and his proposal is depicted in French so that we have restored the balance of using European linguae franca.

Q. 61 *For a nonnegative integer n let $a_n = \left[(3+\sqrt{11})^{2n+1}\right]$ be the greatest integer not exceeding $(3+\sqrt{11})^{2n+1}$.* Find the greatest power of 2 that divides a_n.

Solution. Voici la démonstration que je propose:

$x = 3+\sqrt{11}$ et $x' = 3-\sqrt{11}$ sont solutions de l'equation $z^2 = 6z+2$, d'où $z^3 = 6z^2+2z = 6(6z+2)+2z = 38z+12$ avec $(38, 12) \in \mathbb{N}^2$; ensuite, en supposant que $z^n = az + b$ avec $(a, b) \in \mathbb{N}^2$, on a:

$$z^{n+1} = az^2 + bz = a(6z+2) + bz = (6a+b)z + 2a \text{ avec } (6a+b, 2a) \in \mathbb{N}^2.$$

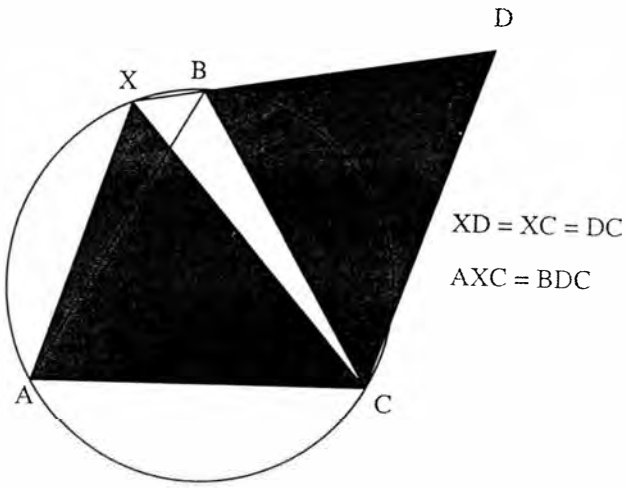
Ainsi, $\forall n \in \mathbb{N}$, $z^n = az + b$ avec $(a,b) \in \mathbb{N}^2$.

En particulier:
$$\left.\begin{array}{r} x^{2n+1} = cx + d \\ x'^{2n+1} = cx' + d \\ (c,d) \in \mathbb{N}^2 \end{array}\right\} \Longrightarrow x^{2n+1} + x'^{2n+1} + 2d = 6c + 2d \in \mathbb{N}.$$

Comme
$$9 < 11 < 16 \iff 3 < \sqrt{11} < 4 \iff 0 < \sqrt{11} - 3 = |x'| < 1$$
$$\Longrightarrow 0 < |x'|^{2n+1} = -x'^{2n+1} < 1$$
$$\iff x'^{2n+1} < 0 < x'^{2n+1} + 1$$
$$\iff x^{2n+1} + x'^{2n+a} < x^{2n+1} = \left(3+\sqrt{11}\right)^{2n+1} < x^{2n+1} + x'^{2n+1} + 1$$
$$\iff x^{2n+1} + x'^{2n+1} = \left[x^{2n+1}\right] = \left[\left(3+\sqrt{11}\right)^{2n+1}\right]. \quad \blacksquare$$

Last of all here's a further straggler to Q. 54 submitted by **Mario Barra**, Dipartimento di Matematica, Università „La Sapienza", Roma, Italy. *It is another proof without words and it looks as if this kind of mathematical reasoning enjoys more and more popularity.*

Q. 54 *ABC* is an equilateral triangle inscribed in a circle. The distances from a point *X* on the circle to *A*, *B* and *C* respectively are *a*, *b* and *c*, where $a \geq b$ and $a \geq c$. Prove that $a = b + c$.



That completes the *Corner* for this number. We are in high Olympiad season. Please collect your contests and send them to me. Also send me your nice solutions to problems posed in the *Corner.*

Finally, propose problems for which readers will send in solutions. Proposals should, whenever possible, be accompanied by a solution, references, and other insights which are likely to be of help for the editor. They can be anything from elementary to advanced, from easy to difficult. Original problems are particularly sought.

So, please submit any interesting problems you came across, especially those from (problem) books and contests that are not easily accessible. But other interesting problems may also be acceptable provided they are not too well known and references are given as to their provenance. I hereby invite my readers to share them with their colleagues and students.

I welcome your input, and especially problem sets and solutions for use!

BRIEF REVIEWS

Edited by Ivan Netuka and Vladimír Souček. Books submitted for review should be sent to the following address: Ivan Netuka, MÚUK, Sokolovská 83, 186 00 Praha 8, Czech Republic.

G.Laumon: Cohomology of Drinfeld Modular Varieties. Part I: Geometry, counting of points and local harmonic analysis, Cambridge Studies in Advanced Mathematics, vol.41, Cambridge University Press, Cambridge, 1995, xiii+344 pp., GBP 40, ISBN 0-521-47060-9

G.Laumon: Cohomology of Drinfeld Modular Varieties. Part II: Automorphic Forms, Trace Formulas and Langlands Correspondence, Cambridge Studies in Advanced Mathematics, vol.56, Cambridge University Press, Cambridge, 1997, xi+366 pp., GBP 40, ISBN 0-521-47061-7

According to Langlands conjectures, automorphic forms on reductive groups over a global field F should correspond to representations of the Galois group $\mathrm{Gal}(\overline{F}/F)$. Automorphic forms over number fields appear in cohomology groups of certain symmetric spaces. If the symmetric space in question consists of complex points of an algebraic variety defined over a number field ("Shimura variety"), then the relevant Galois representation should occur in étale cohomology of the Shimura variety. Drinfeld modular varieties are function field analogues (for groups GL_d) of Shimura varieties. One associates to a global function field F, with a distinguished place ∞, and an integer $d \geq 1$ an affine F-scheme M^d (a projective limit of smooth F-schemes of dimension $d-1$) equipped with an action of $GL_d(A^\infty)$, where A^∞ is the ring of adèles of F outside ∞. The aim of this monograph is to describe étale cohomology groups with compact support

$$W = 3D \sum_{i \geq 0} (-1)^i H_c^i((M^d \otimes_F \overline{F})_{et}, Q_l),\ (l \neq 3D\mathrm{char}(F))$$

as a virtual module over $\mathrm{Gal}(\overline{F}/F)$ x $Gl_d(A^\infty)$. As a consequence one obtains the Langlands correspondence and the Ramanujan-Petersson conjecture for automorphic forms on $GL_d(A)$ satisfying certain ramification hypothesis at ∞. For $d = 3D2$ these results are due to Drinfeld. The author slightly modifies Drinfeld's approach, following ideas of Langlands and Kottwitz. The method consists in comparing two trace formulas: (A) Grothendieck - Lefschetz fixed point formula for the action of (Frobenius) x (Hecke correspondence) on W; (B) Arthur-Selberg trace formula for $L^2(F_\infty^* GL_d(F) \backslash GL_d(A))$. The contents are the following: In Part I, Chapter 1 introduces Drinfeld modules, their level structures, Drinfeld modular varieties and Hecke correspondences. Chapter 2 gives a group theoretical description of isogeny classes of Drinfeld modules. Chapters 3-6 are devoted to the computation of the geometric side of the Grothendieck-Lefschetz formula. Chapter 7 recalls results from local harmonic analysis on GL_d. Chapter 8 relates Euler-Poincaré functions appearing in the Lefschetz formula to representation theory. In Part II, Chapter 9 recalls results on automorphic representations of $F_\infty^* \backslash GL_d(A)$. Chapters 10-11 provide a function-field version of Arthur's trace formula. In Chapter 12 the two trace formulas are compared, proving the main result. Chapter 13 gives a conjectural description of the intersection cohomology of the "Satake compactification"of M^d. Several appendices cover background material (central simple algebras, Dieudonné-Manin theory, representation theory of unimodular locally compact totally disconnected groups, reduction theory, decomposition of L_G^2). A short note by J.-L.Waldspurger proving one of key results of Chapter 11 is appended. Although the book is devoted only to automorphic forms over function fields, it can serve as a self-contained introduction to the methods of representation theory applicable in a more general context (e.g. to Shimura varieties). It will undoubtedly be very useful to both researchers and students specializing in number theory or representation theory. (jnek)

R.R.Hall: Sets of Multiples, Cambridge Tracts in Mathematics, vol.118, Cambridge University Press, Cambridge, 1996, xvi+264 pp., GBP 37.50, ISBN 0-521-40424-X

In 1913 L.E.Dickson introduced the notion of the primitive abundant number, as a number which is not a multiple of another abundant number. He used this notion in proofs of some important results on perfect numbers. In 1933 Davenport proved that the set of abundant numbers has asymptotic density, and one year later Erdös proved this by first proving that the series of reciprocals of primitive abundant numbers converges. This successively led by means of loosening of hypotheses to a series of results where the abundant numbers do not play a role anymore. The effort was concentr= ated on a study of the properties of the so-called primitive sequences (a sequence is primitive if none of its elements is divisible by any other) and the sequences of distinct (positive) multiples of elements of a given sequence. One of the fascinating aspects of the subject is the variety of problems and diversity of methods applied to their solutions. In 1966 in their book Sequences, H.Halberstam and K.F.Roth devoted a chapter to a systematic exposition of

properties of such sequences. There is a substantial theory on primitive sequences, and independently also on the theory of multiples. The book under review is the first devoted solely to the latter subject. It gives the first coherent, systematic and essentially self-contained account of the general theory of such sequences. The reader can find in it not only how surprisingly varied and rich subtle methods (based on elementary inequalities, Dirichlet series, exponential sums, probabilistic tools, etc.) were invented (e.g. new types of density, as t= he logarithmic density) to solve the arising problems. He can also be motivated to develop further contributions to the subject. The author has certainly collected a large number of interesting results in this little book. (šp)

M.Giaquinta, S.Hildebrandt: Calculus of Variations I. The Lagrangian Formalism, Grundlehren der mathematischen Wissenschaften, 310, Springer-Verlag, Berlin, 1996, xxix+474 pp., 73 fig., DM 188, ISBN 3-540-50625-X

The first volume of "Calculus of Variations" is an excellent survey of the formal apparatus as well as nonparametric field theory. Like any book on a subject of so vast an extent as the calculus of variations, it has to have a point of view to guide the selection of topics. In this first part, the authors concentrate on the classical theory presented very clearly in a modern and concise setting. Throughout the volume they use indirect methods, i.e., solutions to Euler-Lagrange equation are investigated to decide which are minimizers (or maximizers). In the first two chapters the rate of change of variational integral F is studied with respect to variations of dependent variables. The necessary conditions are deduced and suitable modifications for constrained minimisers are shown to hold. In the Chapter 3, the variations of F with respect to the independent variables are considered. It leads to the Noether equations for the so-called inner extremals and a deep study of it reveals interesting applications. The last section of this chapter is devoted to transformation behaviour of the Euler operator, if both dependent and independent variables are transformed in a general way. In subsequent Chapter 4, the necessary and sufficient conditions are given in terms of second variation. It is proved that the weak minimisers satisfy the Legendre-Hadamard condition, while strong minimisers satisfy the Weierstrass necessary condition. Chapter 5 deals with weak minimisers investigating the eigenvalues of Jacobi operator. Starting with convexity arguments in Chapter 5, the authors present in Chapter 6 the Weierstrass field theory (for the case of one independent variable), which is an apropriate tool to obtain sufficient conditions for strong minimisers. The reader is given assistance by a carefully written introduction to the volume as well as a detailed introduction to each chapter, section and subsection. The book contains many interesting examples, historical references and comments in footnotes and in Scholia at the end of each chapter where supplementary results and references to the literature are presented. The background from analysis and differential geometry is collected in a Supplement after Chapter 6. The style is excellent, consisting of an insightful overview with illustrative examples followed by well-organised main text. The book is a valuable addition to the literature, indispensable for mathematicians working in the field and interesting and stimulating reading for research workers and postgraduate students. (jsta)

E.H.Lieb, M.Loss: Analysis, Graduate Studies in Mathematics, vol.14, American Mathematical Society, Providence, 1997, xviii+278 pp., GBP 22.50, ISBN 0-821-80632-7

This book appeared in the series Graduate Studies in Mathematics and presents a somewhat unusual selection of material. The authors' intention is to give an exposition of the essentials of modern analysis suitable for physicists and other natural scientists. They emphasize its relation to other parts of mathematics or mathematical physics rather than stressing the presentation of the concepts of mathematical analysis themselves. Basic facts of measure and integration are briefly discussed (including a missing term in Fatou's lemma, layer cake representation, bathtub principle), and followed by a chapter on L^p- spaces. Chapters 3 and 4 are devoted to rearrangement inequalities and integral inequalities (as Riesz's rearrangement inequality and Hardy-Littlewood-Sobolev inequality). The Fourier transform in L^1 as well as in L^2 is studied, the sharp Hausdorff-Young inequality is discussed (not proved). Distributions and Sobolev spaces are investigated and, in particular, H^1, H^2 and Sobolev inequalities are studied in detail. Chapter 9 is on Potential Theory and Coulomb Energies; regularity of solutions of Poisson's equation is treated in Chapter 10. The last chapter presents an introduction to the Calculus of Variations (e.g. the Thomas-Fermi problem, balls have the smallest capacity etc.). I find the selection of the material covered in the book very attractive and I recommend the book to anybody who wants to learn about classical as well as modern mathematical analysis. (in)

C.Grosche: Path Integrals, Hyperbolic Spaces, and Selberg Trace Formulae, World Scientific, Singapore, 1996, xi+280 pp., GBP 31, ISBN 9-810-22431-1

This book collects many computations of various important path integrals, including the author's

results in the theory of path integrals and also in the theory of Selberg formula in the quantum field theory on Riemann surfaces. The book is directed to theoretical physicists working in quantum field theory, string theory and related fields. After an introduction, the book starts with the computations of some basic path integrals of quantum mechanics (and also with their basic transformations) – namely with the computations of path integrals for potentials like quadratic and Pöschl – Teller potentials. Then the author presents an overview of the separable (nonchaotic) potentials and symmetry breaking for path integrals in spaces of constant curvature. Next, some path integrals in homogeneous spaces (more specifically in euclidean and pseudoeuclidean spaces, on the sphere, and also on hyperboloids and pseudosphere) are studied in detail. In addition, computations are included for some hyperbolic biliard systems appearing in the theory of quantum chaos, in connection with the Gutzwiller formula on periodical orbits. This already leads to the (more general) Selberg trace formula, which is the main theme of the second part of the book, and which deals mainly with nonintegrable systems. (For the derivation of such a formula, the path integral is essential.) The following subjects are treated therein, mostly without detailed derivations: Selberg trace formula, Selberg zeta function and also the Selberg super trace formula and zeta function. The whole book has a review-like character. It contains many useful and important formulae and computations and will no doubt be a useful tool and suitable reference text for theoretical physicists working in the field. (mzah)

H.F.Baker: Abelian Functions. Abel's theorem and the allied theory of theta functions, Cambridge Mathematical Library, Cambridge University Press, Cambridge, 1995, xxxv+684 pp., GBP 27.95, ISBN 0-521-49877-5

This is a book on closed Riemann surfaces, algebraic geometry, Jacobian of curves and theta functions. First published in 1897, it is written in an informal style, notions and theorems come in a rapid sequence and are very easy to understand. In this way, the book presents an enormous amount of material - perhaps all that was known about curves and theta functions. Among others, it includes Riemann-Roch theorem, Abel's theorem, Jacobi's inversion with the help of theta functions, uniformization, automorphic forms and many more. The subject of this book is algebraic geometry and it is treated in the classical style. Various transcendental functions are studied and used. Riemann's view of algebraic functions - as a special class of analytic functions that should be understood as a whole and studied through global properties and singularities - is considered to be fundamental. The book presupposes some acquitance with the elements of the theory of Riemann surfaces. It should be an excellent book as a textbook and as a reference. (pš)

C.Chevalley: The Algebraic Theory of Spinors and Clifford Algebras. Collected Works, Volume 2, Springer-Verlag, Berlin, 1997, xiii+214 pp., DM 84, ISBN 3-540-57063-2

In spite of the fact that it is denoted as Vol. 2, this is the first volume published from the Collected Works of Claude Chevalley. They are published by an editorial committee chaired by P. Cartier and the project is supported by the French "Centre National de la Recherche Scientifique". As we can read in the foreword the idea was to collect in this volume the writings of Claude Chevalley about spinors. This volume consists of two main parts: the Nagoya lectures of Claude Chevalley *The Construction and Study of Certain Important Algebras* and his book *The Algebraic Theory of Spinors.* These two parts are complemented by the review by J. Dieudonné of the book The Algebraic Theory of Spinors which appeared in the Bull. Amer.Math. Soc., 60,4 (1954), 408-413 and by a postface "Spinors in 1995" written by J.-P. Bourguignon. These two appendices present the history of spinors and show the role of Claude Chevalley in the development of their theory. The publication of the Collected Works of Claude Chevalley is very important for the mathematical community especially because his works do not seem to age. It is interesting to mention that the whol= e project will also be extended to include the philosophical works of Claude Chevalley. (jiva)

J.B.Conway: On Being a Department Head. A Personal View, American Mathematical Society, Providence, 1996, xi+107 pp., GBP 18, ISBN 0-821-80615-7

This is a clear well-written personal view about the experience of being a department head. University people have a unique opportunity to profit from the author's inside view, from his experiences communicated in a witty readable style. From the Preface: "I want to offer advice to department heads out there. I want to try to educate the rank and file about a variety of aspects of the job of being a department head. I also want to tell you my opinion about this job and perhaps also a little about love, death, and the vagaries of the human condition." Important topics of university life are covered: People vs. institutional ethics, offering a quality professional life, some ideas for an agenda, recruiting, salaries, giving raises, tenure, promotion, staff, making decisions, paperwork, budget, meetings, committees etc., etc. Personal views are clearly expressed (Why do I enjoy being a head, Stay active in mathematics etc.) and presented in a lively style. Strongly recommended not only to heads of departments but also to every

faculty member. (in)

A.C.Thompson: Minkowski Geometry, Encyclopedia of Mathematics and its Applications, vol.63, Cambridge University Press, Cambridge, 1996, xvi+346 pp., GBP 40, ISBN 0-521-40472-X

The book presents a comprehensive and self-contained monography on Minkowski (i.e. finite dimensional normed vector) spaces. Since each such space is fully characterized by its unit ball, which is a centrally symmetric convex body in $\mathbf{R}^d$, the mathematical tools used in the book are mostly those of convex geometry (a survey is given in Chapter 2, with references to specialized monographies such as that of R. Schneider — Convex Bodies: The Brunn-Minkowski Theory, Cambridge Univ. Press 1993). A special chapter is devoted to two-dimensional spaces. Particular attention is paid to the metric properties of Minkowski spaces. The k-dimensional content is defined by a suitable normalization of the translation invariant Haar measures on the k-dimensional subspaces. Two different approaches for the normalization are described (the sc. 'Choquet-Busemann' and 'Holmes-Thompson' definitions) and their consequences for the metric properties are shown. The last chapter contains a survey of fifty unsolved problems. (jr)

E.Boeckx, O.Kowalski, L.Vanhecke: Riemannian Manifolds of Conullity Two, World Scientific, Singapore, 1996, xvii+300 pp., GBP 47, ISBN 9-810-22768-X

This is the first monograph devoted to the semi-symmetric spaces characterised by the condition $R(X,Y) \cdot R = 3D0$ on the Riemannian curvature tensor. The topic of the book was inspired by a problem posed in the 60-ies by J.Eells, S.Kobayashi and K.Nomizu. The text is divided into 12 chapters. A nice introduction makes the reader acquainted with a breaf history starting from investigations of É.Cartan and first non-trivial examples given by H.Takagi, K.Sekigawa and others. A short review of the fundamental work of Z.Szabo is given. After two introductory chapters, foliated semi-symmetric spaces of arbitrary dimension (Riemannian manifolds of conullity two) are treated. The main methods are presented and the basic systems of partial differential equations for the problem are derived in Chapter 3. An explicit local description of a subclass of semi-symmetric curvature homogeneous spaces is done in Chapter 4. It appears that the possibility to write explicit formulae for the metrics in the general case is closely connected with the existence of asymptotic foliations introduced in Chapter 5. In dimension three, all possible metrics are found in an explicit form (Chapter 6). In the following chapters, the general dimension is treated; various explicit classifications and interesting classes of examples are given. Chapter 10 contains applications of the whole theory to the study of isometric deformations of hypersurfaces whose second fundamental form has rank two. The last topic comes from a work of É.Cartan. New contributions to this theory are given. Chapter 11 is devoted to a natural generalisation of semi-symmetric spaces. Again, explicit description is given in dimension 3. Chapter 12 is an expository article devoted to the theory of curvature-homogeneous Riemannian manifolds. The whole theory was motivated by a problem put by I.M.Singer in the sixties. At least the 3-dimensional case is now fully understood. The presented book is very nicely written and can be warmly recommended to anyone interested in Riemannian geometry. (ava)

S.Y.Yan: Perfect, Amicable and Sociable Numbers. A Computational Approach, World Scientific, Singapore, 1996, xx+338 pp., GBP 47, ISBN 9-810-22847-3

Educators in pure mathematics often face the problem of finding a sufficiently attractive elementary problem capable of further development towards important and deep branches of mathematics. The extensive use of computers adds nowadays a new dimension to this problem: as far as possible to create a natural background so that computer-oriented novices can also simultaneously master a program for symbolic computation. It is clear that elementary number theory provides an excellent source of such problems. The book under review is written to alleviate this problem. The underlying themes are the perfect, amicable and sociable numbers. The book is self-contained and accessible even to amateurs in computational number theory familiar with high-school algebra. The book can also serve as a basic reference in the area. It is divided into 6 chapters and has three appendices. Chapter 1 (with Appendix A for neophytes in number theory) provides the necessary introduction, including the history (it is a very pleasant feature of the whole book that almost every mathematician appearing in it is discussed from both the point of view of his contribution to the development of mathematic as well as the discussed topic). Chapter 2 contains and develops some mathematical preliminaries and tools: primality testing, integer factorisation, continued fractions, methods of solution of some Diophantine equations, etc. As it is inappropriate to enter a more detailed discussion of the connections between perfect, sociable and amicable numbers, Chapters 3, 4, and 5 discuss three methods of generating amicable pairs, namely the so called exhaustive numerical search, the algebraic assumption method and algebraic constructive method. Chapter 6 summarizes proposals concerning the future possibilities. The book is in-

terwoven with a huge number of various algorithms, which reflects its computational spirit. Most computations are done in Maple, accordingly Appendix B is devoted to a brief introduction to number theoretical computing facilities in this computer algebra system (up to Maple V, Release 4). Appendix C contains selected Maple programs used in the book. (šp)

B.Chauvin, S.Cohen, A.Rouault (Eds.): Trees. Workshop in Versailles, June 14-16, 1995, Progress in Probability, vol.40, Birkhäuser, Basel, 1996, 158 pp., DM 88, ISBN 3-764-35453-4, ISBN 0-817-65453-4

These proceedings (148 pages) deal with the following main four topics: 1) Disordered systems (Ising models on trees, wavelets and trees, multiplicative chaos) 2) Probability and trees (branching random walks, martingales on trees, systematic study of the branching number of the tree and its relation to Hausdorff dimension and capacity, central limit theorems for random walks on trees) 3) Ultrametric and algebraic aspects of trees (harmonic analysis on trees, non-Archimedean topologies and the replica trick) 4) Large deviations on trees. Overall, this is a very useful collection of contributions on somewhat different themes connected by the common "playground" – a tree – where the investigated subjects live. There are both introductory and systematic as well as more specialised contributions in the volume. Therefore the reader gains an idea of the diversity of the subject; though the list of other possible items which would fit the idea of the book is apparently much larger. (mzah)

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C.C.Hsiung, S.-T.Yau (Eds.): Surveys in Differential Geometry. A Supplement to the Journal of Differential Geometry. Vol. II, International Press, Cambridge, 1995, 456 pp., ISBN 1-571-46027-6

This book is a Proceedings of the conference on geometry and topology hel= d at Harvard University. There are altogether seven contributions discussing several parts of global geometry and algebraic geometry. The authors of the papers are M.F.Atiyah, R.S.Hamilton, H.B.Lawson,Jr. Yu.I.Manin, L.Simon and C.H.Taubes. I would like to add more details on a few of them. Relations between mathematics and theoretical physics in last 15 years are discussed succinctly in the paper of M.F.Atiyah (Reflections on Geometry and Physics). There are many interesting examples and general ideas explaining the interaction between quantum field theory and topology. The article of H.Blaine Lawson, Jr. (Spaces of algebraic cycles) is a survey of results on geometrical and topological structure of the spaces of algebraic cycles on an algebraic variety. Special attention is paid here to homotopy properties of spaces of cycles and homology and cohomology theories related to them as L_*H_* and L^*H =* theories. There are also two contributions of C.H. Taubes on Chern-Simons 3-manifol= d invariants and homology (resp. metabolic) cobordisms. There are some constructions which can be used for a study of invariants of 3-manifolds of Kontsevich, Axelrod and Singer type. These two papers are written with all proofs and details. (jbu)

R.A.Freeman, P.V.Kokotovic: Robust Nonlinear Control Design. State-Space and Lyapunov Technique= s, Systems & Control: Foundations & Applications, Birkhäuser, Boston, 1996, viii+257 pp., DM 118, ISBN 3-764-33930-6, ISBN 0-817-63930-6

This book is devoted to the design of robust nonlinear control systems. Systems are governed by nonlinear autonomous equations (*) $\dot{x} = 3Df(x) + g(x)u$, where u are (vector) control inputs and $y = 3Dh(x)$ ar= e (vector) variables to be tracked. Robustness means to control not only a concrete system of the type (*), but all similar systems corrupted by additive uncertainities and disturbances which can be large. The authors summarise methods based on constructions of robust control Lyapunov functions. After investigations of properties of such functions (Chapters 3,4), the recursive Lyapunov design procedure is presented in the heart of the book (Chapters 5-8). Two nontrivial examples concerning the control of nonlinear mechanical systems (a robot arm and a fan) are solved in detail. The book is intended for graduate students; for researches in control theory it can serve as a summary of recent results and a source of new problems. (jmil)

W.Fulton: Young Tableaux. With Applications to Representation Theory and Geometry, London Mathematical Society Students Texts, vol.35, Cambridge University Press, Cambridge, 1997, ix+260 pp., GBP 14.95, ISBN 0-521-56144-2, ISBN 0-521-56724-6

This book is written by a well known mathematician W.Fulton, the author of wonderful books such as "Intersection theory", Springer-Verlag 1984; "Representation theory: A first course (with J.Harris)", Springer-Verlag, 1991, etc. The aim of the book is to develop the combinatorics of Young tableaux, its appplications to the algebra of symmetric functions; the representation theory of symmetric and general linear groups and geometry of flag manifolds. The book has three parts. Part I is a combinatorial study of two remarkable constructions: the Schensted "bumping" algorithm and the Schutzenberger "sliding" algorithm. Each of them can be used for a combinatorial version

of the Littlewood-Richardson rule, the proof given in the book is simpler than other published versions. In part II, these results are used to study representations of symmetric and general linear groups and in part III, the author applies the results of the first two parts to the geometry of Grassmannians and flag manifolds. The combinatorial chapters of the book are self-contained. The book will certainly be of use to researchers in representation theory, algebraic geometry and combinatorics. (ae)

S.D.Chatterji: Course d'Analyse. Volume 1, Analyse vectorielle, Presses Polytechniques et Universitaires Romandes, Lausanne, 1997, xxiii+592 pp., sFr 92, ISBN 2-880-74314-1

The book covers the first third of Cours d' Analyse for the second year of study of mathematics and physics at École Polytechnique Féderale de Lausanne. Almost 600 pages of the text are devoted to vector analysis: differential calculus in R^n, Lebesgue integration, abstract integral, curvilinear and surface integrals, Green's theorem in R^n and the Gauss and Stokes theorems in R^3 (proofs are sketched in special situations). The last chapter (120 pp.) is a detailed exposition of Stokes' theorem in R^n (differential forms, manifolds, integration). The formulation includes a class of non-smooth domains (e.g. "conical points" and "edges" are allowed). Exercises (with solutions at the end of the book) are attached to almost every chapter. The textbook is well written and the exposition is detailed. The author emphasises the role of concepts introduced for classical physics. The book will be useful for students as well as teachers of mathematical analysis. (in)

R.C.Vaughan: The Hardy-Littlewood Method. Second Edition, Cambridge Tracts in Mathematics, vol.125, Cambridge University Press, Cambridge, 1997, viii+232 pp., GBP 35.00, ISBN 0-521-57347-5

This is an updated and revised second edition of the previous Cambridge Tract on one of the fundamental tools of analytic number theory. Perhaps the most striking addition is an account of the important work of Wooley reflected in the chapter on Vinogradov's method and in the new chapter "Wooley's upper bound for $G(k)$". The spirit of the first edition, where the essence and basic possibilities of the circle method are demonstrated through its contribution to solutions of concrete problems (e.g. Waring's, Goldbach's ones, or Roth's, Furstenberg-Sárközy theorems), remains unchanged. The book can therefore be warmly recommended to all mathematicians interested in analytic methods and their applications. As in the first edition, the book contains exercises of various difficulty at the end of chapters and a bibliography for further reading. (šp)

S.G.Krantz: A Primer of Mathematical Writing. Being a Disquisition on Having Your Ideas Recorded, Typeset, Published, Read, and Appreciated, American Mathematical Society, Providence, 1997, xv+223 pp., GBP 14.95, ISBN 0-821-80635-1

This is a textbook about writing in the professional mathematical environment: writing a mathematical article or a mathematical book; a letter of recommendation; a book review; a referee's report; a CV; grant proposals; applications for a job etc. One finds a useful description of the rules of grammar, syntax, usage, structure and style. Much attention is paid to the organisation of a book or a paper (how to state a theorem, to prove a theorem, state a definition, to write an abstract, to write a bibliography etc.). A chapter is devoted to an expository writing, another chapter to the modern writing environment (use of the computer and TEX, the Internet and hypertext, e-mail etiquette etc.). The book is well-written in a lively style and will be found useful by anybody who is aware of the power and significance of writing in the mathematical profession. (in)

J.J.Duistermaat: The Heat Kernel Lefschetz Fixed Point Formula for the Spin-c Dirac Operator, Progress in Nonlinear Differential Equations and Their Applications, vol.= 18, Birkhäuser, Boston, 1996, 256 pp., DM 68, ISBN 0-817-63865-2, ISBN 3-764-33865-2

The spin-c Dirac operator D is one of main tools for the study of properties of certain structures on manifolds (complex structure, symplectic structure, etc.). It was used recently in Seiberg-Witten theory of 3-manifolds and, because any oriented 4-dimensional manifold admits a spin-c structure, th= is operator is important also in the theory of invariants of 4-dimensional compact oriented manifolds. The book of J.J.Duistermatt is a nice introduction to analysis related with spin-c Dirac operator. The main goal is to develop the heat kernel method for the generalized Laplace operator related with D and to apply it in symplectic geometry. A part of the book is devoted to characteristic classes, Weil homomorphism and to the generalized Lefschetz formula for compact orbifo= lds. The book is almost self-contained, readable and will be useful for anybody who is interested in the topic. (jbu)

A.D.Drozdov: Finite Elasticity and Viscoelasticity. A Course in the Nonlinear Mechanics of Solids, World Scientific, Singapore, 1996, xviii+434 pp., GBP 61, ISBN 9-810-22433-8

The textbook aims to fill the gap between engineers and mathematicians in the field of finite elasticity and viscoelasticity. From the engineers side, the book offers the following: (1) a course of tensor

calculus in the classical coordinate description close enough to classical concepts but correct and quite complete; (2) a correct treatment of kinematics and dynamics of continua; (3) an updated chapter on constitutive equations in finite elasticity containing the concept of polyconvexity and corresponding existence theorems; (4) boundary problems and variational principles; (5) constitutive models and boundary problems in finite viscoelasticity. For mathematicians, the book offers a quite good description of the physical and mechanical side of the problem in finite viscoelasticity written in an old-fashioned but reasonably understandable notation. Also, mathematicians will find here an opportunity to become aware of mechanical concepts and results. (jso)

R.P.Burn: A Pathway into Number Theory. Second Edition, Cambridge University Press, Cambridge, 1997, xv+262 pp., GBP 15.95, ISBN 0-521-57540-0

As the title indicates the book is designed as an undergraduate course in elementary number theory which can also be used for independent study without supporting lectures. The chapters of this unusual book are built from sequences of questions, problems and notes which should lead the reader through the world of basic properties of numbers from the very basic facts to standard theorems. The author's philosophy is based on the belief that an exploration of special cases is best for illuminating generalities. The disadvantage of this method is that only standard elementary results can be reached in this way but with modest up-to-date computing facilities (sometimes a hand calculator is enough) many results of the past giants of mathematics can be reached comparatively easy. What is required is a modern high-school course in mathematics, a familiarity with complex numbers, matrices of low order and properties of group up to Lagrange's theorem. The main topics are the fundamental theorem of arithmetic, modular addition and modular multiplication, quadratic residues, the equation $x^n + y^n = 3Dz^n$, sums of squares, partitions, quadratic forms, geometry of numbers, continued fractions and approximation of irrationals by rationals. Thus for instance, in the Chapter "Modular multiplication" you can find the subsections: Fermat's theorem, Wilson's theorem, Linear congruences, Fermat–Euler theorem, Simultaneous linear congruences, Lagrange's theorem for polynomials, Primitive roots, Chevalley' theorem and RSA codes. Each chapter is concluded by the sections: summary, historical note, notes and answers. Here the reader can find not only hints to solutions, but also suggestions for concurrent reading. This book can be highly recommended to all those interested to enter the fascinating field of elementary number theory. (šp)

S.Y.Cheng, P.Li, G.Tian (Eds.): A Mathematician and His Mathematical Work. Selected Papers of S.S.Chern, World Scientific Series in 20th Century Mathematics, vol.4, World Scientific, Singapore, 1996, xiv+707 pp., GBP 62, ISBN 9-810-22385-4

This book is devoted to the life and work of the differential geometer S.S.Chern. To characterise him I will repeat here the words of I.M.Singer: "To most of us Prof. S.S.Chern *is* modern differential geometry". (To me as well.) The book begins with four articles about S.S.Chern written by R.S.Palais & C.-L.Terng, A.Weil, P.A.Griffiths, and W.-L.Chow and with two articles by S.S.Chern "My Mathematical Education" and "A Summary of My Scientific Life and Works". They are very inspiring for all (and especially young) mathematicians. The main part of the book contains selected papers of S.S.Chern and is divided into two parts: I. Papers published in 1932-1987 and II. Papers published since 1988. This variety of papers shows without any doubt the wide interests of the author. It is also pleasant to have this whole collection at hand avoiding in this way the necessity to look for the particular papers in the library. But I think that the most important phenomenona in the collection are the spirit of originality and the deep understanding of geometry. A great part of the material in the book has already become classical and can be found in textbooks and monographs. Nevertheless we can see here that short remarks, clarifying relations and connections and real ideas are more valuable than a completely correct explanation that lacks the spirit of mathematical insight. I think that even non-systematic reading in this collection is very enriching. We can add that the book includes also the curriculum vitae of S.S.Chern, a list of the Ph.D. theses written under his supervision, and a complete list of his publications. (jiva)

H.Hofer, C.H.Taubes, A.Weinstein, E.Zehnder (Eds.): The Floer Memorial Volume, Progress in Mathematics, vol.133, Birkhäuser, Basel, 1995, xii+685 pp., DM 138, ISBN 3-764-35044-X, ISBN 0-817-65044-X

This volume represents a collection of first class articles prepared by friends and colleagues of Andreas Floer who died tragically on May 15, 1991. It contains a very short biography of Andreas Floer, the list of his 32 papers, his three papers which existed only in the preprint form (two of them prepared for publication by Peter Braam), and then 24 research and expository articles written by very prominent authors and covering the fields of interest of Andreas Floer. These were first of all gauge theory, dynamical systems, symplectic geometry and

low dimensional topology. The high level and the great extent of this volume show the importance of the Andreas Floer's contribution to contemporary mathematics. Obviously, every specialist working in the above mentioned o= r related fields will be interested in this volume. The whole collection is well organised and to a certain extent can also serve the beginner as an introduction to a more systematic study. (The book is endowed with a useful index.) (jiva)

C.Albert, R.Brouzet, J.P.Dufour (Eds.): Integrable Systems and Foliations. Feuilletages et Systèmes Int=82grables, Progress in Mathematics, vol.145, Birkhäuser, Boston, 1997, x+212 pp., DM 138, ISBN 3-764-33894-6, ISBN 0-817-63894-6

This volume represents a collection of papers presented at the colloquium "Systèmes Intégrables et Feuilletages" held in Montpellier, May 22-26, 1995 in honor of Pierre Molino's 60th birthday. It contains 11 papers devoted to foliations, differential dynamical systems, symplectic geometry and Lie algebras. The major part of the papers are research papers. The list of the papers follows. 1. Y. Benoist: Orbites des structures rigides (d'après M. Gromov); 2. G. Cairns, B. Jessup, J. Pitkethly: On the Betti Numbers of Nilpotent Lie Algebras of Small Dimension; 3. V. Cavalier; A. Haefliger: Réalisations feuilletées de quelques pseudogroupes; 4. H. Flaschka, T. Ratiu: A Morse Theoretic Proof of Poisson Lie Convexity; 5. É. Ghys: Sur l'uniformisation des laminations paraboliques; 6. A. Lichnerowicz: Extensions essentielles privilégiées d'algèbres de Lie classiques de dimension infinie; 7. G. Meigniez: Holonomy Groups of Solvable Lie Foliations; 8. I. Moerdijk: On the Weak Homotopy Type of Étale Groupoids; 9. F. J. Turiel: Classification globale des formes différentielles transitives sur la sphère S^5; 10. I. Vaisman: A Lecture on Poisson-Nijenhuis Structures; 11. P. Vanhaecke: Hamiltonian Systems Associated to Families of Curves and Their Bi-Hamiltonian Structure. (jiva)

E.D.Bloch: A First Course in Geometric Topology and Differential Geometry, Birkhäuser, Boston, 1997, xii+421 pp., DM 118, ISBN 3-764-33840-7,=20 ISBN 0-817-63840-7

The textbook is devoted to the study of surfaces from the topological and differential geometrical point of view yet in a unified way. Starting from basic topology, the author gives a detailed explanation of the theory of topological surfaces and the classification of compact surfaces. In the second part, the simplicial theory of surfaces is developed and on simplicial surfaces, the simplicial curvature, the Gauss-Bonet theorem and Brouwer's Fixed point theorem are studied. In the third part, smooth curves and surfaces in R^3 are studied in one of the standard ways. Special attention is given to the theory of geodesics, both local and global. The last part contains a proof of the smooth Gauss-Bonnet theorem and a brief introduction to non-Euclidean Geometry. At the end, there is also a chapter which gives some recommendations for further study of related topics (topology, algebraic topology, differential geometry, differential topology) together with references. In the textbook, there are many interesting examples and exercises at different levels. I can recommend the book to all who want to see relations between topology and geometry within a simple but important case of surfaces. (jbu)

R.A.Brualdi, B.L.Shader: Matrices of Sign-Solvable Linear Systems, Cambridge Tracts in Mathematics, vol.116, Cambridge University Press, Cambridge, 1995, xii+298 pp., GBP 30, ISBN 0-521-48296-8

Sign-solvability is a part of a larger study which seeks to understand the special circumstances under which an algebraic, analytic, or geometric property of a matrix can be determined from the combinatorial arrangement of the positive, negative, and zero elements of the matrix. Several classes of matrices arise in this way: sign-nonsingular matrices, L-matrices, S-matrices, and sign-stable matrices. The theory of S- and L- matrices is primarily combinatorial in nature, although the subject of sign-solvability affords the interplay between linear algebra, combinatorics, and theoretical computer science (combinatorial algorithms). The matrix recognition algorithms, and algorithms for constructing of the matrices with a prescribed zero pattern which are implicit in many of the proofs, are also explicitly described and their complexity discussed. The matrix recognition problem belongs to the class of NP-problems. The book consists of eleven chapters, each with short bibliographical notes concerning related work. At the end of the book, a "master bibliography" is given. The book will be of interest mainly to specialists in economics, statistics and associated areas. (dja)

D.Lomen, D.Lovelock: Exploring Differential Equations via Graphics and Data. Preliminary Edition, J.Wiley & Sons, Inc., New York, 1996, xiii+793 pp., GBP 24.95, ISBN 0-471-07649-X

This book is another member of the family of textbooks which try to make students familiar with one of the most important part of mathematical analysis: differential equations. This topic is treated from all viewpoints (numerical, graphical, analytical and descriptive) but visualization is emphasised. Attention is also given to mathematical modelling from data sets, solution techniques and interpretations of results to show relations between

differential equations and the sciences. The structure of each chapter has a similar form: an overview ("Where are We Going?") at the beginning and a summary ("What have We Learned?") at the end. Interesting parts of chapters are "Comments about ... " which emphasise important points of results and "Words of Caution" which prevent possible dilemmas. Important techniques are summarised in "How to ... " boxes which are easy to find in the book. Many exerci= ses of all kinds are included. The book does not require a computer algebra system, but access to mathematical software is expected. The Appendices of the book include a summary of some of the ideas of single variable calculus and of numerical methods for solving differential equations. The book is very well written and is recommended. (mli)

E.Lozansky, C.Rousseau: Winning Solutions, Problem Books in Mathematics, Springer-Verlag, New York, 1996, x+244 pp., DM 58, ISBN 0-387-94743-4

In many countries all over the world mathematical olympiads - competitions for mathematically talented secondary school students - are held. The winners of the local olympiads are given the opportunity to take part in the International Mathematical Olympiad. In recent years, typically representatives of more than 70 countries participate in IMO. The book is intended for students deeply interested in mathematics who need theoretical guidance and practice to help them solve olympiad-level problems. The fact is that mathematical curricula in most high schools differ from what is expected of an IMO participant. The book wants to bridge that gap — at least in number theory, algebraic equations and inequalities and combinatorics. Each chapter includes useful theorems and techniques followed by examples and exercises (taken mostly from IMO or USA MO). The examples proceed from the easy to the very complicated. The reader gets acquainted, for example, with Ceva's theorem, Chebyshev's inequality, the Chinese remainder theorem and with convex sets. At the end of the book, there is a list of literature recommended for further study that may enrich the student knowledge. Another volume covering geometry and other topics would be necessary for prospective participants in this type of competition. (lbo)

A.Katok, B.Hasselblatt: Introduction to the Modern Theory of Dynamical Systems, Encyclopedia of Mathematics and its Apllications, vol.54, Cambridge University Press, Cambridge, 1997, xviii+802 pp., GBP 30, ISBN 0-521-57557-5, ISBN 0-521-34187-6

This is the paperback version of the book which appeared in 1995 (see Brief Reviews, this Newsletter, No 19, March 1996, p.36).

G.Da Prato, J.Zabczyk: Ergodicity for Infinite Dimensional Systems, London Mathematical Society Lecture Note Series, vol.229, Cambridge University Press, Cambridge, 1996, xi+339 pp., GBP 29.95, ISBN 0-521-57900-7

Investigation of the long time behaviour of solutions is one of the most important topics in the theory of stochastic partial differential equations, the notions and tools coming from the ergodic theory of Markov processes playing a prominent rôle in this study. The monograph under review is an in-depth, systematic and relatively self-contained account of the progress achieved recently in the ergodic theory of stochastic PDEs within the framework of the semigroup approach. Both authors are well known experts in this field and many chapters of the book are based on their recent papers. The book is divided into three parts. In the first, background material from ergodic theory and Markov process theory is recalled. General techniques for establishing existence, uniqueness and regularity of invariant measures for stochastic evolution equations are discussed in the second part. In the last part, the methods developed are applied to various particular models: e.g. to Ornstein-Uhlenbeck processes, stochastic reaction-diffusion equations, spin systems on a lattice, or to stochastic Burgers and Navier-Stokes equations. (jis)

D.V.Anosov (Ed.): Dynamical Systems IX. Dynamical Systems with Hyperbolic Behaviour, Encyclopaedia of Mathematical Sciences vol.66, Springer-Verlag, Berlin, 1995, vii+235 pp., 39 fig., DM 148, ISBN 3-540-57043-8, ISBN 0-387-57043-8

The first part of this volume is mainly devoted to topological aspects of hyperbolic theory (for metric or ergodic properties of hyperbolic sets, see the volume II of this series). After introducing the main notions and examples of hyperbolic sets (a reader should be acquainted with Volume I), deeper facts on the semilocal theory (ϵ-trajectories, topological Markov chains) are described together with brief remarks on methods used. The central role is played b= y global hyperbolic theory (Axiom A, structural stability, Anosov systems) and investigations of structures of strange attractors. The second part of this volume consists of two more special articles which deal with cascades (i.e., discrete dynamical systems) on surfaces and multidimensional analogues of geodesic and horocycle flows on surfaces of constant curvature. Both these topics are closely intrinsically related to hyperbolic theory. As the subject of the second article has an algebraic origin, many more prerequisities are needed. The text is clearly written and can be highly recommended for its orientation in contemporary research and/or for obtaining an overview before studying specialised

texts such as A.Katok, B.Hasselblatt, Introduction to the Modern Theory of Dynamical Systems, Cambridge Univ.Press, 1995. As always in this series, only references and key points are given instead of complete proofs. (jmil)

I.M.Gelfand, J.Lepowsky, M.Smirnov (Eds.): The Gelfand Mathematical Seminars, 1993-1995, Birkhäuser, Boston, 1996, 274 pp., DM 108, ISBN 0-817-63816-4, ISBN 3-764-33816-4

The Gel'fand Mathematical Seminar is one of the most celebrated seminars which started more than 40 years ago in Moscow. The seminar is now held at Rutgers University and at IHES in Paris. The papers are devoted to a broad range of mathematical areas including nonlinear evolution equations, noncommutative algebra, Chern-Simons classes, Radon transform, statistical mechanics, plane curves, evolution of solids, an applications of modern homological algebra to mathematical physics and hypergeometric functions. Many papers are of a survey character and contains all necessary definitions. This makes them understandable not only for experts but also for mathematicians and physicists working in other areas. (ae)

A.Kawauchi: A Survey of Knot Theory, Birkhäuser, Basel, 1996, xxi+420 pp., DM 118, ISBN 3-764-35124-1, ISBN 0-817-65124-1

This book is a research level survey of knot theory written by a well-known specialist and his colleagues from the seminar on geometric topology in Osaka. The expanded English version of the book published originally in Japanese covers many research methods and results of knot theory which were developed before 1995. The purpose of the book is to inform graduate students and researchers in other disciplines about what knot theory is and how to study it and to provide specialists in knot theory with a useful source of references. The last third of the book contains an extensive appendix with tables of knot diagrams and polynomials and a reference part with a respectable number of more than 3500 items. (mč)

E.Brieskorn (Ed.): Felix Hausdorff zum Gedächtnis. Band I. Aspekte seines Werkes, Friedrich Vieweg & Sons, Inc., Braunschweig, 1996, 286 pp., DM 98, ISBN 3-528-06493-5

In addition to the ten-page explanatory and summary introduction (written by E.Brieskorn) and to the last contribution describing the scientific publications of F.Hausdorff (by C.Hertling), the book contains 10 essays. The publication is certainly valuable for all who are interested in the development of important ideas in mathematics and their interrelations. It is not difficult for non-specialists to read the essays. The first essay (by H.-J.Ilgauds) concerns Hausdorff's early scientific publications devoted mainly to astronomy. The next (H.-J.Girlich) describes Hausdorff's contribution to probability theory. Three essays by P.Koepke, E.Scholz a P.Schreiber deal with Hausdorff's set theoretical approaches from various point of view including also measure theory and dimension theory. The last two mentioned topics serve as the main subject of the three following essays (authors Ch.Bandt and H.Haase, K.Steffen, H.-G.Bothe and J.Schmeling). The contribution by E.Neuenschwander (based on documents from E.Bessel-Hagen's estate) describes the last years of Felix Hausdorff. There follows a listing (by G.Bergmann) of the scientific heritage of Hausdorff. (mh)

H.Anton: Multivariable Calculus. Fifth Edition, J.Wiley & Sons, Inc., New York, 1995, xxiii+ pp., GBP 24.95, ISBN 0-471-13909-2

The title of the book already suggests that this textbook covers only one part of calculus – multivariable calculus. In fact, the book consists of several chapters of "Calculus with Analytic Geometry", 5th Edition, written by the same author. We find here information on: three-dimensional space, vectors, vector-valued functions, partial derivatives, multiple integrals, topics in vector calculus and second-order differential equations. It is expected that the reader has completed a course on single variable calculus, nevertheless a summary of the main ideas and concepts of this part of calculus can be found at the front of the book. Supplementary material in the book is devoted to infinite series, first-order differential equations, Cramer's rule and complex numbers. The author presents ideas from the symbolic, geometric, computational and verbal viewpoints (rule of four) in the text. Each chapter of the book concludes two kinds of exercises – section and 'technology' ones. Section exercises consist of routine problems with different level of difficulty. Exercises that require a calculator are listed at the beginning of the exercise set. The aim of the technology exercises is to introduce the students to techniques of problem solving using a graphics calculator or computer algebra system such as Mathematica or Maple. The answers to some of the exercises, historical notes and an index are also included. The book can be recommended to students as well as teachers. (mli)

P.A.Fillmore: A User's Guide to Operator Algebras, Canadian Mathematical Society Series of Monographs and Advanced Texts, J.Wiley & Sons, Inc., New York, 1996, xii+223 pp., GBP 45, ISBN 0-471-31135-9

In the book, selected topics from the theory of operator algebras are discussed. The choice of material is very good, some parts of the theory are discussed only briefly, others are omitted. The

idea of the author was to develop the main ideas of the theory and their mutual interconnections and it was succesfully fulfilled. The first part of the book is a comprehesive introduction to C^*-algebr= as and von Neumann algebras, including proofs and examples. Other important parts of the theory as structure theory, tensor products, crossed products and factors are then described. The last chapter is devoted to K-theory, its basic properties and ideas. Some contemporary aspects of the theory, e.g the Connes-Thom isomorphi= sm, BDF-theory, KK-theory, E-theory and K-homology theory are briefly mentioned here. A good backround in general functional analysis and operator theory is helpful for reading of the book. The book is well written, it is a nice introduction to the main principles of advanced operator theory. There are also hints for further study and a short discussion of subjects not treated fully in the book together with a recommended literature. (jbu) =09

G.I.Lehrer (Ed.): Algebraic Groups and Lie Groups. A volume of papers in honour of the late R.W.Richardson, Australian Mathematical Society Lecture Series 9, Cambridge University Press, Cambridge, 1997, 84 pp., GBP 32.50, ISBN 0-521-58532-5

This volume of Australian Mathematical Society Lecture series is dedicated to the memory of an outstanding person and mathematician — R.W.Richardson. His research was concerned with various aspects of an action of Lie groups and algebraic groups on manifolds and algebraic varieties. These topics are represented in the volume by research papers of the highest quality. Representation theory, which is now closely linked with geometry in many ways, is represented in the volume by Kazhdan-Lusztig theory in papers by Dyer and Cline-Parshall-Scott. Canonical bases are discussed in papers written by Carter, de Concini-Procesi and Lusztig. The paper of Dimca-Lehrer is concerned with representations and cohomology. Geometric aspects of algebraic group actions on spherical varieties are represented by papers by Brion and Luna. The same subject is treated in papers written by Carrell (geometry of Schubert varieties), Casselman (compactification of symmetric spaces) and Springer (B-orbits in symmetric varieties). Algebraic groups and their associated geometries form the subjects of papers by Borel (conjugacy and covering), Donkin (the regular module of quantum groups) and Lusztig (total positivity). Papers by Popov-Röhrle (finiteness of the set of orbits of a parabolic subgroup on its unipotent radical) and Springer (see above) form continuations of earlier joint papers with R.W.Richardson. Analytical aspects of Lie groups and symmetry breaking are addressed in papers by Carey-Jupp-Murray (the phylon group), ter Elst-Robinson (Rochand operators) and Field (symmetry breaking). There is no doubt that the volume will be useful for mathematicians interested in Lie groups and Lie algebras,, algebraic groups and algebraic geometry. (ae)

I.Laine, O.Martio (Eds.): XVIth Rolf Nevanlinna Colloquium. Proceedings of the International Conference held in Joensuu, Finland, August 1-5, 1995, Walter de Gruyter, Berlin, 1996, ix+353 pp., DM 268, ISBN 3-110-14746-7

Since 1964, the Rolf Nevanlinna Colloquia are held in recognition of his fundamental contribution to various fields of mathematics. The XVIth Rolf Nevanlinna Colloquium celebrated moreover the centenary of Nevanlinna's birth in Joensuu. The directions of Nevanlinna's mathematical work naturally influence the main topics of the conference. These include predominantly complex analysis in a wide sense. Nevanlinna's value distribution theory is reflected in many contributions. Great attention is paid to those parts of group theory which are motivated by complex analysis (Fuchsian groups, Kleinian groups, Möbius groups). The theory of Teichmüller spaces is also stud= ied. Another direction of development goes from conformal mappings to quasiconformal and quasiregular mappings, including higher-dimensional theory. Among further topics, let us mention potential theory, partial differential equations, Hardy spaces or geometry of domains. The conference was a special event in complex analysis. It was attended by 194 participants, the top experts in the field. 10 plenary invited lectures, 45 invited lectures in sections and 45 poste= r communications were presented. The volume contains 21 invited lectures and 12 papers based on poster communications. The papers contain mostly all details of the exposition including proofs. All contributions have been refereed. The graphic form is unique and of a high standard. The book is recommendable at least for consultation by a wide spectrum = of readers who have anything to do with complex analysis and the other above-mentioned topics. It is indispensable for mathematics libraries and specialists in the major topics like value distribution theory, groups in complex analysis and quasiconformal geometry. (jama)

K.Murasugi: Knot Theory and Its Applications, Birkhäuser, Boston, 1996, 341 pp., DM 118, ISBN 0-817-63817-2, ISBN 3-764-33817-2

Knot theory is a rapidly developing field of mathematical research which has found many applications in computer science, biological and medical research and mathematical physics. The book under review is a clearly written introduction to this theory directed to a broad audience of

research workers and graduate students. The author has avoided the usage of advanced mathematical terminology and techniques so that the book is easily readable with just a knowledge of basic algebra and topology. It contains most of the fundamental classical facts such as knot diagrams, Seifert surfaces and matrices, Alexander polynomials, tangles and braids, as well as the recent developments such as Jones polynomials and Vassiliev invariants. The connection with statistical mechanics and some applications to chemistry and molecular biology are also presented. In the text there are many exercises and comments. Reading this book provides a good idea of what knot theory is. (mč)

D.N.Riahi (Ed.): Mathematical Modelling and Simulation in Hydrodynamic Stability, World Scientific, Singapore, 1996, vii+190 pp., GBP 34, ISBN 9-810-22308-0

This collection of eight papers reflects recent research achievements in the field of hydrodynamic stability with an emphasis on the problem of the occurence of instabilities during transition processes towards turbulent flows. In addition to the presentation of the newest results, the papers have mostly a survey character, which makes the book worthwhile for scientists in various areas of applied mathematics, engineering, geophysics, etc. The first paper by A.Bottaro and P.Luchini outlines the linear theory of the primary instability of the Götler vortices caused by centrifugal forces. The paper by F.H.Busse and R.M.Clever models the evolution of fluid flows from simple to complex forms by means of a bifurcation approach. An interesting multiparametric perturbation approach to a description of wavy film flows is presented in the paper by A.L.Frenkel and K.Indireshkumar. The fourth paper, by L.Hadji, discusses the influence of thermal Soret dissusion on the instabilities occuring when a dilute binary mixture is solidified. W.R.C.Phillips, in his paper, reviews rotational waves and their nonlinear interaction with shear flows. The next two papers, written by the editor, deal respectively with nonlinear stability analysis for convective flows and mathematical modeling of primary hydrodynamic instabilities for shear flows. The last paper, by A.Zebib, A.Bottaro and B.G.B.Klingmann, studies spatial developemnt of longitudinal vortices. (jomal)

H.Becker, A.S.Kechris: The Descriptive Set Theory of Polish Group Actions, London Mathematical Society Lecture Note Series, vol.232, Cambridge University Press, Cambridge, 1996, xi+136 pp., GBP 21.95, ISBN 0-521-57605-9

The monograph is devoted to the study of continuous (or Borel measurable) actions $a : G \times X \to X$ of a Polish, not necessarily locally compact, group G to a Polish (or standard Borel) space X. We say that X is a Polish G-space (or a Borel G-space) in the respective case. Many new results of the authors, with full proofs, are presented. Some of them solve problems which were known to be open for some time. Also, many results of others with references, and sometimes also with proofs, are stated giving a good insight into the problems and making the book a good survey of the state of the topic at the time of its publication. Several interesting problems are identified. The reader should be acquainted with the fundamentals of descriptive set theory and have some experience with model theory and set theory will help in understanding all of the exposition. Let us indicate several key results and topics in more detail. We divide them into five paragraphs to indicate different themes in approximate accordance with the authors introduction. (1) There is a universal compact Polish G-space X for all Borel G-spaces. This result, together with a theorem of Nadkarni, is used to show the equivalence of the nonexistence of a countably paradoxical decomposition of X with the existence of a G-invariant Borel probability on X for a Borel G-space X. There is also a result on the existence of a universal equivalence relation for suitable G. (2) There is a topology on a Borel G-space X which makes it a Polish G-space with the same action and Borel structure. There is a topology on a Polish G-space X containing a G-invariant Borel set $B \subset X$ such that X remains a Polish G-space and B becomes clopen. The results mentioned first in 1. and 2. are used to discuss thoroughly different modifications of Vaught Conjecture and Topological Vaught Conjecture. As related topics, the known Silver, Glimm-Effros and Harrington-Kechris-Louveau dichotomies are recalled. (3) Borel actions produce analytic equivalence relations. Those Borel actions on Polish spaces are characterized which produce Borel equivalence relations. The existence of $\aleph_1$-decompositions of Borel G-spaces to G-invariant subspaces with Borel equivalence relations is shown. (4) As a special example and a motivation for the general theory on one hand, and as a means for applications in the model theory on the other hand, serve the actions of S_∞, the symmetric group on N, to the space X_L of codes for a nonempty countable relational language L. If L contains symbols of unbounded arity, we obtain a universal S_∞-action. (5) Several results on the possible "definable" cardinality of sets of orbits of an arbitrary action of a Polish group on an arbitrary separable metric space are given assuming mostly the axiom of determinacy of games on reals (and not the axiom of choice). (ph)

S.-T.Yau (Ed.): Geometry, Topology, & Physics For Raoul Bott, Conference Proceedings and Lecture Notes in Geometry and Topology, vol. I=

V, International Press, Cambridge, 1995, ISBN 1-571-46024-1

In 1993, a conference dedicated to Raoul Bott on ocassion of his 70th birthday was organized at Harvard University. The main lectures given at this conference and oth= er contributions dedicated to R.Bott are presented in the book. There are altogether sixteen contributions on different topics from mathematics and mathematical physics (e.g noncommutative geometry, Morse theory, algebraic geometry, differential topology). All papers are very interesting and nice. Let me mention three of them. There is an expository paper "R.Bryant, P.Griffiths and L.Hsu: Towards a Geometry of Differential equations," where some ideas for a study of differential equations from a geometric point of vie= w are presented. The paper is based on examples of different type and level illustrating a general theory. In the paper "E.Witten: The Verlinde algebra and the cohomology of the Grassmanian," a quantum field theory explanation of the relationship between the Verlin= de algebra of the group $U(k)$ at level $N - k$ and quantum cohomology of the Grassmanian of complex k-planes in C^N is given. The paper "W.Schmid and K.Vilonen: Characters, characteristic cycle= s and nilpotent orbits" and gives an affirmative answer to the question of what is a relation between two different constructions of invariants of representations of semisimple Lie groups - algebraic and analytic. (jbu)

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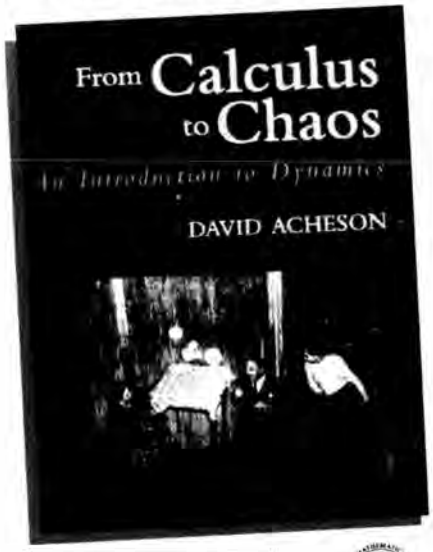

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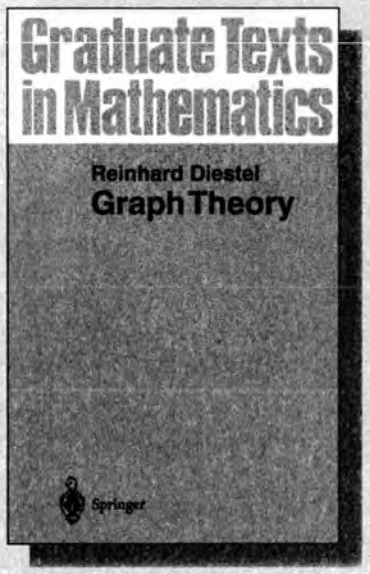

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