European Mathematical Society

December 1998 *Issue 30*

Editorial
Aatos Lahtinen p. 4

Interview
Prof Sir Christopher Zeeman p. 14

EMS Council Meeting
Humboldt University, Berlin p. 6

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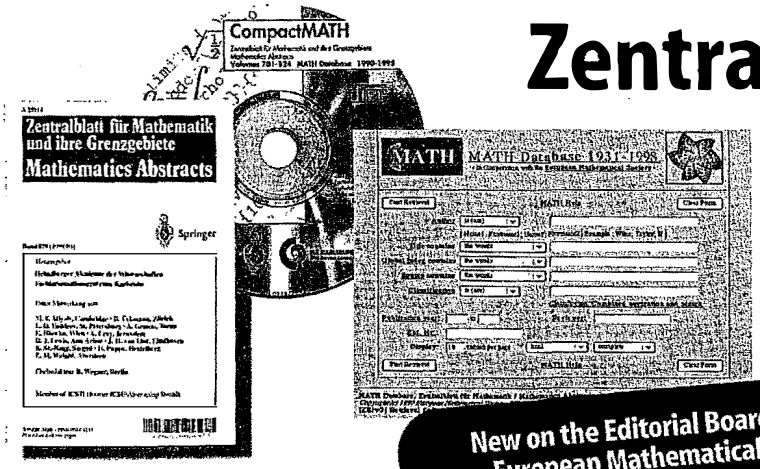
NEWSLETTER



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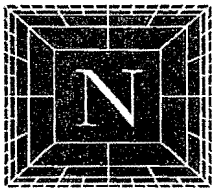
CONTENTS

EUROPEAN MATHEMATICAL SOCIETY



NEWSLETTER No. 30
December 1998

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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 Mäkeläinen

European Mathematical Society, a Personal View

Aatos Lahtinen

Last night I did not understand this, but, now the hour draws near that calls me to my native land, I feel that land is here.
(Kipling: The Roman Centurion's song)

In Kipling's poem a Roman centurion who has served in Britain forty years is ordered home. When he is giving back his sword he has the feeling that he is leaving his native land, not returning to it.
I have a similar experience now. I have served in EMS for its whole history and now when it is time to give my sword to my successor and return home I feel like leaving my native land.

The Finnish Treasurer's song

I should not be surprised at the feeling. My relation to EMS is in fact older than EMS itself. I attended the meeting of the Europeau Mathematical Council at Liblice in 1986 where it was decided to investigate the possibility of the foundation of a Paneuropean mathematical society. This idea was presented already in 1978 during the ICM conference in Helsinki, but then it turned out to be premature. At the next meeting of the European Mathematical Council in 1988 in Oberwolfach it was decided to found such a society with the name European Mathematical Society (EMS). The structure and aims of the society were also formulated there.
I became tied to the destiny of EMS by my remark on the advantages of Helsinki as the official seat of the society. As a corollary the meeting decided that EMS will be registered as a Finnish society with its seat in Helsinki. It became my duty to take care of the official registration of the society. This included the formulation of the Statutes on the basis of a draft so that they could be accepted by the Finnish Ministry of Justice.
I experienced many unforgettable moments during this process. The attitude of the officials was always positive. Still the logic of the lawyers seemed sometimes to be very unlike mathematical logic.
At the foundation meeting of the EMS at Madralin, Poland in 1990 I was elected to the Executive Committee of the Society as the treasurer. My duties also included all the necessary actions demanded by the Finnish law and officials. This has been my responsibility ever since. Now I am the only remaining member from the first Executive Committee and also the only one who has attended every meeting. My second term draws close and by the Statutes I myself formulated, I have to leave the treasury at the end of this year.
This is somehow a sad moment. EMS has been in my thoughts and deeds over eleven years from a seed to a sapling. Now it will continue growing without my attendance. Let it roots lie everywhere in Europe and let its crown reach the firmament.

From a seed to a sapling

It is a slow process to bring up a society from a seed. We, the first pioneers, learned it by experience. On the whole it was possible only by the preparatory work of the European Mathematical Council and especially by the enthusiasm of the trusted representatives of the Society. They put an incredible amount of work and energy to this enterprise.
One of the first tasks of the presidency of Fritz Hirzebruch was to make a plan of action. It defined as primary goals a Newsletter, a European Congress of Mathematics, Euresco Conferences in mathematics, a Journal of EMS, an EMS-lectureship and some kind of partnership in the Zentralblatt. Having determined the goals, the first Executive Committee started to work towards them. The seed of EMS grew but it took time before the first stalk rose above the ground in the shape of the Newsletter of the Society. The first green leaf was the Paris Congress in 1992. This first European Congress of Mathematics gathered about 1300 mathematicians and indicated the existence of EMS to the world.
From that on the progress was faster. Still the Society did not reach a real stability and visibility until during the term of the next president, Jean-Pierre Bourguignon. Then also several new ideas emerged. The greatest innovation was beyond doubt EMIS, the European Mathematical Information Service, for which we can thank Peter Michor. A less visible but very important item is the gradually deepening recognition of the Society in Brussels.

The daily toil

EMS was founded to advance mathematics in Europe, which means contributions to items that are best handled at the international level. Thus the internationality is the added value which the Society is giving to mathematical enterprises. However, when we consider the practical running of the

Society, this same internationality is a hindrance which caused some careful thinking at the planning stage.

An annual general meeting of the Society was considered unpractical. So the decision making organ of EMS was chosen to be a Council elected by postal voting. Moreover, for minimisation of travel expenses and trouble, one meeting every two years was considered sufficient. Of course, it is more demanding to plan everything in the periods of two years than in periods of one year.

For the same practical reasons the Executive Committee has only two or three meetings per year. These are held at weekends when the flights are cheaper and when there is less need to cancel lectures. Of course meetings with an agenda of 30 items and lasting well over 20 hours are not necessarily an ideal way to spend a weekend. In the interval between the Executive Committee meetings questions are treated by the General Purpose Committee consisting of the president, secretary and treasurer. This committee discusses and makes decisions as a rule by e-mail; actual meetings are rare.

By using e-mail we can have almost real time connections with very little cost. We can also exchange documents almost as easily as in a normal meeting. EMS was founded independently of the existence of the e-mail, but it is quite obvious that the e-mail is all that makes the running of EMS with so few meetings (and such small expenses) possible. This is especially clear on those days when computers are down.

Despite meetings and e-mail the responsibility for the Society and its actions lies heavily on the president. One can only admire the energy of both presidents of EMS and wonder where they have found the time they have used for the Society in addition to their standing duties. I have the feeling that we have now reached a limit. In the future there must be much more delegation of duties to the two vice-presidents and others.

Another assiduous worker is Tuulikki Mäkeläinen who runs the office of the Society under the eyes of the treasurer. Her responsibilities are the ever-growing daily routines of the Society and in them she is peerless. The engagement of Tuulikki Mäkeläinen is surely the one of my deeds that has most profited the Society. This is also an economic issue. Her salary is paid by the generosity of the Finnish Ministry of Education and her office space is given by my department.

Still, even if we have the hard-workers, we have reached the level where the present working capacity is not enough. There is no shortage of good ideas but there is a growing shortage of the realisation. That the present finances are not enough for any real-size salary does not make the situation easier. The next Executive Committee has to give serious thought to this aspect which threatens to slow down the progress of the Society.

On the membership

During the years preceeding the foundation, the nature of the Society was discussed thoroughly and exhaustively. The original suggestion was the federation of European mathematical societies which would act as a link between national societies and which would take care of their common projects at the international level. This was challenged by a proposition of a society of European mathematicians which would be the channel of the needs and wishes of individual mathematicians in the united Europe to come.

The final decision combined the aspects. EMS has both corporative and individual members. All the 33 societies which had participated in the activities of the European Mathematical Council joined EMS at the foundation meeting. With the new societies who joined later, EMS has now 52 corporate members. In this sense EMS truly represents European mathematics. This gives us a sound basis for actions at the European level. At the same time the presence of all significant societies in EMS prevents the overlapping of operations by accident and minimises the danger that EMS is mistaken as a competitor of national societies. Also, the fees paid by corporate members are a substantial item in the budget of EMS.

At present the delegates of national societies have a clear majority at the Council. The foundation meeting decided that the structure will be redesigned when we have 5 000 individual members. In less than two years we had already gathered 1 600 individual members, but the increase ceased there. At the moment we have some 1 800 individual members, which is far below our expectations. Still worse, we lose some 200 members every year and the inflow just suffices to cover this loss.

There has been a constant debate about how to enlist more individual members. One reason for the disappointing result might be the shortage of direct contacts between EMS and individual members. The present mechanism was created at the foundation for economical reasons. The national societies take care of the recruiting of new members for EMS as well as of the collection of our membership fees. The direct recruiting of members and collection of fees would increase our expenditure, demand more capacity from our office and increase the danger that we are considered as a competitor of national societies. Still, if we want to

have essentially more individual members, it might be the only way.

There is also a problem rising from the East. For mathematicians who had lived behind the "iron curtain" our present membership fee is both high and difficult to pay. Zentralblatt has very helpfully offered them a possibility to pay our fee with the reviewing money. This has brought us over 100 members, but it does not solve the problem. In this context it must be said that the same problem of payment is valid for many Eastern European societies. We have considered the possibility that their fees could be paid in kind by doing some projects for EMS, but so far it is only a plan.

We have been able to get grants from the European Union for some projects. Otherwise we are economically totally dependent on the membership fees. The fees are sufficient for running the society at the present level. However, if we want to enlarge our standing activities we must also enlarge our regular income. This item has been in agendas of several meetings, but no philosopher's stone has been found.

EMS should represent all European mathematicians independent of their classification. In practice, applied mathematics has not got all the weight it should have. We have been aware of this but the remedy has been too slow. I am confident that the next Executive Committee under the presidency of Rolf Jeltsch will also have success in this area.

Farewell

EMS has grown from a seed to a sapling and continues to grow. It can already give shelter to many ideas which I find important and even necessary. Under the auspices of EMS many more movements will take place for the benefit of European mathematics. I, the treasurer who has served his time shall return to my previous living. However, it is not the same man who returns. It is a much more experienced, much more learned man who treasures in his heart the feeling that he has been with in creating something valuable for Europe, something of lasting importance. One could return with worse.

EUROPEAN MATHEMATICAL SOCIETY

Council Meeting

Berlin (Germany) August 28-29, 1998

The Council Meeting was held in the Senatsaal of the Humboldt University. It was attended by 57 delegates (44 delegates for 30 member societies and 13 delegates representing individual members). Also present were a member of the Executive Committee, observers representing societies that had applied for membership and Ms T. Mäkeläinen representing the EMS Secretariat. In addition, some persons were present with the permission of the President.

Address of the President

In addressing the Council, the President briefly examined the role of the EMS.

"The EMS exists to help the development of a European identity among mathematicians, while preserving the existing diversity. The EMS has been eight years in existence and it is time to review what has been done and whether its development has been appropriate. Should something be changed? This is a matter for the Council to consider.

Turning to the future, we see at the turn of the century many countries facing financial difficulties and a decline in enrolment of students. Attention must be paid also to the image of mathematics and to the image that mathematicians give of themselves. Unemployment among young mathematicians is very low because there is a demand for mathematicians in industry and business but this demand must be met and this requires that we appropriately prepare our students.

EMS is a good structure to help tackle these problems because it forces us to work together, to confront our experiences and to deal with all kind of structures that in general do not treat mathematics very well by shear ignorance of the way it connects to society."

Report of the Executive Committee

Report of the President

Jean-Pierre Bourguignon, the President, reviewed some of the activities of the EMS over the past two years.

The first issue of JEMS, the Journal of the European Mathematical Society, is coming out in early 1999. This is the conclusion of a long process, that

was already initiated by the preceding Executive Committee under the leadership of the first EMS president, Professor Friedrich Hirzebruch. An editorial board has been set up with Professor Jürgen Jost, as editor-in-chief, some associate editors being still in the process of being nominated. Three Diderot Mathematical Forums have taken place and two more are being organised.

The preparation for the Third European Congress of Mathematics to be held in Barcelona in July 2000 is progressing well. The EC of EMS has set up the Scientific Committee, whose work has already resulted in the selection of plenary lecturers. The nomination of the Round Tables Committee is almost finalised. The Prize Committee's composition has been approved.

The contents of the Newsletter have been improved with the appearance of regular columns and its cover has become more attractive. A special issue (appearing ahead of its normal schedule) has been distributed during the ICM at the EMS booth.

The Summer Schools programme, started in 1996, has been continued in 1997 and 1998 with two series of courses given each year, one in pure mathematics and one directed towards applications of mathematics. The summer schools have been very successful, well attended and with high level lectures.

The EMS Lectures are given in odd numbered years: N. Cutland was the lecturer in 1997 in Helsinki, and in 1999 M. Lyubich will give a series of lectures on *"Real and Complex Dynamics"*, at the Russian Academy of Sciences, St. Petersburg, the Technical University of Denmark (Lyngby) and at Universitat de Barcelona.

The web server of the Society, EMIS, is flourishing. It aims to be a model for making information available for the mathematical community. The electronic library is an important contribution and the connection to the database Zentralblatt für Mathematik functions well.

EMS strives to make the database Zentralblatt-MATH (the new name of the Zentralblatt für Mathematik) into a truly European venture, which can be considered a large infrastructure for science. Zentralblatt-MATH comes out in three formats: on paper, on-line and as CD-Rom. EMS has been granted the copyright of Zentralblatt-MATH and has become a partner in all discussions concerning the publication. EMS representatives insist that the database keeps a close relationship with the mathematical community. It fostered the establishment of an Innovation Committee which is, in particular, in charge of channelling the feedback of the community to the structures producing it.

EMS has become an established partner with the European Commission. L. Lemaire is the EMS officer in charge of contact with the Commission, paying regular visits to members of the Commission, often accompanied by the President. The European Union is a complicated organisation with many levels to be consulted before a decision is reached and it is difficult to have it attend to special wishes. The first EMS President, F. Hirzebruch, established good relations with the European Science Foundation. These have been pursued and, with the arrival of a new secretary general, we intend to develop them further.

Report of the Secretary

Peter Michor, the Secretary, reported that the Executive Committee has held 6 meetings since the previous Council meeting. In Budapest, on 23 July 1996, the main discussion topic was the outcome of the Council meeting which had just been held. In Cambridge, on 11–13 October 1996, the new team of the Newsletter was presented and matters of the education committee were discussed. The meeting in Vienna, on 5–6 April 1997, had the ECM2000 and WMY2000 as the main topics on the agenda. The Capri meeting, on 10–11 October 1997, considered EU matters and prepared the forthcoming Council meeting. The Helsinki meeting, on 21–22 March 1998, focused its attention on databases and the Zentralblatt, and the meeting on 25 August 1998, in Berlin, dealt mainly with the present Council meeting.

Other initiatives of the EMS include the EULER project. The purpose is to develop a better interface for EMIS, a better search machine and a preprint server.

Financial Matters

Report of the Treasurer

Aatos Lahtinen, the Treasurer, reported that the Society had reached a sound financial basis. The income has been as budgeted, with some arrears of due payments. The expenditure has been less than income, due to savings on many points; thanks are due to many individuals and organisations. The Society has not been able to secure essential stable new income and is thus basically dependent on membership fees. However, the EMS was able to find support for all the activities it organised; some of them have been supported by the European Union.

Membership Fees, 1999 and 2000

The Council has approved the following fees: the unit fee x for corporate members equalling 340 Ecu and y for the individual members equalling 15 Ecu.

Report of the Officers

Report of the Publicity Officer

M. Chaleyat-Maurel, the Publicity Officer, reminded the delegates that they had received reports of Executive Committee meetings, which have also been reported in the Newsletter.
Logos for different activities have been designed. They can be used in connection with EMS activities along with the EMS logo. The leaflet designed in 1996 has been widely distributed. A dossier had been prepared earlier in French; it is now available also in English. It is convenient for updating information.
Posters have been systematically made for the Diderot Mathematical Forums and Summer Schools with a uniform design. A colourful poster showing the agenda was sent in 1998 to all mathematical departments in Europe.
A new format has been designed for the Newsletter. Following discussions with Springer-Verlag and FIZ, new covers for JEMS and Zentralblatt-MATH have been created.
The visibility of EMS has greatly increased in both large and small conferences.
A new project, EMPRESSA, a mathematical press agency in Strasburg, has not yet reached the level of activity that was hoped for though a certain interest has been evident.

Report of the Publication Officer

Carles Casacuberta, the Publication Officer, reported on the existing publications of EMS, the Newsletter and the JEMS as well as on plans for further ones, the most advanced of which concerns the publication of the EMS Lectures, the proceedings of Summer Schools and Diderot Mathematical Forums.
During the ICM98, EMS organised a meeting for editors of non-commercial European journals with the aim of promoting co-operation in publishing and advertising.

Report of the Committees

Most of the chairs of the Committees had sent written reports. Only oral communications are reported below.

Education

V. Villani reported on the work of the Committee. The committee held a meeting for one week in Trento. Many articles relating to education have been published in the Newsletter. A proposal concerning reference levels in mathematics has been submitted to the European Commission. If accepted, the project can be started in the Autumn of 1998.
During the discussion it was pointed out that the training of teachers is an important issue Europe-wide, as is the knowledge of what students really learn. Cooperation at the European level could be very useful.

Electronic publications

P. Michor reported that electronic publication had been one of the main concerns in his work for the EMS during the past four years. The committee of electronic publications has discussed the policy of electronic publishing. EMIS, the server of the Society, has a direct link to Zentralblatt-MATH. EMIS contains an electronic library with an editorial board and well defined guidelines. It accepts only journals with an editorial board which publish refereed papers only. The library contains both electronic versions of established printed journals and purely electronic ones. There are currently 31 journals in the electronic library, and EMIS has 20 mirrors in Europe and 13 in all other continents. For example, the Annals of Mathematics have agreed to participate in the electronic library, with a delay of 5 years after publications; since they use TEX only from 1995 onwards, the first contribution will appear in 2000. Journals which made their issues available through EMIS report no decrease, even an increase in the number of subcriptions.
Book reviews could be added to EMIS, perhaps even those published by member socities in their newsletters. The Newsletter book reviews could be put on the server as a separate section. Mathematical software will be added as a section to EMIS.

ERCOM

J.-P. Bourguignon described the new EMS committee ERCOM (European Research Centres of Mathematics), which has already held several meetings. The constitution of the Committee has yet to be defined.

Special Events

A. Conte reported briefly on the work of this committee, citing the Diderot Mathematical Forums as its main task. The three forums held so far have been successful. The committee needs additional members.
Other activities suitable for the committee could be special conferences.
Moral support and cooperation of EMS was granted to the History of Mathematics section of the Abel Bicentennial Conference to be held in Oslo in the year 2002. EMS could be the coordinator in that section.

World Mathematical Year 2000

M. Chaleyat-Maurel, a member of the Committee, briefly described the work of the Committee. The World Mathematical Year 2000 events include a conference in Alhambra, subway posters in Paris and elsewhere, stamps in various countries

(France, Belgium, Italy), etc. EMS works in close cooperation with IMU in the WMY2000 project. The logo of WMY/IMU can be obtained as a file and can be used in projects connected to WMY2000.
It was pointed out that TV programmes should be influenced now but a bid for the issue of mathematical stamps may be too late in many countries. For press coverage, the year 1999 may be ideal.
UNESCO has granted USD 20000 to the WMY2000.

European Congresses of Mathematics

3ECM, Barcelona (Spain)

The Chair of the organising committee of the ECM2000, S. Xambo Descamps, presented the plans and structure of the Congress. The Scientific Committee has invited seven plenary lecturers and plans to have 30 invited section speakers. An additional feature will be mini-symposia. The First Announcement will be sent out in January 1999. Preregistration was possible through EMIS at ICM98.
The Congress organisers had wished for contact persons from societies and D. Wallace had sent a letter to that effect to member societies, bringing one answer. The organisers will renew the effort.
The Council asks the Scientific Committee to propose a list of invited speakers and themes of mini-symposia representing a broad spectrum of mathematics including applications in the real world.
The age limit of EMS Prize winners was brought to discussion from the floor. It was proposed to increase it to 34. The Council resolved to keep the age limit of the EMS Prize winners at 32 years.

ECM2004

It was recalled that the timetable for the selection had been decided as follows. In 1998 bids will be requested. The announcement will come out in the December issue of the Newsletter and during the autumn by letters to member societies. The bids should reach the Secretariat by 15 March 1999. The site inspection will take place in 1999 and the final decision will be made in the year 2000.

Society's Life

Membership

The number of individual members has remained at a disappointingly low level even though there has been a certain increase due to the new programme offered by Zentralblatt-MATH to its reviewers.
It was noted, again, that it is difficult to join through some corporate members. National societies should encourage their members to join. EMS has to give national societies material to be handed out to their individual members giving reasons to join EMS, explaining what additional value members get through EMS.

EMS Affiliate Membership in the International Mathematical Union (IMU)

The President informed the Council that the IMU statutes had been changed to include a new category of membership, affiliate membership, for continental mathematical societies and other similar bodies. EMS is in a position to apply for affiliate membership in the IMU and the Executive Committee favours this application. The Council has approved this application.

Election of Corporate Members: Full and Institutional

The following Societies were accepted as corporate members of EMS: the Royal Spanish Society of Mathematics, the Spanish Society of Applied Mathematics (SEMA), the European Consortium for Mathematics in Industry.
The Mathematical Institute of the Serbian Academy of Sciences and Arts was accepted as an institutional member.

Elections to the Executive Committee

The following persons were elected to the Executive Committee for the years 1999–2002:
- Rolf Jeltsch (Switzerland), President
- Luc Lemaire (Belgium), Vice-President
- Olli Martio (Finland), Treasurer
- David Brannan (UK), Secretary
- Doina Cioranescu (France)
- Renzo Piccinini (Italy)

Euro-Job project

S. Gudmundsson has created a service of job advertisements with pointers to the national societies' home pages. Several societies have already joined but the participation of even more societies is encouraged.

Mathematical Dictionary

The Estonian Mathematical Society has prepared a mathematical dictionary in Estonian, English and Russian and a further edition with Finnish, French and German added is in preparation. An electronic version is offered to the EMS free of charge. The member societies should contact the EMS to indicate whether they are interested in participating in a continuation of the development of the dictionary to other languages.

Next Meeting

◇ Friday 7 July–Saturday 8 July, 2000, at the Institute of Catalan Studies, Barcelona (Spain).

Call for bids to hold the 4th European Mathematical Congress

Applications are invited to hold the 4th European Mathematical Congress in the year 2004. Applications should reach the Executive Committee before March 15, 1999, to the following address:

EMS Secretariat
Department of Mathematics
P.O. Box 4
FIN-00014 University of Helsinki
Finland

This call for applications will also be sent by letter to each member society of the EMS. The decision process and the organisation are subject to the following guidelines:

European Congress of Mathematics in the year n

– *Bids:* Bids are asked for in the EMS Newsletter and letters to the members societies in the year $n-6$. The EC appoints a site committee in case there is more than one bid. The site committee makes its inspections during the year $n-5$; the costs are borne by the bidders. The site committee inspects the auditoriums and the accommodation, plans for the scientific programme, the financial plans and the strength of the mathematical community making the bid. It also takes into consideration the costs for the participants to reach the site and the costs for the stay during the congress. Special attention will be paid to the availability of inexpensive student dormitories.

– *Decision:* In the year $n-5$ or $n-4$ the Executive Committee makes a recommendation for the site to the Council and the Council decides in the year $n-4$.

– *Local Organisation:* This is the responsibility of the organisers of the Congress.

– *Finances:* The financial responsibility lies wholly with the local organisers. The EMS assists in seeking outside financial support but, as a rule, does not enter into contracts on behalf of the congress. The EMS provides some financial support for travel of Eastern European mathematicians to the Congress as well as to the satellite conferences.

– *Committees:*

* *Scientific Committee:* the local organisers suggest the chair for the scientific committee for the EC of EMS to approve.

* *Prize Committee*: the local organisers suggest the chair for the prize committee for the EC of EMS to approve.

* *Round Tables Committee:* the local organisers suggest the chair for the round tables committee for the EC of EMS to approve.

The chairs of these committees suggest the members for the respective committees, for approval by the EC of EMS. The local organisers commit themselves to the financial support needed for the work of these committees as well as to any secretarial help needed. The registration fees should be brought to the Executive Committee meeting for discussion before the final decision is made. The EMS individual members must get a reduction of about 20%.

– The local organisers report regularly to the Executive Committee on the progress of preparations. Specifically, it should bring forward plans for:

* the aims of the scientific program and its general plan (number of plenary lectures and their positions in the programme, section lectures, round tables, possible short communications, posters). The selection of the speakers is the responsibility of the scientific committee. The final decision lies with the scientific committee;

* the budget plans, for consultation and advice;

* accommodation: for information and discussion;

* registration: for information and discussion;

* publicity: final responsibility is with the local organizers but EMS strives to give the congress as wide a publicity in its organs as possible;

* publications: final responsibility is with the local organisers.

The local organisers pay for the travel and lodging of the speakers and waive their fees. The funds for the prizes are the responsibility of the local organisers but EMS support for fundraising is provided. The local organisers are free to use contractors in any local arrangements but it is in the interest of all parties concerned that the actions of these contractors are carefully supervised. The social programme is the responsibility of the local organisers. The local organisers take the responsibility for the local arrangements for the EMS Council meeting.

Committee on Applications of Mathematics Revived

The Committee was re-established by the Executive Committee in early 1998, Heinz W. Engl (Chair for Industrial Mathematics, Johannes Kepler Universität Linz, Austria) was appointed Chairman. Further members of the Committee are: Vincenzo Capasso (Milano), Guy Chavent (Paris), Rolf Jeltsch (Zürich), Etienne Pardoux (Marseille), Alfio Quarteroni (Lausanne), J.F. Rodrigues (Lisboa), Walter Schachermayer (Wien), Rüdiger Schultz (Leipzig), Erkki Somersalo (Helsinki), Anders Szepessy (Stockholm), Anatoly Yagola (Moscow).

The Committee had its first meeting on June 20 in Vienna, mainly in order to establish its mission and ways of operation. It was agreed that the Committee would mainly work by e-mail. The following Mission Statement was adopted:

Applied Mathematics and Pure Mathematics are two sides of the same coin, they need each other. The Committee sees its role in promoting Applied Mathematics as a whole through and within EMS, since applications cannot be separated from the mathematical methods. The Committee, instead of competing, wants to cooperate with other, sometimes more specialised, societies on the European and international level and with applications-oriented member societies especially in further improving the public and political awareness about the importance of mathematics to cultural, economic and social development.

The Committee feels that the European Congress is a major fact or in determining the public image of EMS, so that in order to attract applied mathematicians to the EMS, the format and contents of the next congress in Barcelona with respect to the representation of Applied Mathematics will be of utmost importance. Especially, the Committee offers its help to organize events like special sessions, round tables and talks for a broader audience at that congress, also jointly withother more specialized societies like the European Consortium for Mathematics in Industry (ECMI). The Committee would see it as an encouragement to Applied Mathematicians in EMS if the list of plenary and invited speakers (to be determined by the Program Committee) would reflect the breadth of the field of Applied Mathematics.

Another major point of discussion concerned contributions to the EMS-Newsletter. The Committee has concrete plans for interviews with high-profile Applied Mathematicians about their views. Also, interviews with recent mathematics graduates now working in industry and also with employers are intended.

Another major point of discussion concerned plans for stimulating proposals for EMS Summer Schools in Applied Mathematics to be submitted to the respective EMS Committee.

We hope that we will be able to contribute to the strengthening of Applied Mathematics within the EMS in order to keep (or make?) the European Mathematical Society attractive to the Applied Mathematics Community.

We would welcome suggestions for initiatives and activities to be undertaken by the Committee

Heinz W. Engl, Linz, Austria
engl@indmath.uni-linz.ac.at

Interview with Professor Mark Davis

Interviewer: Walter Schachermayer (University of Technology, Vienna)

Professor Mark Davis took his BA at Cambridge University in 1966 and his PhD at the University of California, Berkeley in 1971, both in Electrical Engeneering. He then joined Imperial College, London, eventually being appointed Professor of System Theory in 1984. He has held visiting appointments at several other universities, including Harvard, MIT and the University of Oslo. He has worked in stochastic analysis, stochastic control and nonlinear filtering and the mathematics of finance. He has published many papers and three books on these subjects, most recently "Markov Models and Optimization" (1993). He received the ScD degree in Mathematics from Cambridge University in 1983 and Fellowship of the Institute of Mathematical Statistics in 1993. From 1978 to 1993 he was Editor-in-Chief of the journal "Stochastics and Stochastics Reports". In 1995 Professor Davis moved to Mitsubishi Finance International (now Tokyo-Mitsubishi International) as Director and Head of Research and Product Development.

WS: What got you into the finance industry?
MD: The short answer is: a cold telephone call! I had been based for many years at Imperial College, London, working in stochastic systems and optimal control. Like many of my friends in this area I realized that finance provided a rich field of applications, and my former PhD student Andrew Norman and I made something of a breakthrough with our work on transaction costs. However, all of this was orthogonal to the many other things I was involved in at Imperial and I was in danger of splitting my efforts in too many directions. Also, my 50th birthday was coming up, and along with it the thought that if I was ever going to do something new and radically different, now was the time. At just this moment the phone rang and a City headhunter was on the line asking if I was interested in talking to "a Japanese investment bank".
WS: What surprised you the most when you got there?
MD: Two things. Firstly, the absolute dominance of information technology (IT). In a sense, this is obvious: in the end the bank is just a computer system with a record of all live deals, means for entering new ones, and engines for computing mark-to-market values, sensitivities to market inputs and overall risk exposure. As a practical matter this means that any model one develops as a researcher is useless if it can't be shoe-horned into the company's system. You might think that one could just pass the code over to the IT department and let them take care of it, but life isn't like that. That was a surprise.
The second thing — again obvious in retrospect — is the difficulty caused by apparently innocuous things such as correlation. You would think there was almost nothing to say about such an elementary concept, but in fact it occasions all manner of problems. Many derivative contracts such as cross-currency options or differential swaps depend quite critically on a correlation coefficient, but the point is how do you estimate it? There is very rarely anything like an implied correlation, and a believable estimate based on historical data is notoriously hard to obtain, leaving considerable uncertainty about the value of positions running into many millions of dollars.
WS: Could you describe the set-up at Tokyo-Mitsubishi International?
MD: We are perhaps unusual in having a central quant group, called Research and Product Development, rather than individual quants spread around the trading desks (although there are some of those too). There are six of us, all but one PhD mathematicians or engineers, with four different nationalities. We do a wide variety of assignments on behalf of Front Office groups (trading and capital markets) which in the recent past have included modelling convertible bonds, forecasting volatility for the equity desk and developing models for credit derivatives (these are instruments whose payoff depends on default of some counterparty). The "product development" part of our remit can include close cooperation with people in capital markets developing proposals for clients. I once flew to Australia as part of a team negotiating with someone who wanted to borrow $500 million to develop a nickel mine. We were suggesting that they use nickel options to reduce their funding costs.
WS: What kind of mathematical training should mathematicians have received if they want to be successful in the financial industry?
MD: Stochastic analysis, certainly. You really do have to understand the Girsanov formula! Other than that (and PDEs, of course), a general mathematical "toolkit". I'm happy to confess that, apart maybe from John Hull's book, the book I consult most is probably the wonderful "Numerical Recipes".
WS: Beyond the mathematical training, which other qualities are of crucial importance for these jobs?
MD: A taste for problem solving. It's rather like

being a doctor: you can't tell the patient to go away because the disease isn't completely understood. You need to be able to size the problem up, figure out roughly what the answer must be, understand which factors are the crucial ones and which will only affect the answer by a few basis points, and think up some way of checking that your answer is correct when you get it. This is the sort of training that physicists and engineers often get more than mathematics students. As you know there's a large physics mafia in the financial markets (one day there will be a book called "Coordinate-Free Finance"), and maybe that's why.

POSTDOCTORAL FELLOWSHIPS

Description: The Centro de Matemática e Aplicações Fundamentais (CMAF) offers a limited number of postdoctoral positions at the University of Lisbon with a grant from the portuguese Fundação para a Ciência e a Tecnologia. Appointments are for periods between 3 months and one year to start in March 99. The research at CMAF includes topics in Mathematical Analysis (Partial Differential Equations and Calculus of Variations) in Geometry (Singularity Theory and Manifolds) and in Applied Mathematics (Nonlinear Mechanics and Numerical Analysis).

Eligibility: Applicants for these fellowships must have received their doctorates in 1994 or later in Mathematics or Applied Mathematics. The following materials must be submitted: i) personal statements of scientific interests and research plans, ii) curriculum vitae, list of publications and iii) two letters of recommendation, to be sent directly to CMAF.

Grant amount: Stipends amounts are 270.000 PTE monthly (approx. $1,500) plus health and lodgement benefits and travel expenses.

Deadline: Deadline for applications is January 15, 1999.

Application information: Ask CMAF/Univ. Lisbon, Av. Prof. Gama Pinto 2, 1649-003 Lisboa, Portugal; call +351-1-7904861, see http://cmaf.lmc.fc.ul.pt or send an e-mail to cmaf@lmc.fc.ul.pt.

An Interview with Professor Sir Christopher Zeeman

by
Steen Markvorsen
Department of Mathematics
Technical University of Denmark

Algebraic Geometry

Said Algebra to Geometry
My theorem is a seed.
Said Geometry to Algebra
Where within a seed can lie the beauty of a flower?
Said Algebra
A seed to grow needs must have soil.
Said Geometry
The womb of my imagination can provide the soil.
Said Algebra
Without my seed you could not grow the flower.
Said Geometry
Without my womb the beauty could not then unfold.
Said Algebra
So then it is the child of both of us together.

C. Zeeman

SM: Professor Zeeman, you have raised many beautiful flowers in the course of your scientific career.

CZ: I started out in algebraic topology, and I was in that field for about 10 years. Then I switched to geometric topology.

You see, at the time I was in algebraic topology it was generally thought that 'geometric topology more or less died and topology had been taken over by algebra'. This is a quotation from Marshall Stone.

But then in 1960 there were 4 results that really opened up geometric topology again:

(1) Milnor's proof that the 7-sphere admits different differentiable structures,

(2) Smale's proof of the Poincaré conjecture,

(3) Mazur's proof of the Schoenfliess theorem in higher dimensions and

(4) my own proof of the unknotting of spheres in 5 dimensions.

I think those 4 results began an important resurgence of geometric topology. In topology one uses algebra to disprove things, and geometry to prove things. To prove that knots exist, you have to use algebra, whereas to prove that knots don't exist you have to use geometry, because you actually have to do the geometrical unknotting.

As a research student I tried for 3 years to prove that you could knot a sphere in 5 dimensions. I manufactured a huge piece of algebraic machinery. It was a good machine - useful for other things - but it failed at that particular task. And then 7 years later, I sat down one Saturday morning and I thought to myself, well, why don't I try and prove the opposite, that you can unknot them. And by the end of the morning, I had proved that you can unknot spheres in 5 dimensions. I was very excited and spent the whole weekend writing up the proof of about 20 pages, and then late Sunday night at 2 a.m. when I was contemplating with pleasure my proof, it suddenly struck me, that I could generalize it to n dimensions, and unknot n–spheres in all dimensions greater than $n+2$. Therefore knotting is only a codimension 2 phenomenon. Once I had seen how to do it in n dimensions, then I was able to reduce the proof for a 2–sphere in 5 dimensions down to 10 lines, which I published in the Bulletin of the American Mathematical Society, [60b]. I still consider it one of my best papers.

Incidentally, years later, when I became head of Hertford College (1988–1995) I had to have my portrait painted, and the artist asked: "What are we going to have behind you?" He liked a photograph of me in front of a blackboard, and wanted to do a similar painting. At that time I had reduced the proof of the unknotting of spheres down to 5 lines, so I suggested that that proof might be displayed on the blackboard. He looked at it and said that he would never be able to copy all those symbols down. So I said: "Well, I will chalk the formulas onto the canvas, and then you can paint over them." He said: "Oh no, you are not allowed to touch the canvas at all! That's against the rules!" But eventually we agreed that I should do it anyway, and so now my handwriting is on the portrait.

Now back in the first half of the 60's, out of my small theorem then grew a big industry in the piecewise linear embedding and isotopy of manifolds. I had about a dozen research students write their theses on it. That was also the time when I moved to Warwick University and founded the Mathematics Institute there. It was a big administrative load, because I was on the senate and council and finance committee and everything. After 5 years my research had dwindled to zero and I could not understand what my former students were doing.

But also at Warwick, each year we used to have a year-long symposium focusing on one particular subject with many overseas visitors. We had a year on topology and one on algebra - subjects which we specialised in. After a while I thought we should try subjects, that were not so well represented in England, in order to try and import them into England. And so we had one on harmonic analysis, and another on dynamical systems, at which England was rather weak.

We did this in the hope that we could persuade some of the British mathematicians to take up these fields. Of course I was hoist by my own petard. I myself became very interested in dynamical systems

SM: You went on a sabbatical to Paris, at the IHES.

CZ: Yes, I had earlier written a paper called 'The topology of the brain and visual perception', [62], in which I applied dynamical systems to model the brain. René Thom had read this work, and when he was writing his book on 'Structural Stability and Morphogenesis', he kept sending me his preprints. At IHES I had the next door office to him and began reading the preprints. But I could not understand them, so each day I used to go in and say: "How do you get from line 19 to line 20?" I had to fill in about 99 lines between each 2 of his, but every time I asked him a question a whole goldmine appeared. I got very excited. So much so, that I decided to change direction of research into that area - into dynamical systems and catastrophe theory. When I discovered what he was really saying, I saw it could be applied all over science, including all the biological and behavioural sciences. So I began to write applications in many different branches of science, [77, 81]. In this sense I became a Jack of all trades and Master of none. But it was a very interesting time. And the subject became very popular. Unfortunately press exaggerations led to a backlash and it became controversial.

SM: You have explained this controversy in [93], where you also describe another controversy, between Euler, d'Alembert and D. Bernoulli.

CZ: They had a beautiful and remarkably fruitful controversy on Fourier series. That controversy started about 1750 and lasted about 80 years. It was before Fourier was born, of course, but the interesting thing about it was, that the mathematics had not yet been solved. Indeed the controversy stimulated the discovery of a great deal of new mathematics. It was finally solved by Dirichlet (in 1829), who proved that the Fourier series of a function converges back to the original function.

Bernoulli had anticipated this fact in 1753, but people did not believe him because they said: 'You could not possibly describe an arbitrary function as a Fourier series, because there are so many different possible functions, and only a few terms in the Fourier series, just sines and cosines. And furthermore, how do you calculate the coefficients?' It was not until 50 years later when Fourier calculated the coefficients of the Fourier series that people began to believe Bernoulli.

The reason that this controversy lasted 80 years is because it took that amount of time before the mathematics was proved. In the case of the catastrophe theory controversy the mathematics was proved completely and rigorously *before* the beginning of the controversy. So it was a totally different situation. I thought it was worthwhile to put the two controversies side by side to see the differences and point out that in one the mathematics was proved after and in the other before. That is why the catastrophe theory controversy was so short lived. It was essentially an argument about the applications - the applications to the social sciences and to the biological sciences.

SM: You mentioned that your initial work on the topology of the brain is from before you met Thom.

CZ: I have always been interested in the brain. If I had not become a mathematician, I might have become a brain surgeon. I felt that there was a richness of structure in the dynamics of the brain that was as quite as rich as human thought. That one didn't need anything else. The mind could depend only on the brain. But, of course, when I tried to persuade biologists and brain experts about this, they all said to me: "Predict something!" I

found that I could not predict anything at that time, and so I lost interest a bit because I felt I wasn't doing any good. So I stopped doing studies of the brain because of that.

When I met Thom and we looked at catastrophe theory, I found that the discontinuities were in fact predictable and observable. So I could predict experiments in the brain, and I became very interested again, and in different parts of the brain. Some parts of the brain you use language to model, other parts you use dynamical systems to model, and other parts computer programs to model.

People who speculate about theories of the brain, such as philosophers or mathematicians, usually do not attend to the anatomy, and people who do attend to the anatomy tend to get too reductionist. They measure the behaviour of individual cells or groups of cells. Thus they tend to concentrate on the brain rather than the mind. But I thought that catastrophe theory was a tool which could be based on the physiology, the fine structure, and whose global manifestations could be related to thought. Therefore it gave an interesting link between the physiology and psychology. I think that mathematicians are needed for this - to link the two fields.

Scientists predict and experiment and confirm. Mathematicians explain. Unfortunately they often do not meet, these two ideas. When you can get a bit of mathematics to work where it does both predict and explain, that is good science. I think it is very important to do both. Thom himself only philosophizes. He occupies the position half way between mathematics and philosophy, and he does not want to get involved with the details of predicting experiments. I occupy the position halfway between mathematics and science. I wanted to talk to experimentalists and predict experiments for them to do. That is why our collaboration was very fruitful - because we occupied different positions. We were able to talk in the middle and contribute to each other.

SM: How do you see the prospects for catastrophe theory in the next century?

CZ: There are certainly great potentials. This century is the century of physics. The next century will be the century of biology. There is a huge number of interesting problems in biology. Let me give you three.

Problem 1 is development. How do the genes dictate the geometrical shape of the growing embryo?

Problem 2 is intelligence. How does the brain work? How does the mind work?

Problem 3 is evolution. How does it work? Can you predict it?

These three problems, which are interrelated of course, will be attacked in a major way throughout the coming century. And I think these problems are far more interesting than the present problems in physics. The study of what happened in a fraction of a second after the Big Bang is almost theological in some sense and so far removed from our every day life that it is of less interest to the human race than the problems I have just mentioned.

And to solve these problems we will have to introduce mathematics in a much deeper way to connect the local to the global. Of course, there are not great theories in biology like those in physics that transcend all distance scales from large to small, such as electromagnetism or gravity, so at first sight biology does not look as deep as physics. The problem is that in biology you do not have action at a distance, and so you have to have many levels of modelling, and many different models.

Molecular biologists often claim to be doing embryology, but the type of results they obtain is that at a certain stage of the embryo a certain gene may be switched on, and it then produces a certain chemical which can be measured. But they do not really explain why a bone or a joint should be of a particular shape, nor do they talk about the geometrical growth of the embryo, why it should unfold or why frontiers develop between bone and muscle and so forth. I think that these are really the more important things about the structure of the embryo - the shapes and differences and functions of the different organs rather than just their chemical content. The molecular scientist's modelling process goes from DNA to RNA to proteins to macromolecules. It is a nice combinatorial method of modelling, but it stops there. Their mistake is, I think, to try to extend that methodology to larger scales, whereas you should go on from there with a completely different type of modelling. You should not look at the complexity of the chemical factory within the cell but you should look at the relative simplicity of the gradients that the chemical factory produces across the cells. So you start with the gradients and singularities and dynamics and so forth. In other words a completely different type of modelling for the higher levels. Biology is a hierarchy of levels and the theorems of one level are the axioms of the next level.

SM: Which mathematical disciplines will we need in particular to handle these questions?

CZ: They require the whole of mathematics. And we cannot predict what branch of mathematics will become useful. One has to have all the strings to one's bow, and to pursue those that turn out to be fruitful. We should not expect huge major theories in biology. We should expect a number of small theories, but each one may use a sophisticated branch of mathematics in an unexpected way.

Sometimes when physicists enter biology the results

are disastrous. They mistakenly try to apply large theories that have been designed for fundamental particles, say. I am a great believer in small ad hoc models. If you are given a biological phenomenon, you should start with the simplest possible mathematics to try to explain it.
But of course we are seeing more and more into complicated pieces of biology and therefore the simplest mathematical model may actually require rather sophisticated mathematics.
SM: Speaking about physicists and the necessity of communication across disciplines, let me ask you about your discovery that 'causality implies the Lorentz group'.
CZ: For a long time I never understood relativity. But then I was looking at a fine topology that you have to put on a function space in piecewise linear theory when it occurred to me that the method I had used to describe the topology of this infinite dimensional space could be used to describe a fine topology on ordinary 4-dimensional space time: We define a set to be open if and only if it meets each 3-dimensional space, flat space, and each 1-dimensional time line in an ordinary open set. The homeomorphisms of this fine topology turned out to be the elements of the Lorentz group, so surprisingly the homeomorphisms really are constrained to be linear. You can build the whole of special relativity just on the notion of that fine topology.
When I gave a seminar to the physicists at IHES about this I proved that a homeomorphism in this topology could eventually just be described in terms of a map that preserved the causal relation: a point a is less than a point b if b is in the future time cone of a. In other words an event at a can cause an event at b. I then said that from there on it is an easy lemma to obtain the Lorentz group. At that point the physicists suddenly sat bolt up-right and said: "We don't know anything about topology, but that result you just mentioned - that preserving that causal relationship implies the Lorentz group - is enormously interesting. How did you prove that?" So my little lemma turned out to be important. I published a paper about it, [64], which proved to be seminal in some sense because many people took up the idea and proved other results with it. So it is nice to have physicists around to tell you what you prove is interesting.
SM: Your message is clear: communication in its broadest sense is important.
CZ: Very much so. I will tell you another reason why it is very important. As you get older you get slower. And if you reach the end of your research in one particular area, and you want to try and learn some new subject, it takes a long time to find your way into this new subject, but if you are surrounded by mathematicians you can take short cuts. You can go into one of your friends' room and say: Show me how to do such and such, and in 5 minutes you will learn what it would otherwise take you 2 months to read in a book.
I remember one such experience. I confess I had avoided learning functional analysis all my life, but then I had to use it for a theorem. It was when I was president of the London Mathematical Society. And I founded the journal 'Nonlinearity' to encourage the applied mathematicians to join the LMS. So they asked me to write an article for the first issue. I managed to prove some conjectures about how you classify differential equations in terms of functions, [88]. Briefly: You take an ϵ which represents the smallest distance below which your apparatus cannot measure. And then you take the Fokker-Planck equation with that ϵ as your diffusion. The flow determined by your differential equation gives you a steady state which is a function. So you have then got a map from differential equations to functions. This map turned out to be open. You can therefore lift all the classification theory of functions in terms of elementary catastrophes up to a classification of differential equations. But to prove that the lifting is accurate I had to learn some functional analysis. Instead of taking me a year it only took me 2 weeks, because luckily there were several people at Warwick who knew functional analysis and so I just went from room to room and asked questions until someone pulled out a book and said: "On page 200 is the answer to your question". If you are in a good environment you don't die. You can remain active until the seventies!
SM: This 'good environment' principle is one of the secrets behind your great success in building up the Mathematical Institute in Warwick?
CZ: Yes, very much so! I was trained in Cambridge where people didn't talk - at that time they lived in different colleges and there was no central mathematics building. Once I tried to amalgamate a number theory tea with the topology tea after our respective seminars, but the number theorists rejected that! When I came to Warwick I therefore deliberately designed the Mathematics Institute with a large elegant common room, which sucked people in, and created a lot of talking. Essentially the Institute was a layer of hermit cells around the edge with this very attractive central common room, deeply carpeted and with comfortable chairs and round tables serving tea and coffee and lots of blackboards everywhere. Twice a day people were tucked in there for communication, and it worked!
SM: You have been chairman of the steering committee for the Isaac Newton Institute in Cambridge since its creation in 1990. What do you think of the role of centres today?
CZ: There was a time when if you invited the

top world mathematicians in a particular field they tended to come for 2-3 months. Now they get so many invitations from so many centres that they scatter around and are only staying for 2-3 days. They simply go into orbit. So it may well be that the style of meetings is changing. At Warwick I tried to maximize the ratio of what you get out over what you put in. In a short meeting you put in a lot organising it all, and arranging and solving peoples problems when they arrive. You get so exhausted that you get out relatively little. Whereas in a year-long meeting, where everybody arrives at a different time, you can put in relatively little each day, but you get out a lot because you have time to meet people and talk and get the ideas and do research and write papers together. Long meetings are much more productive.

Of course the top people in the world now can not participate in real long meetings because of the phenomenon that I mentioned, but people who do spend a year at a centre may produce some very valuable research. So the centres are making a major contribution to individuals.

SM: Your poem on Algebraic Geometry has suggestive and clear overtones of the masculine versus the feminine modes of thought. How do we attract more women into mathematics?

CZ: Let me answer your question in the following way. When I teach 13-year old girls they are very good - - certainly just as good as the boys. I remember one little girl who came up to me and whispered: "It's wonderful to be amongst people who don't think you are odd just because you are interested in mathematics". She was participating in one of our so-called masterclasses where we get the best 13-year old boys and girls from some 50 schools. They come on a Saturday morning for three hours or so, and this lasts for 10 weeks. These masterclasses have been going now in Britain for about 20 years, and they are operated from about 50 centres. At that level the girls are certainly just as good as the boys. When you get to university level, it is true that the girls, the women, reach their ceiling earlier than the boys, but that is just a slight difference between the means of the two sexes: The top women are just as good as the top men. Where women face a particular problem is at those crucial moments of career decision: "Shall I get married or shall I go on to a Ph.D. , or have a child or something". That is the point where they need the most help.

The philosophy I have worked out - for myself at any rate - is that at those moments of crucial decisions in the career of a woman, I will be prepared to give her ten times as much time as for a man. If I make one phone call for a man I will be prepared to make ten phone calls for a woman. If I see a man for one hour for advice, I will be prepared to see a woman for ten hours to give her advice. And sometimes it is only in the sixth hour, that the woman may make the decision to go for the academic world rather than succumb to the social pressures around her not to follow an academic career.

SM: How do you view the role of computers in teaching and in doing mathematics?

CZ: Nowadays all children learn computers, and they will not only get computer games but they will even get very skilled at it. And they will learn the importance of rigour from computers - in writing programs and such. Computers are important, and by now they have reached a stage, where they are sufficiently intelligent to converse with mathematicians. I myself am not particular skilled at using the computer. I draw geometrical curves and get some insight from it in that way.

But on the whole I like to prove theorems straight - by traditional methods. And in particular, when teaching the masterclasses I try and get across the notions of 'theorem' and 'proof' to the children.

SM: You had an argument with the BBC on this issue concerning your Christmas Lectures on television in 1978.

CZ: Yes, that was very funny. The lectures were going to be for 6 hours of prime television time, and during the preceeding few months the conversation went more or less like this:

Me: "Mathematics is about theorems and proofs."

BBC: "Oh but we can't have you in front of a blackboard turning your back to the camera!"

Me: "It's OK, I will then use an overhead projector and face the audience."

BBC: "No no. It will be too much like a classroom. You miss the point. You see, the purpose of television is to entertain."

Me: "Oh yes, proofs can be very entertaining and inspiring and beautiful."

BBC: "We strongly advice you against giving proofs."

Me: "I insist on giving proofs."

BBC: "We forbid you to give proofs."

Me: "Well, you can go jump in the lake because I am paid by the Royal Institution to lecture to the young people and you needn't broadcast it if you don't want to!"

BBC: "Alright, you win. Show us the proofs."

That is the only time I ever won an argument against a television company.

But in actual fact the lectures were highly successful, and I gave several complicated theorems. The theorems I chose were of the following quality: Firstly they had to be noble. That is to say, they had to be at the beginning of a large important body of theory and capture the quintessence of that theory. Secondly they had to be completely understandable. Thirdly the proofs had to be rigorous, and fit onto

one single sheet of transparency on the overhead projector. And fourthly they had to be surprising enough to capture the attention and intriguing enough to hold the attention during the whole proof. I was able to find and present over 20 theorems that meet these criteria.

SM: With a substantial amount of preparation, I believe?

CZ: Yes indeed! It took me a year to prepare. A year's preparation ending in a month's panic.

The christmas lectures, which were invented by Faraday 180 years ago, have only twice been given on mathematics. Once in 1978, by me. And once last year by Ian Stewart. Now, Ian did not mention the words 'theorem' and 'proof'. So I think he fell into the entertainment trap. He was persuaded by the BBC. He described applications of mathematics, the interesting ones, but he didn't prove things. Therefore he did not appeal to the mathematician in people, but he appealed to the scientist in the people. Scientists often describe results: they cannot do the experiments on location, so they describe. We have this phrase 'Blinding with science'. You describe the things which are kind of amazing, but without conveying the deep understanding that a proof gives.

Out of the christmas lectures came the masterclasses I mentioned earlier, [89b]. And after giving master classes for about 10 years, my favourite ones were then recorded on videos, each with an accompanying book. I have done three: One on gears [86], one on perspective [87], and one on gyroscopes and boomerangs [89a].

SM: How do the children who attend the masterclasses stay interested in mathematics later on?

CZ: There was a lot of demand from them for more. But of course we only had limited amount of energy. The people who were involved in teaching the masterclasses then encouraged the development of a web site which is now run from Cambridge. It is called NRICH, (National Royal Institution, Cambridge, Homerton college), [97]. It is a club, a monthly magazine, which gives problems on the first of the month. And the next month it gives children's solutions as well as mathematical puzzles, mathematical news and short expository papers. There is also an answering service. There are 40 undergraduates and research students at Cambridge who answer questions interactively. It has only been going for two years, but it receives 800 visits a day to the web site.

SM: The masterclasses are of a different spirit than the mathematical Olympiads?

CZ: Yes, they are not merely trying to solve crack problems. They are trying to actually teach interesting pieces of mathematics that are not on the syllabus, and which maybe come from history. You give half an hour talk and then half an hour problems, which are related to what you have talked about and then repeat that over 2-3 hours. The problems are meant to stimulate the creativity of the students. Each time you are trying to put forward a whole theory rather than an individual problem. I try to put the children in the frame of mind of a research mathematician.

SM: Thank you very much.

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Interview with Alexis Bonnet

(Goldman Sachs International, London)

Interviewer: W.Schachermayer (University of Technology, Vienna)

EMS: You have had a remarkably brilliant career as an academic mathematician: At the age of thirty, you had received a dozen prizes, were a full professor and had already published no less than thirty papers. At this point, you resigned your university position and moved on to the finance industry. What were the main reasons for this decision?

A.BONNET: It was the luck of a meeting with people from Goldman Sachs. I have been amazed by the quality of people starting the arbitrage business: a former Finance Professor from MIT, a former physicist from Princeton, another from Oxford, a Harvard PhD of finance, etc, and the partner in charge of the group a PhD in astrophysics. I realized that this was a place where I could undertake very interesting research activities, and at the same time be as close as possible to the core of the business. There are not many economic activities in which research ideas are used in practice within such a short period.

EMS: Can you give us a very brief description of the work you are doing at Goldman Sachs's?

A.BONNET: Most of the work is financial and mathematical modelling. For instance the idea can be to write a model that describes properly the relationship between prices of given financial products. The mathematical input involves understanding the qualitative property and the limits of the models. An important part of the work is to turn those financial and mathematical intuition into trading ideas.

EMS: Which mathematical skills are most important for your work?

A.BONNET: To some respect my work is not so far from part of my former academic research activity. I was addressing similar questions when I was studying mathematical models of superconductors (Ginzburg-Landau equations) or combustion (reaction-diffusion equations). Although I am not writing theorems on the fine regularity of free-boundaries any more, the intuition on fine mathematical properties is sometimes quite helpful for very applied problems.

EMS: What kind of mathematical training should mathematicians have received if they want to be successful in the financial industry?

A.BONNET: Probability and PDE are natural topics that one encounters frequently in the finance world. But most important of all for a candidate is to have been succesful in his research and to have an inclination towards applied research.

EMS: Beyond the mathematical training, which other qualities are of crucial importance for these jobs?

A.BONNET: A taste for risk and games for those that want to trade or work close to trading. In any case the ability to bring mathematics ideas into practical tools. This involves being able to write small mathematical codes.

EMS: How many hours per week do you work?

A.BONNET: Between 55 and 60 hours but usually not in week-ends. Working time is really concentrated at the office.

EMS: Thank you for the interview.

A.Bonnet, born in 1966 in Marseille, was ranked number one in the Concours of the Ecole Normale Superieure but then he attended Ecole Polytechnique (also with a top rank in the Concours), where again he was ranked first when graduating. He received the research prize of this school, shortly followed by the Rivot Prize and the Laplace Medal from the Academie des Sciences, Paris (all in 1988). After several other important distinctions, he was awarded in 1996 the prize of the EMS at the Congress in Budapest.

A.Bonnet received his Ph.D in 1992 from the University Paris VI (advisor: H.Berestycki) with a thesis on non-linear analysis. In 1994, he took a position as a full professor at the University of Cergy-Pontoise. He resigned from this position in 1996 to join Goldman Sachs International in London, where he is presently the head of the Arbitrage Research in the Fixed Income Division.

Obituary: Dame Mary Cartwright DBE (1900- 1998)

On April 9th this year an obituary was published in the Guardian concerning Dame Mary Lucy Cartwright. It is written by Professor Caroline Series, Mathematics Institute, University of Warwick.

Not many Fellows of the Royal Society live to celebrate the fiftieth anniversary of their election. Dame Mary Cartwright was elected FRS in 1947, the first woman mathematician to be accorded this honour. She was also for nineteen years Mistress of Girton, the longest tenure in the College's history.

Mary Lucy Cartwright was born in 1900, daughter of the Rector of Aynho, in Northamptonshire. At age eleven she was sent away to school, first to Leamington High School and later to the Godolphin School, Salisbury. She thought of history as her best subject, but in her last year a gifted teacher encouraged her into mathematics, which she discovered, had the additional advantage of not requiring one to remember so much.

At the time that she went up to St. Hugh's in 1919, there were only some five women studying mathematics in the whole university. Despite her patchy schooling, Mary became the first woman to last the course until finals, and, as such, naturally attracted some attention. In a chance encounter in her second year, a fellow undergraduate V. C. Morton, later professor at Aberywstwyth, advised her to attend "Hardy's class". This class, quite outside the normal syllabus, met on Monday evenings after dinner, beginning with a talk and continuing with mathematical discussion until late.

The great mathematicians G. H. Hardy and J. E. Littlewood, who between them dominated British pure mathematics for the first half of this century, were both to have great influence on Cartwright. Though Hardy was never mentioned by her official teachers, his class set the course of her career. Armed with a first class degree, but not wanting to impose further on her family for finance, she went into teaching. Dissatisfied with the lack of scope, in 1928 she returned to Oxford to read for a D. Phil. under Hardy. Once again there was a evening class, this time on Fridays, though all the research students still went to the Monday class as well. Cartwright first met Littlewood as her external D. Phil. examiner. He records that the first question by the other examiner was so silly and unreal as to make her blush, but "I was able to get in a wink, and I think it restored her nerve."

In 1930 she went to Girton as a Yarrow Research Fellow, becoming a University Lecturer in 1935 and a Reader in 1959. On her arrival in Cambridge she attended Littlewood's courses and weekly seminar on function theory, and began working in this area. Familiar functions like the sine and cosine of elementary trigonometry, or the exponential function e^x, can be extended so as to make sense even when the variable x is a complex number, as in the famous equation $e^{i\pi} = -1$. With this seemingly artificial extension, old problems and ideas take on a new and powerful life. Complex function theory, as it is called, is equally indispensible to proof of Fermat's last theorem, aircraft design and statistical forecasts.

In one of his seminars, Littlewood had been discussing possible estimates for the maximum modulus of analytic functions p-valent in the unit disc, and Cartwright set herself to prove a sharp result. On her first attempt, Littlewood pointed out that she had fallen into a subtle trap, but some time later she was able to convince him she had a correct, and impressive, result.

Over the next ten years, in a long series of papers she continued to explore the theory of complex (especially entire) functions; particularly their strange behaviour where they "blow up", as, for example, $e^{i(x+iy)}$ as $x + iy$ approaches infinity. Some of the complexity has been captured in modern pictures of fractals, many of which are created by iterating functions of this kind. Cartwright's work describes, among other things, deep and delicate phenomena which can appear near fractal boundaries, and has found new applications in this field.

In 1938 the Radio Research Board of the Department of Scientific and Industrial Research took the highly unusual step of appealing to the London Mathematical Society for help with certain equations occurring in radio work. Cartwright noticed and drew the memorandum to Littlewood's attention, with the result that during the first part of the war, they began a detailed investigation of a deceptively simple looking equation introduced by the Dutch physicist van der Pol in 1920 to describe the oscillation of radio waves. The van der Pol equation, now a textbook example, describes an electric circuit with a triode valve whose resistance properties change with current; in mathematical terms it is a non-linear second order differential equation with periodic forcing and damping. Similar equations model many other physical situations, from wind induced oscillations of buildings to the tracking of rubber tyres.

Cartwright was intrigued by the mathematical

challenge of radio engineers' problems. They had a very detailed list of questions; they wanted their systems to oscillate in a very orderly way, and to know not only whether the system had a periodic solution, but whether it was stable, what were its period and amplitude, and how these varied with the parameters of the equation. Sometimes they needed the periods with a very small error. Numerical and graphical solutions either failed to provide answers or were far too cumbersome, and in any case, were often misleading. In fact, even rounding errors in calculations done to extremely high accuracy with the huge power of modern computers may have profound and unpredictable effects.

Aside from some fairly basic work which had been done in the twenties, and a few experimental results, Cartwright and Littlewood began working largely in the dark. They soon found a rich variety of behaviour, some of it very bizarre. Littlewood wrote: " For something to do we went on and on at the thing with no earthly prospect of "results"; suddenly the whole vista of the dramatic fine structure of solutions stared us in the face." They found ranges of the parameter values with an infinite number of unstable periodic solutions and a highly complicated but stable region of non-periodic behaviour.

Significant as it was, it took another fifteen years for their work to be placed in a wider theoretical framework. The young mathematician Steven Smale suggested that a relatively simple type of dynamical behaviour governed a large class of systems. Norman Levinson told him that this could not be right, pointing him to Cartwright and Littlewood's examples. Smale, partly with disbelief, embarked on a detailed study of these papers, and eventually arrived at his masterly abstraction of the phenomeon causing the strange behaviour. The abstraction was the horseshoe map, the driving mechanism and cornerstone of the whole modern theory of chaos. Smale could locate the horseshoe in the van der Pol equation; Cartwright and Littlewood's fine structures were typical manifestations of what is now known as "the butterfly effect".

Cartwright continued her studies on differential equations and in 1949, on the strength of her wartime work, she was invited to a lecture tour of the US. However, her many qualities besides her mathematical gifts were also in demand. In 1948 she had been pre-elected Mistress of Girton, which office she held from 1949 until 1968. Women had been admitted to full membership of the University in 1948 and Cartwright provided quiet, clear, unassuming leadership at a time of rapid change, skillfully steering the College to quietly assume its proper role in the routine running of the University. Without imposing her views, but carrying her responsiblities to the full, she guided the College with wise and clear headed decisions. She continued her lecturing and research, always finding time for students' problems, and writing research papers until well after her retirement.

Cartwright was resident in Girton from 1930-68, retiring to live in a modest flat nearby. Two older brothers were killed in the first world war, leaving a younger sister and brother W.F. Cartwright, later Director of British Steel in South Wales and himself a C.B.E.. Dame Mary enjoyed travelling and in 1956 was part of a Royal Society delegation to the USSR, getting a memorable view of the Steklov Institute computer. Unofficial travel included Mediterranean cruises, and then after retirement she spent some almost two years as Visiting Professor in the United States and later Poland. She was in the U.S. at the height of protests against the Vietnam war, spending a year as Resident Fellow in a Woman's Dorm at Brown University while the students were forcing major changes, and arriving at Berkeley as a demonstration was in progress, meeting another visitor tear-gassed in the lift.

She had a wry sense of humour. Littlewood recounts that Hardy, who always spoke by analogy with cricket, once declined to be seated next to her at a dinner, remarking "But her fast ball is so very devastating." Even at the age of 96, the TV documentary Our Brilliant Careers captured the sharp sparkle of her wit.

Cartwright was elected to the Royal Society in 1947 and later to its Council. She gave much other service to mathematics, with terms as President of the Mathematical Association from 1951-2 and of the London Mathematical Society from 1961-3. Her contributions led to the award of the Royal Society's Sylvester medal in 1964, the London Mathematical Society's De Morgan medal in 1968, and a D.B.E. in 1969, besides many honorary degrees from both home and abroad.

Dame Mary must have been an inspiration to generations of aspiring young women. As a young research student, I chanced to be present at a heated debate among some very eminent mathematicians about which women would have been worth a chair at one of the top U.S. Mathematics departments. Emmy Noether; yes. Sonya Kovalevsaya; perhaps. The only other name on the table was Dame Mary's.

Good science must surely be judged by how it stands the test of time. As chaos theory becomes more widely understood and its applications spread, interest in Cartwright's and Littlewood's work has been growing. Fifty years on, Cartwright's papers

still bear testimony to the incisiveness of a powerful mind.

Dame Mary Lucy Cartwright, mathematician and Mistress of Girton, born 17th December 1900, died 3rd April 1998.

EMS Lectures

The European Mathematical Society invites a distinguished mathematician, in each odd-numbered year, to visit an institution within the area covered by the EMS, to give a series of three to five lectures of an advanced expository nature on a topic of current research interest.

The EMS Lecturer of 1999 is Professor M. Lyubich (SUNY Stony Brook, USA). He will give his five EMS Lectures at the Russian Academy of Sciences, St. Petersburg on May 17 - 22; and repeat them at Universitat de Barcelona on May 31 - June 4 and at the Technical University of Denmark on June 14 - 18. The title is Real and Complex Dynamics.

Abstract:
Real and complex one-dimensional dynamics have been in the focus of research for the past 20 years. The ideas of dynamics, statistical physics, geometric function theory and hyperbolic geometry (supported by computer experiments) came together to reveal many rich and fascinating structures. As a result, several central problems have been recently resolved. Among them are the proofs of the real Rigidity Conjecture, the Feigenbaum Universality Conjecture and the Regular or Stochastic Conjecture. Altogether it gives a complete picture of dynamics in the real quadratic family.
For more information, please contact either the EMS Secretariat:

EMS Secretariat
Department of Mathematics
P.O. Box 4
FIN-00014 University of Helsinki
Finland
fax: +358-9-1912 3213
e-mail: tuulikki.makelainen@helsinki.fi

or one of the local organisers:

Anatoly Vershik
P.O.M.I.
Fontanka 27
191011 St. Petersburg
Russia
fax: +7-812-310 53 77
e-mail: Vershik@pdmi.ras.ru

Nuria Fagella
Dep. de Mat. Aplicada i Analisi
Universitat de Barcelona
Gran Via 585
E-08007 Barcelona
Spain
fax: +34-93-402 1601
e-mail: fagella@maia.ub.es

Bodil Branner
Department of Mathematics
Building 303
Technical University of Denmark
DK-2800 Lyngby
Denmark
fax: +45-45-88 13 99
e-mail: branner@mat.dtu.dk

The Jahrbuch Project

The first set of volumes of the Jahrbuch are available in the web

Do you want to know when Sophus Lie has written his famous article "Begründung einer Invariantentheorie der Berührungstransformationen"? Do you want to see the complete text of that work on your monitor, to load it down, and to print it out? If you are interested in offers like that, please have a look at the Jahrbuch project under the URL

http://www.emis.de/projects/JFM

What is the Jahrbuch project?

In its first part the Jarhrbuch project is designed to capture the first comprehensive reviewing journal in mathematics, the "Jahrbuch über die Fortschritte der Mathematik" (JFM, published from 1868 to 1943) in a data base. The JFM contains more than 400.000 entries from all fields of Mathematics and its applications. The scope of the database will cover content of the JFM and add some enhancements. This work is done with the help of volunteers from the mathematical community. For example, the rough ordering given in the JFM according to subjects will be reclassified by them on the basis of the MSC 91.

In its second part the Jahrbuch project plans to built up a digitised archive of complete articles and books. To establish this the experts are requested to select the most important publications from the period of the JFM. After having scanned them and installed them on the server in Göttingen you will receive the text of the publication by clicking on the URL given in the corresponding database entry. Up to 20 % of the publications from the period of the JFM will be stored in the digital archive as scanned texts. Hence you will find the probably most important articles, books, and dissertations there.

So far, nearly half of the 68 volumes of the JFM have been re-keyboarded. The enhancement of the JFM data has been made for several of them already, but the volunteers will need some time to do this for all of them properly. Some of the digitised first full texts will be available in the near future.

This essentially will be a free service for the mathematical community. The project is sponsored by the Deutsche Forschungsgemeinschaft. You may look at a preliminary version of the JFM database at the URL given above. For speeding up the project the participation of additional volunteers will be quite helpful. If you are interested to support the project as an expert, please contact us under

jfm@zblmath.fiz-karlsruhe.de

Wolfram Sperber and Bernd Wegner

1999 EURESCO Programme

The Programme of European Research Conferences is run by the European Science Foundation, largely with funding from the Euroconferences Activity of the European Union, except those marked by **. Each Conference consists of a series of meetings, held typically every other year. There are neither written contributions nor proceedings. Unconventional ideas and new approaches, not yet fully explored, are encouraged.

MATHEMATICS

Geometry, Analysis and Mathematical Physics: Analysis and Geometry, J.-M. Bismut (Orsay) - Obernai (near Strasbourg), France, 4 - 9 June ++

Number Theory and Arithmetical Geometry: Arakelov Geometry and Applications, J.-B. Bost (Bures-sur-Yvette) - Obernai (near Strasbourg), France, 25 - 30 June

Algebra and Discrete Mathematics: Infinite Combinatorics and Their Impact on Algebra, S. Shelah (Jerusalem) and R. Goebel (Essen) - Hattingen (near Essen), Germany, 26 June - 2 July **

EUROPEAN NEWS: Country by Country

BELGIUM

BLMS'99

Joint meeting of the **London Mathematical Society** and the **Belgian Mathematical Society**
Université Libre de Bruxelles,
May 14-16, 1999

PROGRAMME

Plenary lectures
The following speakers have accepted to deliver a plenary lecture: Föllmer (Humboldt U.Berlin), W. T. Gowers (Cambridge), M. Kontsevich (IHES), A. Macintyre (Edinburgh).

Parallel Sessions
Algebraic geometry and mathematical logic
Organisers: J. Denef (K.U. Leuven), C. Michaux (U.M.H. Mons), W. A. Hodges (Queen Mary and Westfield College, London).
Speakers: D. Abramovitch (Boston Univ.), A. Borovik (UMIST Manchester), Z. Chatzidakis (CNRS - Paris 7), M. Coppens (Katholieke Hogeschool Kempen, Geel), F. Loeser (Paris 6), T. Scanlon (Berkeley), W. Veys (K.U. Leuven).

Combinatorics and finite geometries
Organisers: P. J. Cameron (Queen Mary and Westfield College, London), J. A. Thas (R.U. Gent).
Speakers: M. Aigner (Freie Univ. Berlin), A. E. Brouwer (T.U. Eindhoven), F. Buekenhout (U.L. Bruxelles), W. Haemers (K.U. Brabant, Tilburg), J. W. P. Hirschfeld (Sussex), H. Van Maldeghem (R.U. Gent), D. Welsh (Oxford), G. Ziegler (Techn. Univ. Berlin).

Differential geometry and mathematical physics
Organisers: N. J. Hitchin (Oxford), L. Lemaire (U.L. Bruxelles).
Speakers: J.-C. Alvarez (U.C. Louvain), B. Bowditch (Southampton), M. Cahen (U.L. Bruxelles), R. Dijkgraaf (Amsterdam): (to be confirmed), B. Driver (U.C. San Diego), M. Gross (Warwick), D. Joyce (Oxford), A. Reznikov (Durham).

Stochastic mathematics
Organisers: W. S. Kendall (Warwick), N. Veraverbeke (L.U.C. Diepenbeek).
Speakers: L. Devroye (Mc Gill), B. Driver (U.C. San Diego), P. Embrechts (E.T.H. Zurich), R. Griffiths (Oxford), G. Louchard (U.L. Bruxelles), G. P. Nason (Bristol), D. O. Siegmund (Stanford-Cambridge), J. Teugels (K.U. Leuven).

Information and registration
See the WEB page of **BLMS'99** at
http://www.ulb.ac.be/assoc/bms/blms'99.html
or contact J. Leroy : **leroy@ulb.ac.be**

CATALONIA

Centre de Recerca Matemàtica

A) Guest list for the period January - August 1999:

J. Llopis, Caracas, 01.01.99 – 31.12.99, Lógica
P. Koskela, Jyväskylä, 10.01.99 – 31.05.99, Anàlisi
Z.V. Aleksandrovich, Moscou, 10.01.99 – 10.02.99, Matemàtica Aplicada
J. Seimenis, Atenes, 11.01.99 – 21.02.99, Sistemes Dinàmics
P. Thomas, Toulouse, 19.01.99 – 06.02.99, Anàlisi
E. Formanek, Pennsylvania, 01.02.99 – 07.02.99, Àlgebra
G. de Abreu, Bedfordshire, 01.02.99 – 15.02.99, Educació Matemàtica
X. Zhang, Beijing, 01.02.99 – 31.01.2000, Sistemes Dinàmics
P. Paramonov, Moscou, 01.02.99 – 31.06.99, Anàlisi
H. Pajot, Cergy-Pontoise, 07.02.99 – 27.02.99, Anàlisi
P. Hell, Burnaby, 15.02.99 – 15.03.99, Matemàtica Aplicada
G. Brousseau, Talence, 23.02.99 – 23.03.99, Didàctica
C. Pérez, Madrid, 01.03.99 – 31.05.99, Anàlisi
M.J. González, Cádiz, 15.03.99 – 15.06.99, Anàlisi
J. Duoandikoetxea, Bilbao, 01.04.99 – 30.04.99, Anàlisi
S. Treil, Boston, 06.04.99 – 05.05.99, Anàlisi
S. Tindel, Villetaneuse, 06.04.99 – 14.05.99, Probabilitats
A. Stray, Bergen, 01.05.99 – 15.05.99, Anàlisi
J. Cannon, Provo, 01.05.99 – 31.05.99, Àlgebra
J.M. Wu, Urbana, 08.05.99 – 08.06.99, Anàlisi
R. Kauffman, Urbana, 08.05.99 – 08.06.99, Anàlisi
C. Pereira, Albuquerque, 10.05.99 – 30.05.99, Anàlisi
B. Bowditch, Southampton, May or June, Àlgebra
A. Adem, Madison, 01.06.99 – 31.07.99, Topologia algebraica
K. Seip, Trondheim, 01.06.99 – 15.07.99, Anàlisi
P. Ahern, Madison, 01.06.99 – 15.07.99, Anàlisi
D. Marshall, Washington, 01.06.99 – 15.07.99, Anàlisi
V. Caselles, Palma de Mallorca, 01.06.99 – 16.07.99, Anàlisi

D. Pigozzi, Ames, 14.06.99 – 14.07.99, Lògica
S. Mallat, Paris, 05.07.99 – 16.07.99, Anàlisi
Y. Meyer, Cachan, 05.07.99 – 16.07.99, Anàlisi
J.M. Morel, Cachan, 05.07.99 – 16.07.99, Anàlisi
J. Serra, Paris, 05.07.99 – 16.07.99, Matemàtica Aplicada

B) Semester on Analysis

Dates: January 10 to July 15, 1999
Place: Centre de Recerca Matematica
Organiser: Artur Nicolau (Universitat Autonoma de Barcelona)
List of visitors:
Patrick Ahern (University of Wisconsin-Madison)
Javier Duoandikoetxea (Universidad del País Vasco)
Maria José González (Universidad de Cádiz)
Pekka Koskela (University of Jyväskyla)
Donald E. Marshall (University of Washington)
Hervé Pajot (Université de Cergy-Pontoise)
Peter Paramonov (Moscow State University)
Cristina Pereyra (University of New Mexico)
Carlos Pérez (Universidad Autónoma de Madrid)
Kristian Seip (Trondheim Universitet)
Arne Stray (University of Bergen)
Pascal Thomas (Université Paul Sabatier)
Sergei Treil (Michigan State University)
Jang-Mei Wu (University of Illinois)
For further information: crm@crm.es

C) Matemàtiques i Ensenyament: Principis i Estat de la Qëstió

Dates: February 8, 9 and 10, 1999
Place: Centre de Recerca Matemàtica and Casal de Joventut, Mataró
Organisers: Núria Gorgorió (Universitat Autònoma de Barcelona)
Speaker: Dr. Guida de Abreu (University of Luton)
For further information:
crm@crm.es or n.gorgorio@cc.uab.es

D) Seminari "Les bases matemàtiques de la civilització tecnològica"

Dates: February 17, 24, March 3, 10, 17 and 24, 1999
Place: Auditori de la Caixa de Sabadell, Carrer d'en Font, 1, Sabadell
Organiser: Dr. Jaume Aguadé (Universitat Autònoma de Barcelona)
Speakers:
José Luís Fernández (Universidad Autónoma de Madrid)
Paz Morillo (Universitat Politécnica de Catalunya)
Andreu Mas Colell (Universitat Pompeu Fabra)
Helmut Neunzert (Institut für Techno- und Wirtschaftsmathematik)
Jesús Mosterín (Instituto de Filosofía, CSIC)
Joan Girbau (Universitat Autònoma de Barcelona)
Ismael Colomina (Institut Cartogràfic de Catalunya)
For further information:
crm@crm.es or aguade@mat.uab.es

E) VI Trobada de Topologia

Dates: March 5 and 6, 1999
Place: Universitat de les Illes Balears, Palma de Mallorca
Organisers: Dr. Manuel Castellet (Centre de Recerca Matemàtica), Dr. Aniceto Murillo (Universidad de Málaga) and Dr. Juan A. Crespo (Universitat de les Illes Balears).
Speakers:
Juan A. Crespo (Universitat de les Illes Balears)
Warren Dicks (Universitat Autònoma de Barcelona)
Antonio Gómez Tato (Universidad de Santiago de Compostela)
Milagros Izquierdo (Mälardalen University)
Vicente Muñoz (Universidad de Málaga)
Juan J. Nuño (Universitat de València)
For further information: http://crm.es/info/vi-et/

F) Advanced Course on mathematical aspects of image processing

Dates: July 6 to July 16, 1999
Place: Centre de Recerca Matemàtica and Centre de Visió per Computador.
Speakers:
V. Caselles (Universitat de les Illes Balears) and J.M. Morel (École
Normale Supérieure de Cachan): "Mathematical models in image processing"
J. Serra (École des Mines, Paris): "Mathematical morphology"
S. Mallat (École Polytéchnique de Palaiseau) and Y. Meyer (École Normale Supérieure de Cachan): "Signal processing with wavelets".
For further information: crm@crm.es

CZECH REPUBLIC

Spring School on Functional Analysis

First Announcement

Following a longstanding tradition, the Faculty of Mathematics and Physics of Charles University is organising a Spring School on Functional Analysis. The School will be held at Paseky in the Krkonoše Mountains, **April 18 – 24, 1999**. The programme will consist of series of lectures on:

Recent Trends in Banach Spaces
delivered by:
Isaac I. Namioka (University of Washington, Seattle, USA):

Fragmentability in Banach Spaces: Interactions of Topologies.

Nigel Kalton (University of Missouri, Columbia, USA):
title will be announced later.

Vladimir Fonf (Ben-Gurion University, Negev, Israel):
Polyhedral Banach Spaces.

Jesus M.F. Castillo (Universidad de Extremadura, Spain):
The structure that subspaces and quotients of Banach spaces may have.

The purpose of this Meeting is to bring together adepts who share a common interest in the field. There will be opportunities for short communications and informal discussions. Graduate students and others beginning their mathematical career are encouraged to participate.

The conference fee will be 300,- US dollars (appr.). A reduced rate of 250,- US dollars (appr.) will be offered, provided a letter guaranteeing participation reaches the organisers before January 15, 1999. The organisers may provide financial support to a limited number of students. Applications must be sent before March 1, 1999.
Payment of fees should be made in **cash** at the registration desk in Paseky, or it may be remitted by a **bank transfer** to

Komerční banka, Praha 1, Václavské nám. 42,
account No. 38330–021/0100, v.s. 810

(a copy of the transfer should be presented at the registration desk at Paseky). Unfortunately, cheques cannot be used and will not be accepted.

If interested please apply before **January 15, 1999.** A final announcement with further details will be mailed in due time.
Due to the limited capacity of accommodation facilities the organisers may be forced to decline registration.

We look forward to meeting you in the Czech Republic.

Jaroslav Lukeš, Jan Kolář

Mailing address:
Katedra matematické analýzy
Matematicko-fyzikální fakulta UK
Sokolovská 83, 186 75 Praha 8
Czech Republic

Phone/Fax: 420 – 2 – 232 3390
E-mail: paseky@karlin.mff.cuni.cz
http://www.karlin.mff.cuni.cz/katedry/kma/ss

Please, kindly inform colleagues and students interested in this field.

GEORGIA

Tbilisi International Centre of Mathematics and Informatics (TICMI)

Advanced Course on Integral Operators and Related Problems

Date: 12 - 20 May, 1999
Location:TICMI (Tbilisi)

Paolo E. Ricci (University of Roma, "La Sapienca")
ON GENERALIZED ORTHOGONAL POLYNOMIALS OF HYPERGEOMETRIC TYPE. General theory. Relativistic orthogonal polynomials (3 hours).

Paolo E. Ricci (University of Roma, "La Sapienca")
COMPUTATION OF NEWTON SUM-RULES FOR THE ZEROS OF ORTHOGONAL POLYNOMIALS.
Starting from differential equation. Starting from three-term recurence relation. Applications (3 hours).

Paolo E. Ricci (University of Roma, "La Sapienca")
COMPUTATION OF THE EIGENVALUES OF SECOND KIND FREDHOLM OPERATORS.
Rayleigh- Ritz and Fichera's orthogonal invariants methods. The inverse iteration method. Applications (3 hours).

Dazmir Schulaia (I. Javakhishvili Tbilisi State University)
LINEAR THEORY OF INTEGRAL EQUATIONS AND THEIR APPLICATIONS.
The lectures present several topics of the theory of linear integral equations, beginning with rather elementary expository material and going on to some of the current developments. Namely, Fredholm theory, theory of singular integral equations, integral equations with fixed singularities, applications to the transport theory (7 hours).

Coordinator: George Jaiani

These course is suitable for advanced graduate students or recent Ph.D.'s. The participants will also have an opportunity to give 20-minute talks on their own work at a mini-symposium which will take place during the Advanced Course. Lectures and abstracts of the talks will be published and distributed among the lecturers and participants after Advanced Course. The registration fee for participants is 400 USD which includes all local expenses during the Advanced Course. A restricted number of participants will be awarded grants.

Further information:
TICMI,
I.Vekua Institute of Applied Mathematics of Tbilisi State University,

University Str. 2,
Tbilisi 380043,
Georgia
e.mail:jaiani@viam.hepi.edu.ge
Tel.:+995 32 305995
On the Web:
http://www.viam.hepi.edu.ge/others/TICMI

ITALY

Preliminary Announcement of a CIME Session

Computational Mathematics Driven by Industrial Applications

Scientific Directors: V.Capasso, Milano, H.W.Engl, Linz, J.Periaux, Paris.
Location: Martina Franca, Apulia, Italy
Dates: June 21-27, 1999

There will be 5-hour lectures by the following eminent speakers:
R.Burkard, Graz: Path, trees and flows: graph optimization problems with industrial applications
P.Deuflhard, Berlin: New computational concepts, adaptive differential equation solvers, and virtual labs
J.L.Lions, Paris: Mathematical problems in industry
G.Strang, MIT: Wavelet transforms and cosine transforms in signal and image processing

There will probably be one more 5-hour-speaker still to be confirmed.
In addition, there will be 2-hour lectures by the scientific directors and by
R.Mattheij, Eindhoven: Mathematics of glass.

The abstracts should soon be available on the CIME web page
http://www.math.unifi.it/CIME/
where also an e-mail address for enquiries about conditions of attendance can be found.

POLAND

XX International Seminar on Stability Problems for Stochastic Models

Lublin - Nalêczów, 5 - 11 September, 1999

FIRST ANNOUNCEMENT The XXth Jubilee International Seminar on Stability Problems for Stochastic Models will be held in Naêczów near Lublin, Poland, from 5 to 11 September 1999 under the auspices of the Steklov Mathematical Institute of the Russian Academy of Sciences, Moscow State University and the Maria Curie-SkLodowska University in Lublin. Lublin is situated about 170 km to the south-east of Warsaw, and Nalêczów is a health and holiday resort 26 km from Lublin.

The scope of the seminar is traditional and embraces:

limit theorems of probability theory and mathematical statistics,

characterisations of probability distribution and their stability,

theory of probability metrics,

limit theorems and characterisation problems in stochastic analysis,

stochastic processes and queueing theory,

applied statistics,

actuarial and financial mathematics.

The programme will have invited and contributed paper sessions, and poster sessions. It is intended to issue two volumes of the Proceedings of the Seminar in the Journal of Mathematical Sciences series published by Plenum Publishing Company.

PROGRAMME AND ORGANIZING COMMITTEE

V.M. Zolotarev (Moscow, Russia)- Chairman of the Seminar
V.Yu. Korolev (Moscow, Russia)- Co-chairman of the Programme & Organising Committee
Z. Rychlik (Lublin, Poland)- Co-chairman of the Programme & Organising Committee
D. Szynal (Lublin, Poland)- Co-chairman of the Programme & Organising Committee
A. Pluciñska (Warsaw, Poland) - Co-chairman of the Programme Committee
M. Arató (Debrecen, Hungary) ; A. Balkema (Amsterdam, The Netherlands);
V.E. Bening (Moscow, Russia) ; R. Jajte (Lodz, Poland);
V.V. Kalashnikov (Moscow, Russia); V.M. Kruglov (Moscow, Russia)
E. Omey (Brussels, Belgium); L. Stettner (Warsaw, Poland)
K. Urbanik (Wroclaw, Poland); R. Zieliñski (Warsaw, Poland)
A.V. Kolchin (Moscow, Russia) - Secretary of the Organising Committee
K. Kubacki (Lublin, Poland) - Secretary of the Organising Committee

REGISTRATION FEE: US $50 for the participants, US $30 for accompanying persons. ACCOMMODATION: approximately US $30 per day per person in a double room at the hotel (meals included).

DATES AND DEADLINES:
Pre-registration December 1998
Second announcement January 1999

Submission of abstracts 31 March, 1999
Third announcement 31 May, 1999
ADDRESSES FOR PRE-REGISTRATION AND COMMUNICATION
Institute of Mathematics UMCS
Pl. Marii Curie-Sklodowskiej 1, 20-031 Lublin, POLAND
Steklov Mathematical Institute of the Russian Academy of Sciences 8 Gubkin St, 117966 Moscow, RUSSIA
E-mail: kolchin@mi.ras.ru
Further information from
http://stabil.umcs.lublin.pl
http://bernoulli.mi.ras.ru

SPAIN

FUNCTIONAL ANALYSIS VALENCIA 2000

Functional Analysis Valencia 2000, an international functional analysis meeting on the occasion of the 70th birthday of Professor Manuel Valdivia, will be held at the Technical University of Valencia, Spain, July 3-7, 2000. It is a satellite conference to the Third European Congress of Mathematics in Barcelona (July 10-14), and it is sponsored by the Technical University of Valencia (UPV) and the University of Valencia (UV). There will be about 15 invited plenary lectures on various topics of functional analysis. Participants will have the opportunity to submit abstracts for lectures of 25 minutes in parallel sessions; details of this and the conference fee will be announced later on. The Proceedings will be published in the series North-Holland Math. Studies.

The following mathematicians have already accepted to give invited talks: G. Dales (Leeds, U.K.), T.W. Gamelin (UCLA, USA), G. Godefroy (Paris VI, France), J. Lindenstrauss (Hebrew Univ., Jerusalem, Israel), N. Kalton (Columbia, MO, USA), R. Meise (Düsseldorf, Germany), A. Pelczyński (Polish Acad. of Sciences, Warsaw, Poland), G. Pisier (Paris VI, France and Texas A&M, USA), D. Vogt (Wuppertal, Germany), P. Wojtaszczyk (Univ. of Warsaw, Poland).

The Scientific Organizing and Program Committee consists of R.M. Aron (Kent State, USA), K.D. Bierstedt (Paderborn, Germany), J. Bonet (Univ. Politécnica, Valencia), J. Cerdà (Univ. Barcelona), H. Jarchow (Univ. Zürich, Switzerland), M. Maestre (Univ. Valencia), J. Schmets (Liège, Belgium), and the Local Organizing Committee consists of the following mathematicians from UPV and UV: C. Fernández, A. Galbis, P. Galindo, D. Garcia, M. López Pellicer, V. Montesinos, A. Peris.

To preregister for the meeting, e-mail VLC2000@uni-paderborn.de or write by regular mail to K.D. Bierstedt, Univ. Paderborn, FB 17, Math., D-33095 Paderborn, Germany or J. Bonet, Universidad Politécnica de Valencia, Departamento de Matemática Aplicada, E-46071 Valencia, Spain.

The homepage of the meeting can be found at the Web Sites:
http://math-www.uni-paderborn.de/VLC2000/
and
http://www.upv.es/VLC2000/

UNITED KINGDOM

51st British Mathematical Colloquium

University of Southampton
29th March–1st April 1999

The 51st British Mathematical Colloquium will be hosted by Southampton University between 29th March and 1st April, 1999, with financial support from the London Mathematical Society.

The plenary speakers are D. Vogan (MIT), A. Shalev (Jerusalem), F. Buekenhout (Brussels) and E. Ghys (Lyon). Special sessions in Geometric Group Theory (organised by D. B. A. Epstein) and in Stochastic Analysis (organised by T. J. Lyons) will take place in addition to morning lectures and afternoon splinter groups.

For further information, consult
`http://www.maths.soton.ac.uk/bmc/`
or email Ian Leary at
`ijl@maths.soton.ac.uk`

Problem Corner

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

Building up a Contest from Scratch

Running a Competition in a Small Country — A Didactic Play

As a science, mathematics has shown vertigious development and continuous growth in diverse fields of applications in recent times. The spread of computer science has facilitated an increase in the influence of mathematics in Economics, Management, Industry, and many other areas. This heightened esteem for mathematics has created a demand for able scientists yet it is difficult to promote sufficient interest and motivation in the learning of mathematics. There is no doubt that (especially) smaller, or emerging countries have to solve this problem using their own resources. One tried and tested recipe for self-help consists of mathematics contests, of which we have many world-wide. Australia and Iran, for example, have performed particularly well at the International Mathematics Olympiad within the last ten years. This has given commerce and industry in those economies an unmistakable boost.

Various surveys that have been carried out into the benefits of mathematics contests all produced the same clear result: Olympiads do make a major contribution to the scientific development of the individual country. Former contestants remarked almost unanimously in interview that the knowledge and abilities they acquired in preparing for their competition and the experience gained in the Olympiad had had positive influences on various facets of their lives. For example, Cuban contestants and Iranian students stated that their participation in such an event

- strengthened their tenacity and scientific vigour when they were challenged to solve exercises and problems of a high level of difficulty;
- increased the number of excellent results in their university studies;
- speeded up university careers or reinforced vocational aptitudes and
- provided them with a broader development in their professional tasks.

Thus, there are many reasons why there should be more successful mathematics contests around the world whether they be regional, national or international or whether they be small or large. It goes without saying that groups of committed mathematicians and teachers or proposers of stimulating questions are amongst the essentials for the continuation of these contests. One factor which has played an important part in the triumph of mathematics competitions is the support from other experienced competition organisers – so that creators of new competitions do not have to 're-invent the wheel' and, worse, possibly repeat past mistakes. In 1984 a *World Federation of National Mathematics Competitions (WFNMC)* was created at the University of Canberra, Australia, during the *Fifth International Congress for Mathematical Education.* The Federation aims to provide a focal point for those interested in, and concerned with, conducting national mathematics competitions for the purpose of stimulating the learning of mathematics. In that time the WFNMC has, via its journal, been an important source for exchanging ideas and information about competitions and related matters among the mathematicians, teachers and educationalists who give so much of their energy, time and expertise to the development of these events.

The flagship of the Federation is the excellent journal *Mathematics Competition.* Many mathematicians hold the *Newsletter of the WFNMC* in high repute because it is alleged to be the only mathematics journal which is read from cover to cover. At any rate, mathematicians and teachers who are involved with competitions and challenge-activities and who work in isolated areas deeply appreciate this journal. Its periodic arrival gives them a boost of enthusiasm and a feeling of unity with similar minded professionals around the world, and it provides support for those who plan on starting-up an effective mathematics contest programme. Thus this journal works as an amplifier for these efforts, but its impact on the international involvement in mathematics competitions stands or falls with the willingness of those engaged in coaching competitions to communicate their experiences. There is an imperative need for those readers who organise competitions in remote areas to write short articles, or even just a short letter to the journal's editor, on their involvement in mathematics competitions, their specific local problems and so on. These contributions should encourage other readers to write to these authors and give them support and a sense of fellowship as a result.

One of these much sought-after pioneers, who had pushed through a mathematics contest despite much opposition, is **Pierre-Olivier Legrande,** Professor of Mathematics at the *École Normale de Tahiti* and the *Conservation National des Arts et Métices.* He wrote a substantial article on the problems associated with mathematics competitions in French Polynesia. I quote from his article in the newsletter of the WFNMC and pick out some revealing stages from his valiant struggles in starting a mathematics competition from scratch in the back of beyond.

The parable commences with the definition of *small.* Many West African countries are not exactly 'small': it all depends on the means of measurement. French Polynesia — Tahiti — is not geographically small: from

Maupiti to Rapa is as far as from London to Bucharest. The population of Tahiti is indeed small: it numbers less than 200000 inhabitants (though it should be noted that 60% are under 20, which means that almost half of the population is within the educational system). In a small country, the small number of positions of power in politics or economics means that the official channels are reduced; but on the other hand the decision centres are closely interlinked.

The consequence is that nothing can be done without a modicum of political goodwill. So, to a certain extent, a small 'acting' population characterises developing countries. Comparison can go further. In Tahiti, as in Francophone Africa, the syllabus and educational structures are mainly French or deeply influenced by the French tradition. Teachers graduated from French or French-styled African universities. There is a long tradition of compulsory mathematics in French schools, mathematics being the main topic and often the only criterion for selection in high schools. Ideologically, it has often been considered that selection based on mathematics was less unfair than selection based upon topics with a strong cultural background — such as Latin, Greek or Art History. All the conditions should be present to form fertile ground for mathematics competitions, but the ground was found to be somewhat sterile.

It is important to understand the obstacles to the creation of a competition bsed upon mathematical problem solving. In the French system, education is the sole responsibility of the Republic; all employees within the system, whether administrative, pedagogical or technical, are public servants and, to a certain degree, may feel hemmed-in by such a tight hierarchical system; taking initiatives can make you suspect! There is no personal promotion for teachers in the French system: advancement is linked with age, not merit. Taking on the responsibility of running a mathematics contest will not help a teacher gain promotion. *A priori*, private enterprise in the educational field is disregarded by many teachers who often think that mathematics is what they learn in universitites, nothing else, and in these universities little emphasis is placed on problem-solving. All in all, hardly a conducive environment for mathematics competitions!

Without an external stimulus no competition would ever have started in Tahiti. Good fortune intervened with the visit, in 1980, of an enthusiastic professor of mathematics and an indefatigable worker in the world of competitions, Peter O'Halloran, who in 1994 was the director of the Australian Mathematics Competition (AMC). Immediately, the idea of importing such a contest fired the imagination of our man in Tahiti, and Peter O'Halloran was enthused with the concept of running a Francophone version of the AMC in French Polynesia. He agreed to be the regional director for the AMC. Unfortunately, the French people with whom they had to deal suspected that the AMC was some sort of Australian Trojan horse and the two professors were viewed with suspicion. No-one wished to take the responsibility of making an agreement with the AMC but neither did they want to stop the venture as international relations were involved, so they obtained permission to run the event on a Wednesday afternoon, after formal lessons were over. This was the end of the first act, and this is the first lesson: creating a competition in this type of country may be difficult, running an established competition may be easier. Being in a smnall country fortunately makes the job easier. As soon as Prof. Legrande was given the administrative green light, he went to the media and obtained a lot of publicity. People immediately lovd the idea of co-operation with Australia. And a second lesson had to be learnt: making public appearances is far easier in small countries than in well-developed countries. Finally, the first regional director and Prof. Legrande did the rounds of all the schools to meet the maths teachers. They flew to remote islands in a little plane as a new kind of missionary but the idea of a mathematics competition was anything but welcome to their colleagues. Our couple had already encountered two major objections but this third one, the hard one, was hidden, and so they would have been well advised to heed the following precepts:

* Do not introduce a private and alien institution not able to be adapted to local syllabuses;
* Take care over who the selection of sponsors, some may be regarded with suspicion; * Intellectual competitions can be seen to be unfair and divisive;
* Competitions can be used to provide precise statistics on performance across schools and this information could be used by the central authorities to evaluate teaching.

Prof. Legrande had to stop the rot. The volte-face came at the behest of the children, reinforced by the press: the pupils loved the papers that were so different from their textbooks and they enjoyed the idea of an international competition aimed at them. After two years, the organisational team was then faced with the fact that most schools were entering the contest and with an increasing number of pupils. This teaches the third lesson: choose a high-quality, well-organised competition, with papers that are fun, encourage discovery and are challenging and good enough to capture the pupils' attention.

By this time, the material or financial aspect could no longer be ignored — running a competition in a thinly-populated, widespread country is expensive. The costs of contacting remote places (and all places in Tahiti are remote) were not covered by the comparatively small number of entrants. With success, it

quickly became impossible to meet the expenses and so here comes the fourth lesson: running a competition of respectable standard need sponsors but choosing sponsors can bias the competition. The association between a competition and its backer must be fair, reciprocal and based on interest in the competition itself, not on self-interest.

AMC is sponsored by the biggest bank of the southern hemisphere, Wespac, which at that time had no interest in Tahiti. So Prof. Legrnade had to be on the look-out for a local financier and he chose Qantas, the Australian airline. Qantas gave him free tickets to fly people in or out in the interests of the competition, and conceded free freight for the papers. The competition was now on the rails (or should we better say, on the wing?). The day of the competition was officially on the schools' schedule and directors had instructions to offer examination conditions in working time for the competitors with all lessons to stop for two hours; teachers were asked to supervise. Today, the competition has official status and information reaches the schools through official channels.

In 1991, to celebrate its tenth anniversary, the then Minister of Education, R Van Bastolar, made the competition compulsory in all public shools, for that one year, in order to have an independent appraisal of the pupils' levels of abilities with the government bearing the costs. It is probably the first time ever that a state used a competition officially. And that ends the story.

So, what can be learnt from this example? If you intend to run a competition in a country with no long scientific tradition you should:

* link with a great exisiting competition, able to provide you with high quality papers, generous enough to support the funding and possessing a strong efficient administrative structure to support you;
* try to get internationally recognised credentials (the support of UNESCO would be perfect);
* find good and affluent sponsors — preferably one or two big ones rather than many small sponsors and coming from non-competing sectors of the economy.

The description of the genesis of the competition in the Pacific rim may in some respects have a very localised slant. I would therefore be very interested to hear of the difficulties you may have faced in designing and administrating your own competitions. Principally, I am interested in the answers to:

* when did the idea of a maths competition become an important factor in your life?
*what motivated you to create your own competition?
* what activities are woven round the contest?
* what do you believe were the reasons that in the early days (possibly) there was some antagonism towards your ideas?
* alternatively, what do you think you acheived successfully?
* what are the outstanding memories of your work?
* what should a university support a maths competition and/or challenge activities?

A creator of a competition must have many admirable qualities. These include driving determination, a grand vision, good organisational ability, concern for young people in general and the disadvantaged in particular. I would like to encourage you to reveal your recipe for success and to this end I would like to offer you a 'market-place' in this Problem Corner. This would cover concepts and ideas and through its discussion and dialogue would provide a forum with which to articulate your ideas and vision and so help guide the development, support and initiation of maths competitions in other countries.

I expect this forum to enhance the status of the Problem Corner. In accord with that I consider the growing stream of submissions that I have recently received to indicate general approval with this section. The Corner exists only with your help and so I present now problems received from the indefatigable Niels Bejlgaard of Stavanger, Norway. A regular contributor, some of his proposals are highlighted today.

Q. 98 Find all sets of four points in the plane so that the sum of the distances from each of the points to the other three is constant.

Q. 99 A piece of land has the contour of an equilateral triangle with side length 6km. At each corner a vehicle is placed, and each vehicle is pointing towards that in front of it. At a given instant of time the three vehicles start to move all with constant speed $v = 2\,\text{km/h}$ in clockwise direction. What distance has each vehicle covered up to that moment they eventually meet?

Q. 100 Let $x_1 > 0$ be any real number. Define the infinite sequence $x_2, x_3, \ldots$ by the recurrence relation $x_{n+1} = {x_n}^2 + x_n$. Prove that

$$\lim_{k\to\infty} \sum_{1}^{k} \frac{1}{1+x_i}$$

exists, and sum the infinite series.

Q.101 Given an arbitrary triangle ABC with circumcircle $\gamma(O,R)$. Let AO intersect BC in point A_1, and let points B_1 and C_1 be determined analogously. Show that $OA_1+OB_1+OC_1 \geq \frac{3}{2}R$.

Q.102 Three points X, Y, Z are given in the plane, where X is the circumcentre, Y is the midpoint of the side BC, and Z is the foot of the altitude from B to side AC in a triangle ABC. Show how one can construct this triangle.

Q.103 A real-valued function f is defined for positive integers, and a positive integer a satisfies $f(a)=f(1995)$, $f(a+1)=f(1996)$, $f(a+2)=f(1997)$, $f(n+a)=\frac{f(n)-1}{f(n)+1}$ for any positive integer n.
i) Prove that $F(n+4a)=f(n)$ for any positive integer n.
ii) Determine the smallest possible value of a.

At long last we move to solutions of problems posed earlier. Enjoy solving problems over the next weeks — and send me your nice solutions as well as your Olympiad materials. **Oren Kolman**, King's College London, rings the bell to signal the last lap of this Corner with his brainwork. He has worked out Q. 78 and thus closed another gap in the set of unsolved problems.

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 piles with 1993, 199 and 19 stones to get one empty heap after several operations?

Solution The answer is no. For if (k_0,k_1,k_2) is any 3-tuple of odd numbers and F is a permitted operation, then the result (n_0,n_1,n_2) of applying F to (k_0,k_1,k_2) is also a 3-tuple of odd numbers. Hence any finite sequence of permitted operations applied to an initial triple of piles, each containing an odd number of stones, yields heaps which contain odd (hence non-zero) numbers of stones. In particular this is true for the initial triple $(1993,199,19)$.

Q.86 Consider the triangle with vertices $(-6,0)$, $(0,12)$ and $(16,0)$. How many points with integer coordinates lie on the sides of the triangle and form together with the points $(0,0)$ and $(5,0)$ an obtuse triangle?

Solution (**Pietro Fanciulli**, Porto S. Stefano, Italy) Let $A(0,12)$, $B(-6,0)$, $C(16,0)$ be the vertices of the triangle, $O(0,0)$ and $D(5,0)$ the two given points, and let $P(x,y)(\neq A,B,C,O,D)$ be any point on the circumference of the triangle. We have $-6<x<16$ and $0<y<12$. Consider three cases:
I. $-6<x<0 (P\in AB)$ and $0<y<12$ with $y=2x+12$ (equation of side AB). For $\alpha=\angle POD$, we have $tan\alpha=\frac{y}{x}<0$, i.e. $x<0$, and we yield five points with integer coordinates $x=-1,-2,-3,-4,-5$, and $y=10,8,6,4,1$.
II. $0\leq x\leq 5$: There exists no point, because $\alpha=\angle POD$ is an acute angle. If $x=0$ or 5, we get a right-angled triangle.
III. $5<x<16$ and $y=-\frac{3}{4}x+16$ (equation of side AC) and $x=0(mod4)$, for x an integer. Then $x=8,12$ and $y=6,3$ yield another two points on side AC.
In all, seven points lie on the sides of triangle ABC with integer coordinates, that for an obtuse triangle with points O and D. *also solved by Niels Bejlegaard, Stavanger, Norway.*

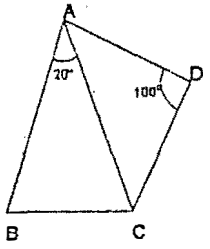
Q.87 Let a,b and c be the lengths of the medians of a right-angled triangle, such that $a\geq b\geq c$. Find the numerical value of $\frac{a^2+b^2}{c^2}$.

Solution (**Niels Bejlegaard**, Stavanger, Norway) Let the sides denoted x,y and z with z the hypotenuse. By the Pythagorean Theorem we have: $a^2=(\frac{x}{2})^2+y^2$; $b^2=x^2+(\frac{y}{2})^2$; $c^2=(\frac{z}{2})^2 \Longrightarrow a^2+b^2=\frac{5}{4}(x^2+y^2) \Longrightarrow \frac{a^2+b^2}{c^2}=\frac{\frac{5}{4}}{\frac{1}{4}}\cdot\frac{x^2+y^2}{z^2}=5$. *Also solved by Maurice Brémond, Avignon, France; Pietro Fanciulli, J. N. Lillington, Dorcester, UK.*

Q.88 ABC and DAC are two isosceles triangles with $B\hat{A}C=20^\circ$ and $A\hat{D}C=100^\circ$ (see figure). Prove that $\overline{AB}=\overline{BC}+\overline{CD}$.

Solution 1 (**Maurice Brémond**) La loi du cosinus, appliquée aux

triangles ADC et BAC, permet d'écrire:



$$AB^2 = AC^2 = 2CD^2 - 2CD^2\cos 100^\circ$$
$$= 2CD^2(1 - \cos 100^\circ)$$
$$= 4CD^2(\sin 50^\circ)^2$$

d'où:

$$AB = AC = 2CD\sin 50^\circ = 2CD\cos 40^\circ$$

d'une part. et

$$BC^2 = 2AB^2 - 2AB^2\cos 20^\circ = 4AB^2(\sin 10^\circ)^2,$$

d'où:

$$BC = 2AB\sin 10^\circ$$

d'autre part. On peut donc écrire:

$$BC = 4CD\sin 10^\circ\sin 50^\circ = 2CD(\cos 40^\circ - \cos 60^\circ)$$
$$= 2CD(\cos 40^\circ - 0.5)$$
$$= 2CD\cos 40^\circ - CD$$
$$= AB - CD,$$

soit: $AB = BC + CD$.

Solution 2 (J.N.Lillington, Winfrith Technology Centre, Dorchester) By sine rule on triangles ABC and ADC, we have

$$\frac{AB}{\sin 80^\circ} = \frac{BC}{\sin 20^\circ} \text{ and } \frac{AC}{\sin 80^\circ} = \frac{CD}{\sin 40^\circ}.$$

Since $AB = AC$,

$$BC + CD = \frac{AB}{\sin 80^\circ}(\sin 20^\circ + \sin 40^\circ) = \frac{AB}{4\cos 20^\circ\cos 40^\circ}(1 + 2\cos 20^\circ)$$
$$= \frac{AB}{2\cos 20^\circ\cos 40^\circ}(\cos 60^\circ + \cos 20^\circ) = AB.$$

Solution 3 (Combined solutions of Niels Bejlegaard and Pietro Fanciulli, slightly modified by the editor) Choose point E on the extension of BC past C such that $CE = DE$. and connect E with D. As $\angle DCE = 60^\circ$, triangle CDE is equilateral by construction, hence $CD = CE$.
We notice that quadrilateral ABCD is cyclic because if $\angle ADC + \angle CBA = 100^\circ + 80^\circ = 180^\circ$ and $\angle BAD + \angle DCB = 60^\circ + 120^\circ = 180^\circ$. So we have $\angle CBD = \angle CDA = 40^\circ$ (because they are inscribed angles intercepting the same arc CD) and $\angle BAD = \angle DEB = 60^\circ \Rightarrow$ triangles DBA and EBD are congruent whcih gives $AD = CD = CE$. Hence $AB = BE = BC + CE = BC + CD$.
Bejlegaard comments that he prefers the pure geometric solution since one is forced to describe a problem pictorially, by means of a figure – a most important concept as proposed by the famous French geometer Joseph Caron, teacher of descriptive geometry, and former mentor of Henri Lebesgue. At that time (about 1920) the discipline of algebraic geometry had made its entrée, thereby 'threatening' the art of geometry.

Q.89 The number 1997 is expressed as the sum of some natural numbers, not necessarily different from one another. What is the greatest possible value of the sum?

Solution (Niels Bejlegaard) (*Ed.* I apologize for a misprint in the text. In order that the question becomes meaningful, the final word should read 'product' instead of 'sum'.)
Let $1997 = \sum i = 1^j n_i$. From the arithmetic mean - geometric mean inequality we have

$$\prod_{i=1}^{j} n_i \le \left(\frac{\sum_{i=1}^{j} n_i}{i}\right)^i = \left(\frac{1997}{i}\right)^i.$$

Now extending the domain of the i's from N to R, we have to seek the one i that corresponds to the maximum value of $\left(\frac{1997}{i}\right)^i$. We notice that

$$\frac{d}{di}\left(\frac{1997}{i}\right)^i = \left(\frac{1997}{i}\right)^i \left\{ln\frac{1997}{i} - 1\right\} = 0,$$

from which we see $i = \frac{1997}{e}$. Due to monotonicity, and the fact that $2 < e < 3$, we get:

$$\max \prod_{i=1}^{j} n_i = \max\left\{2^{\{\frac{1997}{2}\}}; 2.3^{\{\frac{1997}{3}\}}\right\} = 2.3^{665}.$$

(*Editor's comment*: Denote the maximum value of the product by p and the summands of 1997 whose product is p by $s_1, s_2, \ldots, s_k$, No summnads can be greater than or equal to 4. For suppose that one summand $s_i \geq 4$. In that case, $s_i = 2 + (s_i - 2)$ and $2(s_i - 2) = 2s_i - 4 \geq s_i$. This leads to a contradiction. No summand can be equal to 1. In fact, suppose that $s_i = 1$; then, for any s_j such that $j \neq i$ the sum $s_i + s_j$ is equal to $1 + s_j$ and $s_i\, s_j = 1.s_j < 1 + s_j$. Thus, by replacing the two summands s_i and s_j by their sum, a greater product would be obtained. This shows that the summands of 1997 are all equal to 2 or 3. Suppose that there are more than summands equal to 2. In that case $2 + 2 + 2$ can be replaced by $3 + 3$ and the product 3.3 is greater than the product 2.2.2. So p must be of the form $p = 2^r 3^s$, with $r \leq 2$. As $1997 = 665.3 + 2$, we finally yield the maximum value $p_{\max} = 2.3^{665}$.

Marc de Wilde, Université de Liège, Institut de Mathématique, Belgium, submitted a rather simpler solution to Q. 84 than the published one: Let O and O' be the centres of the circles C and C' and I one of the common points. Let A (resp. B) be the (second) intersection of OI with C (resp, $O'I$ with C'). The n OB and $O'A$ are two medians od IAB. If G is their intersection, the third median IG intersects OO' at its midpoint.

Steve Kallenborn, Greifensee, Switzerland, has pointed to a careless mistake which has cropped up in the solution to Q. 83. he had his computer break down 6-digit numbers into different categories (i.e. 6 different digits, 3 pairs, 2 triples, ...), exhaustively. Kallenborn writes: the offered solution on the number of 6-digit numbers containing exactly 4 discrete digits seemed suspiciously high. 554400 is more than half of the 6 digit numbers, and it seemed likely (to me) that there should also be a lot of 6-digit numbers with exactly 5 distinct digits. In fact there are 453,600 of these numbers, giving us more than a million ... already! The number of solutions with one digit occurring three times is given correctly as 100,800. The number of solutions with two pairs of digits is only *half* of the offered solution, because the two repeated digits can be exchanged, yielding the same solution set twice. Thus there are only 327,600 solutions. I also made several mistakes while working the figures out, which possibly demonstrates the difficulty we seem to have in visualising such permutatin problems!

That is all for this issue of the Corner. I need your suitable materials and your suggestions for directiosn for this feature.

Finally, you are invited to propose problems for which readers will send in solutions. Proposals should, whenever possible, be accompanied by a solution, references, and other insights whcih are likely to be of help to 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 come across, especially those from (problem) books and contests that are not easily accessible. But other interesting problems may also be acceptable provided thay 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 75 Praha 8, Czech Republic.

R.Goodman, N.R.Wallach: Representations and Invariants of the Classical Groups, Encyclopedia of Mathematics and its Applications, vol.68, Cambridge University Press, Cambridge, 1998, xvi+685 pp., GBP 65.00, ISBN 0-521-58273-3

This remarkable book is indeed an encyclopedic treatment of the classical groups and their representation theory, the subject of the ground breaking book by Weyl which appeared more than half a century ago. Based on their graduate courses over many years at several universities, the authors have offered a fascinating modern monographic treatment covering all the material in Weyl's book and much more, which can be used at many levels. First, since it requires nearly no prerequisites – just an abstract algebra course – it can be read as an introduction to the representation theory of semisimple Lie groups and Lie algebras. Further, the book can be viewed as an introduction to algebraic group theory focusing on the classical groups, with many new points of view. Last, but not least, the book will definitely serve as an excellent reference source for the main results in classical invariant theory and the finite dimensional representation theory of the classical groups. Since the original book by Weyl has become quite difficult to read, this is a very timely contribution to the literature. The book is worked out with great care, its structure is very elaborate, and the authors themselves give several plans of various types of courses based on specific choices of material. The authors pay a lot of attention to clarifying the role of analytical and algebraic methods in the theory. The methods of analysis are applied when complex Lie groups are studied via complexifications of real compact Lie groups. The other possibility is to employ techniques from algebraic geometry. The authors do not hesitate to prove many fundamental results in both ways. More than 300 exercises containing further material are offered too. Clearly, the book will be a very valuable item in each private or public library and, in particular, it should be recommended to everybody who is interested in (classical) representation theory. (jsl)

S.Albeverio, J.Jost, S.Paycha, S.Scarlatti: A Mathematical Introduction to String Theory: Variational Problems, Geometric and Probabilistic Methods, London Mathematical Society Lecture Note Series, vol.225, Cambridge University Press, Cambridge, 1997, viii+135 pp., GBP 22.95, ISBN 0-521-55610-4

The main aim of this book is to establish rigorous mathematical foundations of one part of string theory, namely Polyakov's approach to quantisation of strings, but in the text we can find many comments, remarks, and references connecting the exposition with other parts of string theory. The book is divided into two chapters. While chapter II represents the main part of the book, the aim of chapter I is to present and explain the necessary mathematical tools. These tools are rather nontrivial and belong to various branches of mathematics (algebra, analysis, infinite dimensional differential geometry, algebraic geometry, probability), and it is admirable how the authors managed to introduce such a quantity of material in 85 pages. Not all the details are to be found here, but the ideas are presented in such a clear way that a reader with little experience can easily fill them in. The same holds for the text of chapter II. Here the authors convert the heuristic ideas of Polyakov and others into mathematical theory. Most of the results are new. The book can serve as a good introduction to contemporary research in the field. It will be appreciated by specialists. For a beginner with little mathematical background it will probably not be so easy to understand the whole exposition, but such a reader will understand the main steps and I am sure that the book will arouse his or her interest. The references run to 119 items and go up to 1996. (jiva)

T.Frankel: The Geometry of Physics: An Introduction, Cambridge University Press, Cambridge, 1997, xxii+654 pp., GBP 65.00, ISBN 0-521-38334-X

A very good description of the contents of the book is printed just behind its cover on page i. Let us quote: 'This book is intended to provide a working knowledge of those parts of exterior differential forms, differential geometry, algebraic and differential topology, Lie groups, vector bundles, and Chern forms that are essential for a deeper understanding of both classical and modern physics and engineering. Included are discussions of analytical and fluid dynamics, electromagnetism (in flat and curved space), thermodynamics, elasticity, soap films, special and general relativity, the Dirac operator and spinors, and gauge fields including Yang–Mills, the Aharonov–Bohm effect, Berry phase, and instanton winding numbers. Before discussing abstract notions of differential geometry, geometric intuition is developed through a rather

extensive introduction to the study of surfaces in ordinary space; ... ' Looking at this long list of various subjects covered in about 600 pages, one might think that this is yet another rough guide to the 'usage of mathematics', but this is *not* true. The reader finds a very elaborate, detailed, and consistent introduction to several areas of mathematics, underlining the natural links and relations between them. At the same time, a lot of motivating and illuminating applications of physical character are given. The exposition is, of course, less focused on the absolute rigour and full discussion of all degenerate cases of the individual theorems, in favor of stressing the main ideas. On the other hand, the development of the concepts and results is clean, transparent, and based on modern approaches in differential geometry, global analysis, and topology. I believe that this approach is extremely helpful for students in physics and engineering. Moreover, it will be of particular help to pure mathematics students as a counterpart to the more common absolutely rigorous specialised texts that are so common nowadays. Thus the textbook is recommended to a wide audience, including advanced undergraduate students and graduate students in mathematics, physics, and engineering. (jsl)

M.P.Brodmann, R.Y.Sharp: Local Cohomology: an algebraic introduction with geometric applications, Cambridge Studies in Advanced Mathematics, vol.60, Cambridge University Press, Cambridge, 1998, xv+416 pp., GBP 45.00, ISBN 0-521-37286-0

This book was written for postgraduate students with the aim of preparing them for research in local cohomology. The authors assume that the reader is familiar with many basic sections of the books by H. Matsumura: Commutative Ring Theory (Cambridge University Press, 1986), and by J. J. Rotman: An Introduction to Homological Algebra (Academic Press, 1979). The book is well organised, very nicely written, and reads very well. It is recommended even to those readers who think that they do not know all the necessary prerequisities. The major part of the book is pure algebra but at many places you feel and find the strong background of algebraic geometry. The authors systematically apply the algebraic results of local cohomology in algebraic geometry. With the exception of the last chapter the reader needs only basic knowledge of affine and projective varieties. The more advanced notions of schemes and sheaf cohomology appear only in this last chapter. In fact, the last two chapters are completely devoted to the applications of local cohomology in algebraic geometry. The penultimate chapter deals with the connectivity of algebraic varieties and the last chapter shows the links between local cohomology and cohomology of sheaves. The book gives a very good overview of local cohomology theory. The authors present quite recent results, their own results, and some new proofs of older theorems. To keep the reader interested, they have incorporated into the text many exercises and many examples. The references have 67 items and go up to 1996. (jiva)

M.A.Guest: Harmonic Maps, Loop Groups, and Integrable Systems, London Mathematical Society Students Texts 38, Cambridge University Press, Cambridge, 1997, xiii+194 pp., GBP 14.95, ISBN 0-521-58932-0, ISBN 0-521-58085-4

The main topic studied in the book is harmonic maps from a Riemann surface to a compact Lie group or to a symmetric space. This is a topic that has been studied for decades, with recent important interrelations with problems in mathematical physics. A parametrisation (or a classification) of the space of such maps in the general case is still an open problem. Methods used in the book for the discussion of harmonic maps come from the theory of integrable systems. The first part of the book describes one-dimensional integrable systems, the second part contains a discussion of two-dimensional integrable systems and the final part brings both these themes together. Information obtained in such a way is used for description of harmonic maps in particular cases. Generality of the exposition was abandoned here with the aim of making the book more readable (the book is based on a series of lectures and partly keeps their flavour). The bibliographical comments at the end of individual chapters are quite useful. The book will certainly be appreciated by mathematicians as well as theoretical physicists interested in the subject. (vs)

W.A.Coppel: Foundations of Convex Geometry, Australian Mathematical Society Lecture Series, vol.12, Cambridge University Press, Cambridge, 1998, xiv+222 pp., GBP 24.95, ISBN 0-521-63970-0

This book presents a modern axiomatic approach to affine and convex geometry, revising the classical treatments of Euclid and Hilbert. 'Convex geometry' is understood here as any set where segments joining two arbitrary points are defined and mild axioms are added in order to guarantee the required properties (e.g. Helly's theorem). Numerous examples of convex geometries (besides the classical one of a vector space over the reals) are presented. The book is accessible at a relatively low mathematical level and may serve as a valuable complement to the large amount of existing literature on 'classical' convexity. (jrat)

A.Martsinkovsky, G.Todorov (Eds.): Representation Theory and Algebraic Geometry, London Mathematical Society Lecture Note Series,

vol.238, Cambridge University Press, Cambridge, 1997, vii+123 pp., GBP 20.95, ISBN 0-521-57789-6

This book presents proceedings of the conference held in memory of Maurice Auslander from March 24-26, 1995 at Brandeis University. It contains the following seven contributions: M. Artin: Some problems on three-dimensional graded domains; R. Bautista: The mathematical influence of Maurice Auslander in Mexico; D. A. Buchsbaum: Intertwined with Maurice; E. L. Green: Introduction to Koszul algebras; I. Reiten: Old and recent work with Maurice; C. M. Ringel: The development of the representation theory of finite dimensional algebras 1968-1975; L. Szpiro: Algebraic geometry over $\overline{Q}$. All these articles are high level survey articles, and most of them cover even recent research in the corresponding topic. The book will be interesting for specialists as well as for mathematicians working in other fields but wishing to become familiar with some of the topics mentioned above. (jiva)

R.T.Rockafellar, R.J.-B.Wets: Variational Analysis, Grundlehren der mathematischen Wissenschaften. A Series of Comprehensive Studies in Math.,vol.317, Springer-Verlag, Berlin, 1998, xiii+733 pp., 151 fig., DM 198.00, ISBN 3-540-62772-3

This monograph is the collaborative work of two persons well-known in current optimisation theory. Therefore, the reader may expect an exhaustive and thorough explanation of modern optimisation theory, and the book really fulfils these expectations. The text starts with a tutorial description of the optimisation concept given by 'min' and 'max' procedure. Considering penalties and constrained optimisation, the authors are naturally led to minimisation of the function $f : R^n \to [-\infty, +\infty]$. The introductory chapter provides us, moreover, with the calculus convenient for optimisation and explains the essential properties of the considered functions, such as continuity, closure, growth etc. The next two chapters are designed to explain the notion of convexity which is key to modern optimisation theory. After that topologies on closed sets are discussed, namely epi-convergence and the epi-graphical distance. Studying the rate of convergence requires the theory of set-valued mappings; especially, their differentiability. The reader can find necessary theory in Chapter 6. The other important theoretical apparatus, such as subdifferential calculus, the Lipschitzian property, duality theory, etc., are also explained and illustrated in this book. The monograph is intended for graduate students, researchers and practitioners interested in and applying optimisation. Of course, some mathematical skill is required. The text is written in a clear and helpful manner. The subchapters explaining subjects outwith the framework of optimisation theory are marked by an asterisk and can be skipped without any misunderstanding of the sequel. (pl)

M.Musiela, M.Rutkowski: Martingale Methods in Financial Modelling, Applications of Mathematics, vol.36, Springer-Verlag, Berlin, 1997, xii+512 pp., DM 118.00, ISBN 3-540-61477-X

Although financial mathematics has already established itself as an attractive and dynamically developing part of probability theory, the mathematical and perhaps also the financial community has, until now, lacked a comprehensive and self-contained text on the subject. Books by *M.W.Baxter, A.Rennie (1996), L.Chen (1996), D.Duffie (1988), J.Hull (1994,1996), I.Karatzas, S.Shreve (1988,1997), S.R.Pliska (1997), S.P.Sethi (1997), etc.* are either concentrated on special subjects or prefer a calculus-like presentation. This book starts at an elementary mathematical level and does not presume any special knowledge of financial markets. This part of the text offers good material for two one-semester courses on financial mathematics suitable for (under)graduate students in such different subjects as mathematics, physics, computer science, engineering and economics. Later, and gradually, the authors exhibit more complex mathematical tools for handling continuous models - martingales and of course stochastic analysis, Lévy's, Girsanov's theorem and Brownian representations included. This part provides rich material for a (post)graduate lecture or seminar accessible to all students with standard background in mathematics and probability. Among the subjects the authors treat are the *Cox-Ross-Rubinstein Model, Finite, Continuous Security Markets, Black-Scholes Model, Foreign Market Securities, American and Exotic Options, Interest Rates Models, Models of Bond Prices, Option Valuation in Gaussian Models, Swap and Cross-Currency Derivatives.* (jste)

I.S.Duff, G.A.Watson (Eds.): The State of the Art in Numerical Analysis, The Institute of Mathematics and its Applications Conference Series, vol.63, Oxford University Press, Oxford, 1997, xiv+562 pp., GBP 95.00, ISBN 0-198-50014-9

The book is the Proceedings of the meeting "The State of the Art in Numerical Analysis" organised by the Institute of Mathematics and its Applications and held at the University of York in April 1996. The goal of this meeting was to bring together specialists from various areas of numerical analysis and to create a forum where an account of the important recent developments in the subject could be presented in a coherent and concentrated way in a manner accessible to the non-specialist in the sub-area. The Conference Committee consisted of C. Baker, I. Duff, A. Iserles, B. Morton, M. Powell and A. Watson. The

contributions in these proceedings are concerned with linear algebra, ordinary differential equations, integral equations, partial differential equations, approximation, optimisation, numerical tomography and image processing. The proceedings will be useful for specialists as well as students interested in numerical analysis. (mf)

F.Di Biase: Fatou Type Theorems. Maximal Functions and Approach Regions, Progress in Mathematics, vol.147, Birkhäuser, Boston, 1998, viii+152 pp., DM 88.00, ISBN 0-817-63976-4, ISBN 3-764-33976-4

This beautiful book is devoted to boundary behaviour of harmonic functions. It contains an introduction to the subject as well as the latest results of research in this area. It is well known that under certain growth conditions every harmonic function on a half-space admits non-tangential boundary limits at almost every point of the boundary. If the non-tangential approach region (cone) is replaced by a region containing a curve tangential to the boundary the analogy of the Fatou theorem fails. However, A. Nagel and E.M.Stein showed in 1984 that for any sequence of points (arbitrarily tangential to the boundary), there exists an approach region containing its subsequence for which the Fatou theorem holds. The analogy of non-tangential convergence holds in a lot of other cases (unit ball in C_n, strictly pseudoconvex domains of finite type in C_2, NTA domains in R_n, symmetric spaces, certain negatively curved manifolds, certain Gromov-hyperbolic spaces, e.g. trees) and there exist some natural approach regions. The author introduces a new method of construction of such approach regions based on discretisation leading to the discrete settings of trees, for which the problem is solved. The Nagel-Stein phenomenon is proved under some minimal assumptions. The book is divided into 6 parts. In the first two chapters known results are recalled - the situation on the unit disc is described, spaces of homogeneous type are introduced and explained, approach regions and natural approach regions are defined. The third chapter is devoted to the NTA domains, domains in C_n and trees including natural approach regions. In the fourth chapter the existence of exotic approach regions is shown for trees and hence the discrete case is solved. In the fifth chapter these results are applied to the space of homogeneous type using the quasidyadic decomposition in cubes. In the sixth chapter the results are applied to the case of the Euclidean half-space (to demonstrate the idea), NTA domains in R_n, finite-type domains in C_2 and strongly pseudoconvex domains in C_n. The book contains a rich and representative bibliography which can be used as a good source for the study of this area. Minimal prerequisites make it possible to understand quite recent and difficult results which are explained in the book and it is recommended to anybody interested in potential theory. (jran)

W.Krawcewicz, Jianhong Wu: Theory of Degrees with Applications to Bifurcations and Differential Equations, Canadian Mathematical Society Series of Monographs and Advanced Texts, J.Wiley & Sons, Inc., New York, 1997, xiv+374 pp., GBP 70.00, ISBN 0-471-15740-6

This book is devoted to the theory and applications of the degree of nonlinear mappings in finite (the Brouwer degree) and infinite dimensional spaces (the Leray-Schauder degree and its generalizations to condensing maps including the coincidence degree). Attention is paid to maps with symmetries for which the S^1-degree and the Dold-Ulrich equivariant degree are defined. The explanation in the book is self-contained, chapters on algebraic and differential topology and transformation groups are included. Degree theory is applied to local and global bifurcation inclusive of the Hopf bifurcation. The second type of application is towards ordinary, delay and neutral differential equations (boundary value and eigenvalue problems, periodic solutions). This part of the book is closely related to the authors' investigation. The book is clearly written and is recommended to graduate students interested in differential equations. More than 170 exercises of a medium level of difficulty serve to develop a mastery of degree theory. (jmil)

L.Schneps, P.Lochak (Eds.): Geometric Galois Actions 2: The Inverse Galois Problem, Moduli Spaces and Mapping Class Groups, London Mathematical Society Lecture Note Series, vol.243, Cambridge University Press, Cambridge, 1997, ix+347 pp., GBP 24.95, ISBN 0-521-59641-6

This is the proceedings of the conference held at Luminy in August 1995 on "Geometry and Arithmetic of Moduli Spaces". The volume begins with abstracts of the talks which were actually given at the conference. The rest is divided into four separate sections. The first part (Dessins d'enfants) contains five papers forming a bridge with the previous conference: N.Adrianov & G.Shabat: Unicellular cartography and Galois orbits of plane trees, G.Jones & M.Streit: Galois groups, monodromy groups and cartographic groups, T.Hsu: Permutation techniques for coset representations of modular subgroups and L.Zapponi: Dessins d'enfants en genre 1. The second part (Inverse Galois problem) contains the following papers: P.Debes & B.Deschamps: The regular inverse Galois problem over large fields, K.Strambach & H.Völklein: The symplectic braid group and Galois realisations, and M.Fried & Y.Kopeliovich: Applying modular towers to the inverse Galois problem. The third part

(Galois actions, braids and mapping class groups) consists of two papers: M.Matsumoto: Galois group G_Q, singularity E_7 and moduli M_3 and Z.Wojtkowiak: Monodromy of iterated integrals and non-abelian unipotent periods. In the fourth part (Universal Teichmüller theory), the following papers are gathered: R.Penner: The universal Ptolemy group and its completions, M.Imbert: Sur l'isomorphism du groupe de Richard Thompson avec la group de Ptolémée, and P.Lochak & L.Schneps: The universal Ptolemy–Teichmüller groupoid. (šp)

P.J.Cameron: Introduction to Algebra, Oxford University Press, New York, 1998, x+295 pp., GBP 16.95, ISBN 0-198-50194-3, ISBN 0-198-50195-1

This is an excellent introduction to abstract algebra. After developing basic concepts - rings, groups, vector spaces, and modules - from the very beginning, the author then proceeds to more abstract concepts like extensions of groups, simple groups, Noetherian rings, and briefly mentions even lattices and categories. The section on applications has two major themes - coding theory and Galois theory. Another section contains constructions of number systems from scratch, and also deals with ruler-and-compass constructions. Th clearly written exposition is accompanied by well-chosen exercises. This book should be useful as a textbook for most undergraduate courses on algebra. (jtu)

M.Hušková, R.Beran, V.Dupač: Collected Works of Jaroslav Hájek - With Commentary, Wiley Series in Probability and Statistics, J.Wiley & Sons, Inc., Chichester, 1998, ix+677 pp., GBP 95.00, ISBN 0-471-97856-9

Thi volume is far from being only a tribute to the leading theoretical statistician of 1960-70s Jaroslav Hájek, or a collection of his important papers. On the contrary, this publication will be seen by researches in statistics as a concentrated source of the ideas that Hájek brought to this field of mathematics. Part I recalls the personality of Jaroslav Hájek and his professional career as observed by his colleagues. The essays by *R.Beran, L.Le Cam, M.Hušková, J.Jurečková, J.Machek, E.Parzen, Z.Prášková and P.K.Sen* both overview Hájek's fundamental results in statistical inference in stochastic processes, in finite population sampling, in the theory of rank tests and in asymptotic statistics, generally, and evaluate their role in actual research in mathematical statistics. Special attention is given to his less known early papers. A complete list of Hájek's publications and a list of PhD theses he supervised is also attached. Part II introduces a collection of 36 of Hájek's most important papers that thematically belong to the fields listed above. The volume also presents the first translations from Czech of several papers on sample surveys corrected according to the notes Hájek made on his reprints. The editors and *John Wiley & Sons* have provided the statistical community with a nice and valuable book. (jste)

J.L.Bell: A Primer of Infinitesimal Analysis, Cambridge University Press, Cambridge, 1998, xiii+122 pp., GBP 19.95, ISBN 0-521-62401-0

Apart from the concept of infinitesimals introduced in the Sixties by Robinson within *nonstandard analysis* another theory of *smooth infinitesimal analysis* was created in the Seventies. It is an axiomatic theory of nilsquare and nonpunctiform infinitesimals. On this base, certain parts of analysis are developed in this book, e.g. calculus of functions of a single and several variables, Taylor theorem, and the (definite) integral. The book contains many historically motivated examples. Motivating quotations have a philosophical flavour. To illustrate the character of the smooth world **S** let us describe the approach to the derivative. In **S** the *derivative* of an arbitrary function $f : R \to R$ is defined as follows: For a fixed x in R define the function $g_x : \Delta \to R$ by $g_x(\varepsilon) = f(x + \varepsilon)$. Then by the so-called Principle of Microaffineness there is a unique $b = b_x$ in R, such that, for all ϵ in Δ, $f(x + \epsilon) = g_x(\epsilon) = g_x(0) + b_x \cdot \epsilon = f(x) + b_x \cdot \epsilon$. Allowing x to vary then yields a function $x \mapsto b_x : R \to R$ which is written f' and called, as is customary, the *derivative* of f. Applying these ideas to complex function theory the author obtains this *Theorem.* The following conditions on a complex function f are equivalent: (i) f is analytic (= differentiable at every point of **C**); (ii) the real and imaginary parts u, v of f satisfy Cauchy-Riemann equations, namely, $u_x = v_y$, $v_x = -u_y$. He explains that in classical complex analysis analyticity is not generally implied by satisfaction of the Cauchy-Riemann equations; one requires also that certain continuity conditions are satisfied. In **S**, however, these extra conditions are fulfilled automatically. The book will be of interest to philosophically orientated mathematicians and logicians. (jve)

U.Küchler, M.Sørensen: Exponential Families of Stochastic Processes, Springer Series in Statistics, Springer-Verlag, New York, 1997, x+322 pp., DM 98.00, ISBN 0-387-94981-X

Exponential parametric families of stochastic processes play an important role in statistical theory and applications whenever independent observations are involved. They provide a simple model for which the likelihood function exists on R^+ and has an exponential representation that provides the canonical statistics which have finite dimension and are independent of time. This structure of exponential families yields many properties that are of interest both in probability and statistics, generally, and are studied systematically in the text we review. Thus, the book presents, as its main theme from the point of view of statistics, *Likelihood*

Theory and *Sequential Methods*, while *Stochastic Analysis* serves as the main probabilistic tool with which to treat the above mentioned properties of exponential families, with the advantage of a thoroughly global approach. *"A Tool Box from Stochastic Analysis"* in *Appendix A* presents a compact overview of stochastic calculus results (no proofs) that may provide a handy introduction to this increasingly important field that is not widely known among statisticians. The book is mainly intended for researchers and graduate students as a review of the actual state of statistical inference in the exponential model, but it may also provide rich material for more advanced seminars or lectures on statistics of stochastic processes, generally, introducing nicely the modern and efficient martingale approach. Important items from the *"Contents"* are *Random Time Transformations, Exponential Families of Markov Processes, The Envelope Families, Likelihood Theory, Sequential Methods, and Semimartingale Approach.* (jste)

S.Sivasundaram, A.A.Martynyuk (Eds.): Advances in Nonlinear Dynamics, Stability and Control: Theory, Methods and Applications, vol.5, Gordon and Breach Science Publishers, Amsterdam, 1997, xi+390 pp., GBP 84.00, ISBN 9-056-99030-6

This volume, which has been prepared on the occasion of the 60th birthday of Prof. S. Leela, consists of 39 papers devoted to various aspects of nonlinear differential equations. The first paper is a survey of Prof. Leela's work and most of the contributions are connected with her activity. Almost one half of the papers are concerned with stability properties of ordinary differential equations; the rest of them are related to similar problems including controllability for delay equations and partial differential equations. (jmil)

P.N.de Souza, J.-N.Silva: Berkeley Problems in Mathematics, Problem Books in Mathematics, Springer, New York, 1998, xiv+443 pp., DM 118.00, ISBN 0-387-94934-8, ISBN 0-387-94933-X

This volume of the Problem Books in Mathematics Series of Springer contains a compilation of problems from various parts of mathematics. All of them appeared in written *entrance* exams for Ph.D. students at the University of California, Berkeley. The exams were introduced in 1977 and the book brings the problems together with solutions collected since that time. From more than 500 carefully chosen problems from analysis and 360 from algebra (some problems contain several questions) several would be easy for a good student to solve; The book is aimed at those who like learning how to use theory to crack some interesting problems and hence it is strongly recommended for problem-solving seminars and also for students wanting to check their preparation for advanced exams. Detailed information about the exams in which the problems were used, including passing scores, a good index, and many references are also given. Some information contained in the book is also available via the internet in electronic form that may be downloaded in different formats (try `http://math.berkeley.edu` and choose `Preliminary Exams`). Thus collections of problems for different exams can easily be printed. The authors will appreciate receiving comments to solutions by e-mail. (jve)

B.Buchberger, F.Winkler (Eds.): Gröbner Bases and Applications, London Mathematical Society Lecture Note Series, vol.251, Cambridge University Press, Cambridge, 1998, viii+552 pp., GBP 29.95, ISBN 0-521-63298-6

This book is the outcome of the special activities at RISC–Linz at the beginning of 1998. An intensive course for young researchers and the conference '33 Years of Gröbner Bases' were held there. This volume contains a series of remarkable tutorials: B. Buchberger, *Introduction to Gröbner Bases*; F. Chyzak, *Gröbner Bases, Symbolic Summation and Symbolic Integration*; W. Decker and T. de Jong, *Gröbner Bases and Invariant Theory*; M. Green and M. Stillman, *A Tutorial on Generic Initial Ideals*; G.M. Greuel and G. Pfister, *Gröbner Bases and Algebraic Geometry*; S. Hoşten and R. Thomas, *Gröbner Bases and Integer Programming*; H.M. Möller, *Gröbner Bases and Numerical Analysis*; L. Robbiano, *Gröbner Bases and Statistics*; S. Sakata, *Gröbner Bases and Coding Theory*; F. Schwarz, *Janet Bases for Symmetry Groups*; D. Struppa, *Gröbner Bases in Partial Differential Equations*; B. Sturmfels and N. Takayama, *Gröbner Bases and Hypergeometric Functions*; V. Ufnarovski, *Introduction to Noncommutative Gröbner Bases Theory*; D. Wang, *Gröbner Bases Applied to Geometric Theorem Proving and Discovering.* Another 17 original contributions are included and the English translation of the first Buchberger's work on Gröbner Bases is appended. The wide range of the applications given, the transparent and readable introductions to the various subjects, and also the careful editorial work of the tutorials including a detailed Index, have resulted in an impressive contribution to the literature on the Gröbner Bases. The book is warmly recommended to experts in some of the areas covered, as well as to everybody who feels curious about the prospective usage of the Gröbner bases technique in his or her own area of research. (jsl)

D.J.Newman: Analytic Number Theory, Graduate Texts in Mathematics, vol.177, Springer-Verlag, New York, 1998, viii+76 pp., DM 59.00, ISBN 0-387-98308-2

These days, time that can be devoted to reading is

(unfortunately) generally decreasing, and so a slim but concise book is always welcome. The book under review is of this kind. The names of individual chapters are almost self explanatory: The idea of analytic number theory, The partition function, The Erdős–Fuchs theorem, Sequence without arithmetic progressions, The Waring problem, A "natural" proof of the nonvanishing of L–series and Simple analytic proof of the prime number theorem. All material presented in the book is written in a very elegant and lucid manner. Chapters end with problem sections containing interesting and clever extensions to each chapter. The book is well suited as a first course for graduate students with an interest in analytic number theory at an early stage or to students oriented towards applications of classical function theory. Unfortunately, there is no bibliography. (šp)

N.D.Cong: Topological Dynamics of Random Dynamical Systems, Oxford Mathematical Monographs, Oxford University Press, Oxford, 1997, viii+203 pp., GBP 45.00, ISBN 0-198-50157-9

As a differential equation determines a (smooth) dynamical system, so a stochastic differential equation generates a random dynamical system. The book under review is devoted to the latter systems, a relatively new field which joins the theory of dynamical systems and probability theory. The preparatory chapter presents basic facts on structural stability and classification of deterministic dynamical systems. These two basic problems are studied for random dynamical systems throughout the book. The central results are full solutions of these problems for the case of linear hyperbolic random systems both for discrete and continuous time. The interaction between measurability and dynamics needs methods and results of algebraic ergodic theory (e.g. Osedelec's multiplicative ergodic theorem, Lyapunov exponents and norms) which are briefly explained in Chapter 2. Chapters 3-8 are devoted to solutions of the above mentioned problems. The book is not a textbook (the author recommends the forthcoming book by L.Arnold, Random Dynamical Systems) but it presents the current state of research. It is written very carefully with many references and valuable comments on relations to deterministic dynamical systems. (jmil)

E.Mendelson: Introduction to Mathematical Logic. Fourth Edition, Chapman & Hall, London, 1997, x+440 pp., GBP 45.00, ISBN 0-412-80830-7

This book is the fourth edition of this title (the first one appeared in 1964). It contains an excellent fundamental course in mathematical logic for undergraduate students (but it is also useful for many other readers). Standard topics - propositional logic, first order logic, first order number theory (Peano arithmetic) with Gödel's theorems, axiomatic set theory (Gödel-Bernays version of axiomatic system is used) and computability - form the contents of the course. Many exercises are given in the book. Various other books on this subject have appeared (since the first edition) but this book still holds its own. It is a very pleasant experience to revisit this book in this nice updated (but not completely reworked) edition. (kču)

W.Hodges: A Shorter Model Theory, Cambridge University Press, Cambridge, 1997, x+310 pp., GBP 22.95, ISBN 0-521-58713-1

The book is a shorter version of the author's book "Model theory", published in 1993 by Cambridge University Press, but with the addition of a new chapter concerning the Morley theorem on uncountably categorical theories and elementary parts of stability theory. The first eight chapters cover standard fundamental themes of model theory such as the compactness theorem, theorems of Skolem, quantifier elimination, diagrams, homomorphisms, embeddings, automorphism groups, omitting types, model-completeness, saturation and ultraproducts. Moreover, notions such as the finite cover property and elimination of imaginaries are introduced and briefly discussed, the Frais methods are presented and various examples are given. At the end of each section some exercices are included and each chapter finishes with a discussion of the subject, commentaries on the literature, and suggestions for further study. This book contains rich material for a good introductory course in model theory and chapter nine provides a basic material for a more advanced course. (jml)

V.Jurdjevic: Geometric Control Theory, Cambridge Studies in Advanced Mathematics, vol.51, Cambridge University Press, Cambridge, 1997, xviii+492 pp., GBP 60.00, ISBN 0-521-49502-4

The geometric point of view of control theory stresses the description of systems of differential equations by non-commuting vector fields. Thus, geometric control theory relies on a background in the theory of differential systems, the calculus of variations, and Lie theory. The scope of this book is even wider. Besides the exposition of geometric control theory itself, it considers the above-mentioned subjects in the perspective of their application. No advanced prerequisites are required. The first part of the book is devoted to the geometric analysis of control systems, with special emphasis on those which are easily studied by means of Lie theory. The second part of the book deals with optimal control. The maximum principle and Hamiltonian formalism are the basic concepts here. The development of control theory in this purely geometrical setting has definite advantages and the

book will be of interest to physicists and engineers. At the same time, it should be even more attractive for mathematicians who may enjoy the enrichment of the subject by the inclusion of applications. (jsl)

J.K.Lindsay: Applying Generalized Linear Models, Springer Texts in Statistics, Springer-Verlag, New York, 1997, xiii+256 pp., 35 fig., DM 98.00, ISBN 0-387-98218-3

This is a book on statistical modelling, not just about statistical inference. The main aim of the book is to provide a unified approach to many commonly used statistical procedures by means of generalised linear models. Motivating examples and common features of generalised linear models are explained in the introductory chapter. A great deal of space is then devoted to log-linear and logit models for categorical data, regression models and survival models, and their transformation into the family of generalised linear models. In subsequent chapters, not only linear models, but also non-linear models and models with dependent structure, models known from time series and spatial analysis, and dynamic generalised linear models are considered. In each chapter, examples of real data sets that could be explained and fitted by the models under consideration are given and discussed; the inference is based on the maximum likelihood method and the model selection is based on the Akaike Information Criterion (AIC). Other data sets are given in exercises that follow each chapter. The reader is assumed to have knowledge of basic statistical principles; the necessary background is summarised in two Appendices. The book is an excellent text for teaching the principles of statistical modelling; it should also draw the attention of applied statisticians and scientists. (zp)

O.Kallenberg: Foundations of Modern Probability, Probability and Its Applications, Springer-Verlag, New York, 1997, xii+523 pp., DM 112.00, ISBN 0-387-94957-7

Researchers and graduate students in probability will find that the book under review contains a comprehensive coverage of practically all subjects of importance in the field, in a manner met previously only by the celebrated *P. Loèves' "Probability Theory"* in 1955. The importance of a text that provides a general overview should be obvious, considering the extreme degree of specialisation among probabilists that has been witnessed since the early 1970's. Olav Kallenberg has ably achieved the goal and presents all the important results and techniques that every probabilist should know. The book is not an easy one to read. The proofs are intended for a sophisticated reader who is familiar with classical probability and analysis and who possesses a good knowledge of subjects like topology, functional and complex analysis. Nevertheless, we do not doubt that the book and the problems attached to each of its chapters will be widely used as material for advanced postgraduate courses and seminars on various topics in probability. These topics cover: Elements of Measure Theory, Random Sequences an Processes, Classical Limit Theorems, Conditioning, Martingales and Markov Processes, Renewal Theory, Stationary Processes, Poisson Type Processes, Gaussian Processes and Brownian Motion, Invariance Principles, Continuous Stochastic Analysis, Feller Processes, Stochastic Differential Equations, Connections between Probability and Potential Theory. (jste)

R.Cooke: The History of Mathematics. A Brief Course, A Wiley-Interscience Publications, J.Wiley & Sons, Inc., New York, 1997, xvii+530 pp., GBP 50.00, ISBN 0-471-18082-3

This book is a brief course on how mathematics has developed over the centuries. It is based on the author's lectures on the history of mathematics and mathematics education. The author prefers simply to present the most significant problems in the history of mathematics so that the reader can appreciate the mathematics at first hand. He is not striving to give readers a detailed chronological history of any part of mathematics, but he encourages readers to ask why people were interested in the problems that mathematicians were solving and what consequences their solutions had for the further development of mathematics and its applications. The author has omitted biographies entirely. The book is divided into four parts. In the first part *Early Western Mathematics*, Cooke looks at the origins of mathematics and examines its progress in the world around the Mediterranean Sea from prehistoric times until the end of the Roman Empire. The author observes the foundation of the organisation of mathematics into a system of definitions, axioms, theorems, formal proofs of results and so we see that our mathematics were built by people who came from the lands surrounding the Mediterranean Sea. The development of mathematics in Ancient Egypt, Mesopotamia, early Greeks, i.e. the Hellenistic world and the Roman Empire is also studied. Different mathematical traditions in other parts of the world (India, China, Korea, Japan and the Muslim world) are presented in the second chapter. It describes reasons why we must study mathematics of other cultures (the alternative ways of looking at our problems, the existence of parallels in our own culture etc.). At the end of this chapter we see that Muslim mathematics provides a natural bridge from the ancient world to the modern world. The third chapter *Modern Mathematics* contains a description of the development of mathematics from medieval Europe to the present day. The story comes to a

close with a survey of the vast world of twentieth-century mathematics. The last chapter contains answers to selected exercises. An alphabetical index is included. The book is an ideal textbook for undergraduate students who are interested in the history of mathematics. Many readers will find new information about the historical development of mathematics in this book. (mn)

A. Desmarets, B. Jadin, N. Rouche, P. Sartiaux: Oh, moi les maths ..., Talus d'approche, Essais, 1997, 170 pp., FF 124, ISBN 2-87246-060-8

This fascinating booklet addresses a twofold target of readers:

1. Those who are already interested in mathematics, and who would like to broaden their knowledge about crucial aspects of the teaching-learning process.
2. Those who are not interested at all in mathematics, with the aim of changing their perception and attitude.

Needless to say, the reviewer belongs to the first category of readers, as – no doubt – do most of the readers of this Newsletter. The book fulfills its promises, discussing in depth such challenging questions as:

* Why is the curiosity and the strong wish to learn of young children killed at the end of a dozen of years of schooling? (Ch. 8)
* Mathematics: For whom? And why? (Ch. 11)
* How to use the history of mathematics in the teaching of mathematics? (Ch. 14).

All the other chapters are also rich in thoughtful remarks and in provocative concrete examples that may be suitably adapted to enliven teaching at all levels, from primary to high school. It is not clear how many of the potential readers of the second category will be attracted by this book. It is to be hoped that many will be, although some parts of the book may be quite demanding for these readers. Nevertheless, their efforts will be worthwhile. (vv)

A.N.Parshin, I.R.Shafarevich (Eds.): Algebraic Geometry III. Complex Algebraic Varieties. Algebraic Curves and Their Jacobians, Encyclopaedia of Mathematical Sciences, vol.36, Springer-Verlag, Berlin, 1998, vii+270 pp., DM 158.00, ISBN 3-540-54681-2

The third volume of the Encyclopaedia on algebraic geometry consists of two contributions. The first one is written by V.S.Kulikov and P.F.Kurchanov (Complex algebraic varieties: periods of integrals and Hodge structures). The survey article contains some of main topics of the contemporary algebraic geometry which were intensively developed during last decades. Starting with a short overview of the classical Hodge theory, the authors give a description of problems related to periods of integrals and Torelli theorems. The second part is devoted to the study of cohomology of smooth algebraic varieties using the methods related to mixed Hodge structures. In the last part, degeneration of families of algebraic varieties is studied, the main tool being the Clemens-Schmid exact sequence. The second part of the book is written by V.V.Shokurov (Algebraic curves and their Jacobians). It is a continuation of the survey article "Riemann surfaces and algebraic curves" of volume 23 of the series. It contains a nice introduction to the recent development of the theory of algebraic curves, their Jacobians and theta functions and relations with partial differential equations of mathematical physics (see also survey article by Dubrovin, Krichever and Novikov - "Integrable systems I." in EMS 4). In more details, properties of the variety of special divisors, Prymians and Jacobians are discussed there as well as main ideas of the theory of Burnchall, Chaundy and Krichever, results of Mumford, Shiota and Novikov and others. Both contributions are very well written and give a possibility to the reader to obtain a comprehensive information concerning the development in the presented field. (jbu)

D.A.Klein, G.-C.Rota: Introduction to Geometric Probability, Lezione Lincee, Cambridge University Press, Cambridge, 1997, xiv+178 pp., GBP 12.95, ISBN 0-521-59654-8, ISBN 0-521-59362-X

This is a brief and useful introduction to the field in the title called also integral geometry (in Euclidean spaces). The authors use the famous Buffon needle problem as motivation and develop the necessary basic technique based mainly on convex geometry. Relatively simple proofs of all presented results are given (including the Hadwiger's characterisation theorems for convex bodies). The book is written at an elementary level and presents classical results only. Later developments (as local versions of intrinsic volumes or translative formulae) are not mentioned, nor are other useful approaches as geometric measure theory. (jrat)

D.Quinney, R.Harding: Calculus Connections. A Multimedia Adventure. Volume 2, J.Wiley & Sons, Inc., New York, 1997, 158 pp., GBP 22.50, ISBN 0-471-13797-9

The package Calculus Connections is a software product which can be used as an excellent supplement to a calculus course. This volume consists of eight modules that cover these topics: application of definite integrals, rectilinear motion, numerical integration: Simpson's rule, sequences and series, differential equations, parametric equations, spherical and polar coordinates and mathematical modeling. Each module has three parts: Applications (i.e., a multimedia presentation of real-life situations that are applications of that part of calculus which is explained in the module),

Concepts (i.e., an explanation of the theme) and Exercises (in which a student can change parameters and functions and see effects of these changes). The software package includes a laboratory workbook which extends ideas introduced in the software, tests understanding of concepts and applies this understanding to new situations. This package is recommended to everybody. (ml)

S.Levy (Ed.): Flavors of Geometry, Mathematical Sciences Research Institute Publications, vol.31, Cambridge University Press, Cambridge, 1997, ix+194 pp., GBP 13.95, ISBN 0-521-62962-4, ISBN 0-521-62048-1

Flavors of Geometry is a collection of four lecture series given at the Mathematical Sciences Research Institute in 1995 and 1996. The topics of these series have in common a strong connection to geometry, although they use different viewpoints and methods. Two of them focus on convex bodies in Euclidean spaces, namely "An elementary introduction to modern convex geometry" by Keith Ball and "Volume estimates and rapid mixing" by Béla Bollobás. Especially, Ball's contribution is an outstanding presenttion of several classical results using modern methods of proofs, and this contribution may serve as a useful introductory textbook to convex geometry. Interesting overviews "Hyperbolic geometry" are provided by James W. Cannon, William J. Floyd, Richard Kenyon and Walter R. Parry, and "Complex dynamics in several variables" by John Smillie and Gregery T. Buzzard complete the collection. (jrat)

K.Ueno: An Introduction to Algebraic Geometry, Translation of Mathematical Monographs, vol.166, American Mathematical Society, Providence, 1997, xii+246 pp., GBP 60.00, ISBN 0-821-80589-4

The book is written for non-specialists to explain main ideas of algebraic geometry. At the beginning of the book, the historical evolution of the algebraic geometry, starting from ideas of Descartes and Fermat is presented. Then the theory of curves in the projective plane is developed systematically and in details. The theory of projective algebraic manifolds in higher dimensional projective space is presented as a generalization of the theory of plane curves. In the second part of the book, the author describes basic facts concerning geometry of algebraic curves related to the Riemann-Roch theorem. As a nice illustration of the theory, the study of elliptic curves over rationals is presented. The last chapter is devoted to analytical theory of algebraic curves and their Jacobian varieties. The corresponding relations are explained there in a very nice and simple way. The book really offers an invitation to algebraic geometry for anybody interested in understanding basic ideas and tools used in algebraic geometry. I would like to recommend it to everybody as a nice textbook for the beginners. (jbu)

J.Le Potier: Lectures on Vector Bundles, Cambridge Studies in Advanced Mathematics, vol.54, Cambridge University Press, Cambridge, 1997, vii+252 pp., GBP 40.00, ISBN 0-521-48182-1

Moduli spaces of vector bundles have been intensively investigated during last forty years and a substantial amount of knowledge is available on this topic at present. The book has two parts. The first one is more elementary, it describes a classification of holomorphic vector bundles on algebraic curves and a construction of the moduli space of stable bundles. Main tools used here are the Hilbert-Grothendieck schemes and the Mumford geometric invariant theory. The second part is based on an advanced lecture series given by the author five years ago and it describes the structure of the moduli space of semi-stable sheaves on the projective plane. The prerequisities needed to understand this part are more substantial (Chern classes of vector bundles and of coherent algebraic sheaves, spectral sequences, the Serre theorems A and B, the finiteness theorems and the Riemann-Roch formula). While the first part can be useful for a broader audience, the second part is designed more for mathematicians working in the field. (vs)

F.Catanese (Ed.): Arithmetic Geometry, Symposia Mathematica, vol.XXXVII, Cambridge University Press, Cambridge, 1997, x+300 pp., GBP 40.00, ISBN 0-521-59133-3

Proceedings of the I.N.d.A.M. Symposium 'Arithmetic geometry' held from October 16 till 21 in the "Palazzone" of the Scuola Normale in Cortona (Italy) devoted, as the title indicates, to geometric methods stemming from arithmetic problems. The papers included in the proceedings are either surveys or original papers. The following contributions are contained in the book: Y.André & F.Balassari: Geometric theory of G-functions, M.Bertolini : Growth of Mordell–Weil groups in anticyclotomic towers, S.Bloch, H.Gillet & C.Soulé: , Algebraic cycles on degenerate fibers E.Bombieri: The equivariant Thue–Siegel method, A.Buium: Differential algebraic geometry and diophantine geometry: an overview, Ch.Deninger: Extensions of motives associated to symmetric powers of elliptic curves and to Hecke characters of imaginary quadratic fields, Ch.Deninger: Motivic L-functions and regularized determinants II, G.Faltings: The determinant of cohomology in etale topology, G. van der Geer & M. van der Vlugt: How to construct curves over finite fields with many points, W.Gubler: Heights of subvarieties over M-fields, F.Oort: Canonical lifting and dense sets of CM-points, C.Pedrini: Finite-

ness results for Chow groups of varieties over number fields, J.F.Voloch: Diophantine geometry in characteristic p: a survey, G.Wüstholz: Computations on commutative group varieties. (šp)

T.E.Cecil, Shiing-shen Chern (Eds.): Tight and Taut Submanifolds: Papers in Memory of Nicolaas H.Kuiper, Mathematical Sciences Research Institute Publications, vol.32, Cambridge University Press, Cambridge, 1997, xvii+349 pp., GBP 30.00, ISBN 0-521-62047-3

The class of tight and taut submanifolds is formed by special submanifolds with certain curvature properties. They were studied extensively during last decades. Professor Nicolaas H.Kuiper contributed substantially to this study. The presented book contains seven survey papers on various parts of the topic, including the first unfinished paper by Kuiper who died in 1994. The second paper (by T.F.Banchoff) is a survey of smooth and polyhedral theories of tight immersions, the third one (by D.P.Cevone) compares both these theories in important special case, the next one (by T.E.Cecil) describes taut and Dupin submanifolds, the fifth one (by C.-L.Terng andn G.Thorbergsson) studies taut submanifolds of an arbitrary complete Remannian manifold, the sixth one (by D.Ruberman) shortly describes some topological results needed in previous part and the last one (by R.Niebergall and P.J.Ryan) is a survey of results on real hypersurfaces (with special curvature properties) in complex space forms. There is a special overall bibliograpy added at the end. The book brings a comprehensive survey of the field. (vs)

M.Cabanes (Ed.): Finite Reductive Groups: Related Structures and Representations. Proceedings of an International Conference held in Luminy, France, Progress in Mathematics, vol.141, Birkhäuser, Boston, 1997, xii+452 pp., DM 168.00, ISBN 3-764-33885-7, ISBN 0-817-63885-7

This volume is an outgrowth of talks and conversations at a conference on reductive groups held at Luminy in France, 1994. After a short introduction by Paul Fong, follow papers on linear representations of finite reductive groups (authors Aubert, Curtis and Shoji, Lehrer, Shoji) and their modular aspects (authors Cabanes and Enguehard, Geck and Hiss). Papers on Hecke algebras associated with Coxeter groups (authors Ariki, Geck and Rouquier, Pfeifer), complex reflection groups (authors Broué and Michel, Malle), quantum groups and Hall algebras (author Green), arithmetic groups (Vignéras), Lie groups (Cohen and Tiep), symmetric groups (Bessenrodt and Olsson) and general finite groups (written by Puig) reflect numerous connections of the theory of reductive groups to other parts of algebra. (jtu)

K.L.Chung: Green, Brown and Probability, World Scientific, Singapore, 1996, xii+106 pp., GBP 7.00, ISBN 9-810-22453-2, ISBN 9-810-22533-4

This is a small and pleasant book on some relations between Probability Theory (namely the theory of Brownian motion) and Potential Theory (study of Green functions, capacity etc). The concept of the Brownian motion and the study of its properties like the first and last exit times (assuming suitable regularity properties of the corresponding volumes) make the core of this book. The intuitive physical ideas which played an important role in the development of the subject are also discussed. Some historical remarks are added (including reprints of front pages of 6 selected historical papers related to the subject) as well as some personal reminiscences of the author on many influential mathematicians and physicists mentioned in the book. In comparison to the huge number of already existing books devoted to the subject, this introductory and concise text (106 pages) surely deserves a special attention both for novices and experts in the field for the clarity of its presentation and a carefully selected small number of important topics treated in the book. (mzah)

E.Packel, S.Wagon: Animating Calculus. Mathematica Notebooks for the Laboratory, Springer-Verlag, Berlin, 1997, xiv+292 pp., DM 54.00, ISBN 0-387-94748-5

This book is a collection of 22 labs which try to help students to understand and apply the ideas of calculus. The computer algebra system Mathematica is used for this purpose. This book covers standard calculus topics (for example derivatives, integrals, differential equations etc.). We can also find there some extensions and applications of calculus (population dynamics, rolling wheels etc.). Each module is accompanied with an overview, in which prerequisites for the module are presented. The main part of modules consists of exercises, in which fundamental ideas and applications are emphasized. The instructions for teachers and students, how to use this book effectively, trouble-shooting appendix, a list of Mathematica commands for calculus and index are included. Animating Calculus can be used for self-study or as a laboratory supplement. The book is recommended to everybody. (ml)

B.Bergersen, M.Plischke: Equilibrium Statistical Physics. 2nd Edition, World Scientific, Singapore, 1995, xv+520 pp., GBP 32.00, ISBN 9-810-21641-6, ISBN 9-810-21642-4

This is a book on classical and contemporary statistical mechanics. Numerous new achievements of the last decades are reflected in the book, especially those based on the use of the renormalization group techniques. The book starts with a quick overview of thermodynamics and with an introduction to stan-

dard statistical ensembles. Then, the mean field and Landau theory, the theory of dense gases and liquids (virial expansion, BBGKY hierarchy, etc.) are exposed. Two chapters are devoted to the study of critical phenomena starting with the Onsager solution and then continuing by the application of the block spin techniques and the renormalization group method. Chapters on simulations, polymers and membranes, and quantum fluids then follow. The linear response theory (mean field theory, Kubo formula, Onsager coefficients, Boltzmann equations) is also treated. The book is concluded by a chapter on disordered systems and an appendix on occupational number representation (Fock representation). Thus, the book covers a wide range of subjects important in the modern statistical physics. In addition it contains many excersises of different range of difficulty. However, from the point of view of a mathematician the focus of the book is rather one sided. The large body of mathematical statistical physics emerging in the last 20-30 years is still mainly ignored in the book and some of its important methods (and related authors) are hardly (if at all) mentioned. Partially this can be explained by an attempt to make the text accessible also to undergraduate students. However, some of the well established methods of the mathematical statistical physics like the Peierls method of contours (and the proof of the existence of low temperature ferromagnetism in Ising type models) surely deserve a more appropriate presentation in a book of a comparable scope. For example, a fully rigorous treatment of the simplest form of the (so called) Peierls argument hardly requires more space than the intuitive and incomplete discussion given on pages 68–69. Though generally well written and attractive to read, there are passages of the book which are slightly confusing from a mathematical point of view. This remark concerns also some parts of the text which are elementary in principle, like the discussion of the maximum entropy principle (on finite sets) given on pages 49 – 50. Nevertheless, even for the mathematically inclined reader this book can be very useful as a source of a complementary information and physical insight usually not to be found in the books on mathematical statistical mechanics. (mzah)

S.Wolfram: Mathematica 3.0 Standard Add-on Packages: The official guide to over a thousand additional functions for use with Mathematica 3.0, Wolfram Research, Cambridge University Press, Cambridge, 1996, 516 pp., GBP 19.95, ISBN 0-521-58585-6, ISBN 0-521-58586-4

This book comes with the Mathematica 3.0 professional and educational version but not with the student's version. It may be ordered separately, however. The book serves as a user's guide to many useful and sophisticated routines which are not included in the Mathematica Kernel. It is an extended edition of the previous "Standard Add-on packages" for 3.0* version users. The changes in the reviewed edition are marked by " " and the novelties by "+", which enables the reader a better orientation in the text. The chapters of the book coincide with the corresponding packages; in the following list of chapters only parts of particular interest and newly added routines (marked by "+") are mentioned: Introduction; Algebra (+AlgebraicInequalities, +FiniteFields, +InequalitySolve, +PolynomialExtendedGCD, +Quaternions, +RootIsolation, +SymmetricPolynomials); Calculus (+DSolveIntegrals (a complete integral of a partial differential equation)); Discrete Mathematics (partitions, compositions, subsets, representing and generating graphs, computational geometry, difference equations, +ZTransform); Geometry; Graphics, Linear Algebra, Miscellaneous, Number Theory (+PrimitiveElement, +SiegelTheta); Numerical Mathematics (+Horner, +IntervalRoots, +NResidue, +NSeries, +NewtonCotes, +TrigFit); Statistics (+DataSmoothing, +MultiDescriptiveStatistics, +MultinormalDistribution). Appendix provides the reader with the important topics like how the packages are set up, the contexts, and loading. Despite the full documentation is available on the hard disk (if the user selects option "include documentation" during the setup of the program), it is convenient to have the description of the add-on functions in the paper form as a handy reference. (jh)

Y.Miyaoka, T.Peternell: Geometry of Higher Dimensional Algebraic Varieties, DMV Seminar, vol.26, Birkhäuser, Basel, 1997, vi+217 pp., DM 44.00, ISBN 0-817-65490-9, ISBN 3-764-35490-9

Both parts of the book consist of extended lecture notes coming from lecture series on higher dimensional algebraic varieties in Oberwolfach three years ago. The first part (written by Y.Miyaoka) describes the deformation theory, the theory of rational curves and questions related to classification of higher dimensional varieties over complex numbers. The methods used here are coming from geometry in characteristic p. Examples and exercises included in the text are quite helpful. The second part (by T.Peternell) starts with a short review of the Kodaira classification of smooth projective surfaces. It indicates a minimal model strategy for a description of higher dimensional varieties which is discussed in the lectures. The both parts complement each other well and form a nice overview of this modern and interesting topic. (vs)

T.Banakh, T.Radul, M.Zarichnyi: Absorbing Sets in Infinite-Dimensional Manifolds, Mathematical Studies. Monograph Series, vol.1, VNTL Publishers, Lvov, 1996, 232 pp., ISBN 5-777-30061-

8

The central objects studied in this book are the absorbing separable metric spaces. The notion goes back to Anderson's capsets, Bsessaga and Pelczynski's skeletoids, and West's absorbing sets. Every absorbing space is absolute neighbourhood retract. Absorbing spaces are important tools in the examination of topological equivalence of, in general non-complete, subspaces of infinite-dimensional manifolds. First three chapters are devoted to the theory of absorbing spaces. The last two chapters present some significant applications of the theory. Chapter II provides us with several constructions of absorbing spaces based on the sufficient condition in terms of a $\overline{C}$-universal $\overline{C}_\sigma$ space for special, $[0,1]$-stable and closed hereditary, classes $\overline{C}$ (here $\overline{C}$ is a class of spaces in a separable metric space). The $\overline{C}$'s studied are the Borel classes or the projective classes. Moreover, subclasses with restrictions on the (infinite) dimension are also investigated. For some of them, on the contrary, the non-existence of a $\overline{C}$-absorbing space is stated. Chapter III is devoted to the study of relations of universality for spaces and pairs of spaces. The applications are split to those which describe absorbing spaces that arise as products, as hyperspaces, or that admit a compatible group structure, and to those which deal with convex absolute retracts in linear metric spaces. The book sums up a good deal of recent results of the chosen part of the infinite-dimensional topology. The authors point out the absolute notion of absorbing spaces rather than the relative notion of absorbing subsets of manifolds. Many of the results mentioned are due to the authors. For a better understanding, the reader should be aquainted with some related results and methods of infinite-dimensional topology. In places the book is very compedious. The short introduction to each chapter and comments at the end of each one, together with a short but sufficient index, enable a simple orientation, although it is not easy to explain briefly a theory that needs quite a number of special notions. Some problems may be unfortunately caused by misprints which in several cases complicate searching for references and even may complicate the understanding of statements and their proofs. For example, this could be the case in Theorems 2.4.10 and 2.6.3. (ph)

D.Schwalbe, S.Wagon: VisualDSolve. Visualizing Differential Equations with Mathematica, The Electronic Library of Science, Springer-Verlag, New York, 1997, xiv+271 pp., DM 54.00, ISBN 0-387-94721-3

This is another attempt to visualize some parts of calculus with the help of a computer algebra system - in this case system Mathematica. VisualDSolve is a package that provides a lot of tools for the visualization of solutions to differential equations. Of course, the package is accompanied by a book. The book is divided into two parts. The first one is devoted to introduction how to use the package. It contains an explanation of functions and options that are included in the package. The second part of the book tries to illustrate the using of the package for better understanding of solutions to differential equations. The first two chapters of the second part of the book can be used in labs - they contain a collection of exercises. The aim of these two chapters is to help students to be familiar with the basics of Mathematica and VisualDSolve. The other chapters present various aspects of modeling. The authors emphasize numerical computation of solutions and examination of models. VisualDSolve can be used as a supplement in the course in differential equations and modeling course. Therefore it is recommended to all teachers of these courses. (ml)

R.J.Nowakowski (Ed.): Games of No Chance: Combinatorial Games at MSRI, 1994, Mathematical Sciences Research Institute Publications, vol.29, Cambridge University Press, Cambridge, 1996, xii+537 pp., GBP 40.00, ISBN 0-521-57411-0

Combinatorial games are finite, two person, full information games such as chess, checkers, go, and many others. This remarkable volume, which arose from a workshop held at MSRI in July 1994, represents a significant addition to already quite impressive literature on combinatorial games. It includes expository articles by some of masters of the field (including J.H.Conway, R.K.Guy and E.Berlekamp), studies of the classical games of chess and go from the point of view of combinatorial number theory, reports on computer advances such as the solution of nine-men morris and pentominoes, and new theoretical approaches, including extensions of the traditional framework to games with many players, or lacking the perfect information, or involving loops. This is a colorful area and even the chapters headlines read like fairy tail: All Games Bright and Beautiful (including an article by A. Fraenkel: Scenic Trails Ascending from Sea-Level Nim to Alpine Chess); Strides on Classical Ground; Taming the Menagerie; New Theoretical Vistas (inculding E.Berlekamp's substantial article: The Economist's View of Combinatorial Games) and Coda (including R.K.Guy: Unsolved Problems in Combinatorial Games and A.Fraenkel: Combinatorial Games: Selected Bibliography with a Succinct Gourmet Introduction). A thoroughly edited volume, Combinatorial Game Theory at its best. (jneš)

D.Redfern, E.Chandler: The Maple O.D.E. Lab Book, Springer-Verlag, New York, 1996, ix+160 pp., 50 fig., DM 44.00, ISBN 0-387-94733-7

This book is another member of a family of books which use a computer algebra system - Maple - to achieve a better understanding of one of the most important part of mathematical analysis, ordinary differential equations. Students can learn from this book how to model, solve, explore and visualize these equations with help of Maple. The use of the book does not require readers to be familiar with Maple. To help Maple beginners, the first chapter is devoted to an introduction to this computer algebra system. The other chapters have the same structure - at the beginning a list of Maple commands, which are used in the chapter, then explanation, and a set of exercises at the end. Maple worksheets containing answers to all exercises can be found on the diskette which is included. The book can be a very good supplement to any textbook describing ordinary differential equations. (ml)

R.Lidl, H.Niederreiter: Finite Fields, Encyclopedia of Mathematics and its Applications, vol.20, Cambridge University Press, Cambridge, 1997, xiv+755 pp., GBP 60.00, ISBN 0-521-39231-4

An excellent and (almost) self-contained book that seems to be the first one devoted completely to the theory of finite fields – a branch of (rather modern) algebra which is becoming increasingly better known because of its various applications (e.g. in coding theory). The book fully covers the necessary algebraic backgrounds, the general structure theory of finite field and the theory of polynomials and factorisation algorithms for polynomials over finite fields. Besides, many links between number theory and finite fields are treated, using elementary methods only, and, of course, diverse applications are described. The notes at the end of each chapter contain historical remarks, useful comments, references and exercises. The bibliography at the end of the monograph is comprehensive. (tk)