



European Mathematical Society

NEWSLETTER No. 22

December 1996

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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

SECOND EUROPEAN CONGRESS OF MATHEMATICS

Opening Speech

Budapest, July 22, 1996

Monsieur le Maire de Budapest,
Monsieur le Secrétaire d'Etat l'Education,
Monsieur le Représentant de la Commission Européenne en Hongrie,
Messieurs les Présidents,
Mesdames et Messieurs,
Chères et chers collègues,

Au nom de la Société Mathématique Européenne, je viens vous remercier d'honorer de votre présence la cérémonie d'ouverture du Deuxième Congrès Européen de Mathématiques ici Budapest, dans un pays de grande tradition mathématique.

Notre hôte est la Société Mathématique Janos Bolyai. Nous remercions ses membres pour leur confiance dans la S.M.E. en mettant sur pied ce congrès et pour tout le travail qu'ils y ont investi.

The Bolyai Society is named after one of the founders, some 175 years ago, of a completely new geometry. In his own words (which remarkably encapsulate the power of Mathematics), Janos Bolyai "created a universe out of nothing". Besides the new mathematical fields that were opened on this occasion, was then created a possible model which has now become a standard tool for statistical physicists in their study of disordered media. This model is also relevant for the architecture of computers of the latest generation. This illustrates the versatility of mathematical concepts, and the long-range value of investments in this field.

Mathematics is diverse as Europe is. It struggles and sometimes achieves its unity, as I wish Europe will do it. This quest and this achievement, you will have plenty of opportunities of seeing it at work during this week because the international Scientific Committee of this congress, chaired by Professor Jürgen Moser, which selected the speakers, chose the "Unity of Mathematics" as theme of the Congress.

Nowadays, Mathematics has become a key for the harmonious development of modern societies for at least three independent reasons :

- (1) mathematical concepts lie at the heart of many different techniques, those on which high technology is based, such as numerical windtunnels (whose use is now widely spread in the aeronautics industry), scanners in use in medical imaging, telecommunications codes (on which the quality and security of data transmission rely), more generally models, either deterministic or stochastic, used in economy, in banks and insurance companies, but also in meteorology, epidemiology and in environment sciences, to name a few ;
- (2) Mathematics is now present in our daily life, besides our regular use of many technical devices, by the constant reference made to statistics and to polls. Democracy requires that citizens be properly trained to detect inadequate uses of such data. We, if we believe in democracy, must make sure that citizens are indeed comfortable with mathematics. In our fast evolving world in which decentralized centres of decision are a must, the comfort with mathematics becomes a necessity.
- (3) finally, and this third reason is particularly dear to my heart, Mathematics remains, as it has been throughout History, a privileged path to critical reasoning, in school and more generally in cultural circles. To learn how to think independently is both a shield against authoritarian ruling and a passport for innovation.

You will therefore understand that I feel of my responsibility

- to call the attention of people in charge of running the society to conditions necessary to meet these challenges : positions for mathematicians (they can be teachers, engineers, technicians or researchers) belong to strategic resources ; means to develop research and innovation, and to make contacts between industry and the academic world fruitful belong to investments with the highest returns. Failing to recognize this may prove an expensive mistake some years later ;

- to make an appeal to my fellow mathematicians for being receptive to calls from society for training (at all levels, keeping in mind that students have to become ambassadors of our discipline no matter what their future professions are going to be), for innovation (this requires curiosity for applications), and for what may prove the decisive point, the cultural dimension of our discipline.

Mathematicians are here at home in one of the cities lying in the heart of historical Europe, in this finishing century which has witnessed so many dramatic changes. Mathematics is indeed one of the major construction sites for tomorrow's world. All of us have to be convinced of this. We all have our share of work in this endeavour.

I thank you for your attention.

Jean-Pierre Bourguignon, President of the European Mathematical Society

REPORT ON THE SECOND EUROPEAN CONGRESS OF MATHEMATICS BUDAPEST : JULY 22 - 26 1996

The Second European Congress of Mathematics organised by the Hungarian Mathematical Society Janos Bolyai on the initiative of the European Mathematical Society, was held in Budapest (Hungary) from the 22nd to the 26th of July 1996 .

The purpose of this event, which takes place every fourth year, is threefold:

- (1) to present the main and most recent results in pure and applied mathematics
- (2) to provide a forum for discussion of the relationship between mathematics and society in Europe
- (3) to enhance cooperation among mathematicians from all European countries.

On the occasion of each congress, the European Mathematical Society awards prizes to ten talented young European mathematicians.

The programme of this year's congress consisted of a conventional part with 10 plenary lectures and 45 parallel lectures but also included the *Round Tables*, seven of them, which allowed the participants to discuss the relationship between mathematics and society.

An exhibition of scientific books, electronic material and software as well as a festival of scientific films was available for participants.

Owing to the large number of foreign mathematicians present, the Second European Mathematical Congress provided the perfect opportunity to set up a series of satellite conferences in Hungary and adjacent countries.

Finally, a Junior Mathematical Congress attended by college and university students was held in Miskolc (Hungary) from July 29th to August 2nd.

I - PROGRAMME OF THE SECOND EUROPEAN CONGRESS OF MATHEMATICS

1. Opening ceremony

The opening ceremony was held at the Convention Centre of Budapest on July 22, at 10 a.m in the presence of the following :

- Mayor of the city of Budapest, Mr. Gábor Demsky
- Hungarian Vice-Minister of Education, Mr. Zoltán Szabó
- Delegate of the European Union in Hungary, Mr. Hans Beck
- President of the E.M.S., Professor Jean Pierre Bourguignon
- Representative of the Academy of Sciences of Hungary, M. Ákos Császár
- President of the János Bolyai Society, Professor Revesz
- Manager of Motorola in Hungary, Mr. Thomas Szekely
- General Secretary of the János Bolyai Society, Professor Gyula Katona ;
- A Vice-President of the European Mathematical Society, Professor László Marki ;
- President of the Prize Committee, Professor László Lovasz.

2. Plenary Lectures

Ten plenary lectures of about 50 minutes were given by scientists chosen by the scientific committee chaired by J. Moser (ETH Zurich).

July 22nd 1996 J.P. Serre (Paris), D. Mc Duff.(Stony Brook), N. Alon (Tel Aviv), G. Ben Arous (Paris)

July 24th 1996 J. Kollár (Salt Lake City), J. Laskar (Paris), A.S. Merkurjev (Moscow)

July 26th 1996 B. Dubrovin (Trieste), S. Müller (Fribourg), V. Milman (Tel Aviv)

3. Parallel Lectures

Forty-five parallel lectures of about 50 minutes were given.

4. Round tables

Seven round tables were organized for exchange and debate. Themes were the following :

July 23rd 1996

- (1) Communication in mathematics,
- (2) Women and mathematics,
- (3) Mathematics and Eastern Europe.

July 24th 1996

- (1) The public image of mathematics,
- (2) Mathematics education.

July 25th 1996

- (1) Mathematical games,
- (2) Demography of mathematicians.

5. Scientific films and music

Scientific films were shown to participants and several folkloric and classical music concerts were organized during the week.

The film "N is a Number - A portrait of Paul Erdős" was on screen at the Convention Centre the last day of the Congress.

This documentary made by George Paul Csiscery gives a portrait of the eminent Hungarian mathematician, Professor Paul Erdős, who chose to live his life without a permanent home or work position.

Mr. Paul Erdős died September 20th 1996 while attending a conference in Warsaw.

6. Exhibition

Several publishers and book distributors exhibited scientific books, reviews, software and electronic material in the Technical University of Budapest.

II - PRIZES OF THE EUROPEAN MATHEMATICAL SOCIETY

During the opening ceremony of the Congress, the European Mathematical Society awarded prizes to ten young European mathematicians to reward their talent, to acknowledge the outstanding work they have accomplished and to encourage them in their current research.

1. Criteria for the awards

- (1) At most 10 prizes are allocated to European mathematicians under 32 years old : exceptionally, under special conditions, the age limit may be extended to 34 years old.
- (2) Names of potential recipients may be submitted to the jury by external persons or by the jury.
- (3) The Jury, or Prize Committee, is appointed by the E.M.S. Executive Committee and is sovereign in the designation of recipients. However, the jury must look for applicants in every mathematical field and in all countries .

2. Members of the Prize Committee (Jury)

- L. Lovasz, President : Yale University, New Haven, USA
- E. Bayer-Fluckiger : CNRS Besançon, France
- Z. Ciesielski : Academy of Sciences, Sopot, Poland
- F. Götze : University of Bielefeld, Germany
- J. Lindenstrauss : Hebrew University of Jerusalem, Israel
- Y. Manin : Max-Planck-Institut, Bonn, Germany
- Y. Meyer : ENS Cachan, France
- M.J.D. Powell : Cambridge University, United Kingdom
- G. Segal : Cambridge University, United Kingdom
- R. Tijdeman : Leiden University, Netherlands
- J. Tits : Collège de France, Paris, France

3. Recipients of the 1996 E.M.S. Prizes

- (1) Alexis Bonnet (France) : applied analysis
- (2) William T. Gowers (UK) : geometry of Banach spaces
- (3) Annette Huber (Germany) : algebraic geometry, category theory
- (4) Aise J. de Jong (Netherlands) : arithmetic algebraic geometry
- (5) Dmitri Kramkov (Russia) : statistics and financial mathematics
- (6) Jiri Matousek (Czech Rep.) : algorithmic geometry, functional analysis
- (7) Loic Merel (France) : number theory
- (8) Grigory Perelman (Russia) : Riemannian geometry. *Declined the Prize*
- (9) Ricardo Perez-Marco (Spain) : dynamical systems
- (10) Leonid Polterovitch (Israel) : symplectic geometry

PRIZE WINNERS

2nd European Congress of Mathematics

Alexis Bonnet works on a broad spectrum of problems in applied analysis. His results on the Mumford-Shah conjecture in the theory of computer vision were a breakthrough. This conjecture deals with a variational problem with a singular boundary set and proposes a finite representation of the optimum solution. Bonnet obtained the first finiteness result under additional assumptions, which is a major step in understanding this difficult free-boundary-value problem. In a different direction, his results on partial differential equations, in particular on flame propagation and combustion, are very significant.

William Timothy Gowers' work has made the geometry of Banach spaces look completely different. To mention some of his spectacular results: he solved the notorious Banach hyperplane problem - to find a Banach space which is not isomorphic to any of its hyperplanes; he gave a counterexample to the Schroeder-Bernstein theorem for Banach spaces; he proved a deep dichotomy principle for Banach spaces which, if combined with a result of Komorowski and Tomczak-Jaegermann, shows that if all closed infinite-dimensional subspaces of a Banach space are isomorphic to the space, then it is a Hilbert space. He gave (jointly with Maurey) an example of a Banach space such that every bounded operator from the space to itself is a Fredholm operator. His work in Mathematics is both very original and technically very strong. The techniques he uses are highly individual; in particular, he makes very clever use of infinite Ramsey theory.

Annette Huber developed the difficult and important theory of the derived category of mixed motivic realisations. The theory of motives was discovered by Alexander Grothendieck in the 60's. This important topic is still largely conjectural. The definition of mixed motives is one of the central problems of this theory. Annette Huber defines a derived category of the category of mixed realisations defined by Jannsen. She constructs a functor from the category of simplicial varieties to this derived category, whose cohomology objects are precisely the mixed realisations of the variety. She then defines an absolute cohomology theory, over which the usual absolute theories - absolute Hodge-Deligne and continuous étale cohomology - naturally factorise.

Aise Johan de Jong has produced a large variety of deep results on various aspects of arithmetic algebraic geometry. His personal influence on the work in the field is impressive. His work is characterised by a truly geometric approach and an abundance of new ideas. Amongst others, his results include the resolution of a conjecture of Veys and the answer to a long-standing question of Mumford on moduli spaces. Resolution of singularities by modification is difficult and unknown in most cases; in recent outstanding work, de Jong found an elegant method for the resolution of singularities by alterations, which is a slightly weaker question but sufficient for most applications. This basic method combines geometric insight and technical knowledge.

Dmitri Kramkov has developed important results in statistics and the mathematics of finance. He did fundamental work in filtered statistical experiments. In particular, he obtained a deep result on the structure of Le Cam's distance between two filtered statistical experiments, and proved very general theorems about the structure of the limit experiments which cover many results in the asymptotic mathematical statistics of stochastic processes. Recently he proved a remarkable "Optional decomposition of supermartingales" which is an extension of the fundamental Doob-Meyer decomposition for the case of many probability measures. This unexpected result is rather difficult and refined technically but conceptually of deep importance. In the direction of mathematical finance, Kramkov obtained impressive results on pricing formulae for certain classes of "exotic" options based on geometric Brownian motion. He succeeded in computing explicit solutions for "Asian options" where the pay-off is given by a time-average of geometric Brownian motion.

Jiri Matousek's achievements have combinatorial and geometric flavour; his research is characterised by its breadth, by its algorithmic motivation, as well as the difficulty of the problems he attacks. He gave constructions of epsilon-nets in computational geometry, which provide tools for derandomisation of geometric algorithms. He obtained the best results on several key problems in computational and combinatorial geometry and optimisation, such as linear programming algorithms and range searching. He solved several long-standing problems (going back to the work of K.F.Roth) in geometric discrepancy theory, in particular on the discrepancy of halfplanes and of arithmetical progressions. He solved a problem by Johnson and Lindenstrauss on embeddings of finite metric spaces into Banach spaces. He also obtained sharp results on almost isometric embeddings of finite dimensional Banach spaces using uniform distributions of points on spheres. In mathematical logic, he found a striking example of a combinatorial unprovable statement.

Loic Merel proved an absolute bound for the torsion of elliptic curves. Thereby he gave a solution to a long-standing problem, open for more than 30 years, that has resisted the efforts of the greatest specialists in elliptic curve theory.

The group of torsion points of an elliptic curve over a number field is finite. Merel found a bound of the order of this group in terms of the degree of the number field; such a bound was known in a very few cases only (the case of the rational numbers (Mazur 1976), number fields of degree less than 8 (Kamienny–Mazur 1992), and number fields of degree less than 14 (Abramovitch 1993).

Grigory Perelman's work played a major role in the development of the theory of Alexandrov spaces of curvature bounded from below, giving new insight into the extent to which the results of Riemannian geometry rely on the smoothness of the structure. Now, mainly due to Perelman, the theory is far more complete. His results include a structure theory of these spaces, a stability theorem (new even for Riemannian manifolds), and a synthetic geometry à la Aleksandrov. He proved a conjecture of Gromov concerning an estimation of the product of weights, and the Cheeger-Gromov conjecture. This last problem attracted the attention and efforts of many geometers for more than 20 years, and the method developed by Perelman yielded an astonishingly short solution.

Ricardo Perez-Marco solved several outstanding problems, and obtained basic results, in the theory of dynamics of non-linearisable germs and non-linearisable analytic diffeomorphisms of the circle and, in the theory of centralisers, a natural complement of non-linearisability. He discovered a new arithmetic condition under which a germ without periodic orbits is linearisable. He gave a negative answer to a question of Arnold on the linearisability of analytic diffeomorphisms of the circle without accumulating periodic orbits. Perez-Marco developed a theory of analytic non-linearisable germs based on an important and useful compact invariant.

Leonid Polterovich contributed in a most important way to several domains of geometry and dynamical systems, in particular to symplectic geometry. Polterovich ties together complex analytic and dynamical ideas in a unique way, leading to significant progress in both directions. In particular, he brings complex analysis into the realm of Hamiltonian mechanics, which constitutes a new major step in this classical field. Among others, he established (with Bialy) an anti-KAM estimate in terms of the Hofer displacement of a Hamiltonian flow. Polterovich found the first non-trivial restriction on the Maslov class of an embedded Lagrangian torus and, with Eliashberg, completely solved the knot problem in real 4-space.

4. Delivery of the 1996 E.M.S. Prizes

Each of the Prize winners received a bilingual certificate (English and the recipient mother-tongue) and a sum of money in the presence of the mayor of the city of Budapest, the Hungarian vice-minister of Education, the president of E.M.S., the manager of Motorola Hungary and the chairman of the Jury. The money was provided by the City of Budapest, the Hungarian Ministry of Education and the telecommunications company Motorola.

III- GENERAL INFORMATION ABOUT THE CONGRESS

1. Scientific Committee

- J. Moser, President : ETH, Zurich, Switzerland
- E. Bayer-Fluckiger : CNRS, Besançon, France
- L. Babai : Eötvös Lorand University, Budapest, Hungary
- L. Carleson : Royal Institute of Technology, Stocholm, Sweden
- C. de Concini : Scuola Normale Superiore, Pisa, Italy
- S.K. Donaldson : University of Oxford, United Kingdom
- B. Engquist : Royal Institute of Technology, Stocholm, Sweden
- S. Hildebrandt : Bonn University, Germany
- S. Novikov : Landau Institute of Theoretical Physics, Moscow, Russia
- E. Pardoux : Université de Provence, Marseille, France
- A. Schinzel : PAN Mathematical Institute, Warsaw, Poland
- D. Szasz : Hungarian Academy of Sciences, Budapest, Hungary

2. Organizing Committee: János Bolyai Mathematical Society (Budapest)

G. Katona (President) ; A. Balog ; C. Kulcsar ; V. Ola ; A. Recski ; M. Revesz.

3. List of Sponsors

The Organising Committee, together with the European Mathematical Society, wish to thank the following institutions and companies for their financial support :

ACEM - Association pour le Congrès Européen de Mathématiques
BKV; Budapest Transport Ltd
City of Budapest

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 Deutsche Mathematiker-Vereinigung
 Edinburgh Mathematical Society
 European Commission
 European Mathematical Society
 Hungarian Academy of Sciences
 IFHERD International Foundation for Hungarian Education, Research and Development
 Inter-Europa Bank Ltd, Budapest
 International Mathematical Union
 London Mathematical Society
 Ministry of Culture and Education, Hungary
 Motorola
 National Committee for Technological Development, Hungary
 Soros Foundation, Hungary
 Technical University of Budapest
 Tungram Co. Ltd
 UNESCO Venice Office (Roste)
 Unione Matematica Italiana
 University of Economic Sciences of Budapest
 Weizmann Institute of Science

4. Location

Convention Centre : opening and closing ceremonies, plenary lectures, film "N is a Number - a portrait of Paul Erdős"

Technical University : parallel lectures, round tables, scientific films, exhibitions.

5. Number of Participants : 724

The number of registered participants is 724 of which 122 were women. However, a great number of Hungarian students attended this congress without being registered.

6. Number of represented countries : 58

<i>Albany</i>	2	<i>Iceland</i>	2	<i>Ouzbekistan</i>	1
<i>Austria</i>	3	<i>India</i>	1	<i>Philippines</i>	1
<i>Azerbaijan</i>	1	<i>Iran</i>	2	<i>Poland</i>	6
<i>Belgium</i>	7	<i>Ireland</i>	4	<i>Portugal</i>	8
<i>Bielorussia</i>	10	<i>Israel</i>	18	<i>Romania</i>	16
<i>Bolivia</i>	1	<i>Italy</i>	40	<i>Russia</i>	88
<i>Bosnia – Herz.</i>	2	<i>Japan</i>	6	<i>Serbia</i>	10
<i>Bulgaria</i>	2	<i>Kazakhstan</i>	3	<i>Singapore</i>	1
<i>Canada</i>	9	<i>Latvia</i>	3	<i>Slovakia</i>	3
<i>China</i>	2	<i>Lithuania</i>	8	<i>SouthAfrica</i>	2
<i>Croatia</i>	3	<i>Luxembourg</i>	2	<i>Spain</i>	23
<i>CzechRep.</i>	7	<i>Macedonia</i>	2	<i>Sweden</i>	7
<i>Denmark</i>	11	<i>Malaysia</i>	1	<i>Switzerland</i>	7
<i>Estonia</i>	9	<i>Malta</i>	2	<i>Turkey</i>	3
<i>Finland</i>	6	<i>Mexico</i>	3	<i>UK</i>	33
<i>France</i>	56	<i>Moldavia</i>	3	<i>Ukraine</i>	60
<i>Georgia</i>	6	<i>Mongolia</i>	1	<i>USA</i>	23
<i>Germany</i>	59	<i>Morocco</i>	2	<i>Vietnam</i>	1
<i>Greece</i>	6	<i>Netherlands</i>	6		
<i>Hungary</i>	109	<i>Norway</i>	11		

JUNIOR MATHEMATICAL CONGRESS - 96 MISKOLC, HUNGARY

29 July to 2 August

An Organiser's Report

Peter Kortesi

The JMC-96, as one of the official satellite meetings of the 2nd European Congress of Mathematics, was aimed at bringing together the future mathematicians of Europe. Apart from attending lectures given by invited scholars and meeting famous European mathematicians, the participants themselves gave talks and exhibited posters. All active participants were given the opportunity to present their results in subject-oriented parallel sessions.

The invited speakers of the congress were : Roland Bulirsch, Miklos Laczkovich, Vilmos Totik, Judita Cofman, Elemer Kiss, Mihaly Hujter, Istvan Lenart, Christian Mauduit, Janos Suranyi, Tibor Nemetz, Lajos Posa, Zsofia RuttKay, Jean-Pierre Bourguignon, Robert Tijdeman, Paul Erdos, Boris Klebanov, George Shabat, Alan Huet, Olivier Gerard, Piroska Csorgo and Peter Michor.

The 345 participants (175 from abroad, coming from 19 different countries) presented 39 titles. The individual 15 minute talks and 30 minute collective presentations involved 65 active participants.

The best papers sent in have been published in three volumes, a special English language edition of the Hungarian mathematical journal KoMaL, a number in the Hungarian language journal Pi edited in Miskolc, and the Abstracts of the congress. The European Mathematical Society has offered special prizes for the authors of these papers and has supported all the expenses of the participation of three talented young people.

The meeting provided an excellent opportunity for the participants to make friends and to visit this part of Hungary as well. A welcome party on Monday, an organ concert on Tuesday, two trips around Miskolc, a disco and a Hungarian folk-dance evening completed the programme.

It is really hard to decide what moment of the congress impressed most. For us, the organisers, the enthusiasm of the participants, students and colleagues was a very pleasant surprise and the memories will be long-lasting. We are grateful to everyone who supported the congress.

SECOND JUNIOR MATHEMATICAL CONGRESS

Miskolc, July 29–August 2, 1996

A Participant's Report

Johanna Michor, aged 16, Austria

'I have created a different, new world from nothing...'

Janos Bolyai

Miskolc is the biggest town in Hungary after Budapest and is situated in nice surroundings at the edge of the Bükk-mountain, whose caves contain some of the oldest relics of prehistoric man.

Three hundred and forty young people, aged 12 to 19, and students from 16 countries met in Miskolc to participate in the 2nd Junior Mathematical Congress, a satellite congress of the 2nd European Congress of Mathematics. The 1st Junior Congress, held in Paris 4 years ago had more participants, but this congress attracted participants from a high number of countries and provided an interesting environment for young people who wanted to develop their knowledge of languages and their multicultural thinking. For many of us it was the first experience of living on a campus and of sitting in a University lecture hall. Maybe it reduced the anxiety of life after high school.

Some participants had prepared lectures. They presented the outcome of their first research, which often impressed me, remembering that these 'scientists' are still attending high school. A group from Erlangen, Germany demonstrated the properties of Fibonacci Numbers and ways to prove them, and how to find new problems and their solutions. Likewise the group 'Math en Jeans' from Paris presented their work about Farey sequences. I only wish that we could also have similar interest groups back in Austria.

The participants communicated with great enthusiasm with their new-found friends and experienced the international character of mathematics. Lectures by famous mathematicians and discussions with them left us feeling connected to the world of mathematical research: we now know about the proof – which took 350 years to complete – of Fermat’s last theorem. Pál Erdős told us numerous anecdotes and offered huge sums in dollars for solving difficult problems, but he seemed to forget that we were just children. One (seemingly older) participant shocked us by opening his lecture with the sentence: ‘Everybody knows about partial differential equations?’

Food and accommodation sometimes led us to (hysterical) peals of laughter, funny stories about the last dinner circulated, ... Social events in the evenings (in particular the Hungarian Folk-dance and farewell party at the Herman Ottó Gimnázium) helped us to appreciate the other participants better. Now we all know, more or less, how to dance Czardas.

I guess that many of the pupils now look forward to attending university and I hope that some of them feel encouraged and confirmed to study mathematics after this congress.

Paul Erdős (1913-1996)

Paul Erdős, one of the most outstanding mathematicians of our century and a close friend of many of us, died in Warsaw, on Friday, September 20, 1996, while visiting a conference in combinatorics and graph theory. He was 83 years old.

“He died in the battlefield”: in Warsaw there was a five-week long Minisemester in Combinatorics. He participated in this series of workshops for two weeks, gave two lectures, the second one on Wednesday, September 18, received a warm ovation, and died on Friday. Two days later he should have left for Vilnius, for a conference in Number Theory.

“To conjecture and prove”

Paul had already had problems with his heart. Not so long ago (during a graph conference in Kalamazoo, Michigan) a pace-maker was implanted into his chest. It is not that surprising when an 83 year old man dies - and yet we are shocked.

Erdős and death: the relation itself is so strange. When he was young he kept joking about it. Recently, I think, he started to feel uneasy about death but (perhaps by inertia) he went on joking about it. “To conjecture and prove” he used to say, “and if you can not do this any more, you should change the pills”. This meant in his strange slang that “old age and stupidity” are sad things, and one terrible thing about old age is that a mathematician cannot continue the most important thing in his life: doing Mathematics.

Some basic facts.

Erdős Pál (or Paul Erdős, in English) was born on March 26, 1913. Both his parents were mathematics teachers. He has received the Cole prize and the Wolf Prize, honorary degrees from 15 universities and was member of 7 Academies. He was co-author of several mathematics books of great impact.

All the obituaries will doubtless say that Erdős published around 1500 mathematical papers collaborating with about 450 co-authors. For me these facts do not really mean that much: there are quite a few giants amongst mathematicians with many dozens of papers. What really matters for me is his unbelievable impact on Mathematics.

Instead of commenting upon the unusually high number of co-authors, I would definitely prefer to emphasise his unbelievable impact on Mathematics all over the world. The way he spoke to young gifted mathematicians was also a characteristic feature of Erdős. He helped young talented mathematicians in various ways.

Erdős was a child prodigy. Yet, I would emphasize here that he became a Grown-Up-Prodigy. Sometimes one says that Hilbert was the last polyhistor in mathematics. The age of those mathematicians who deeply understand and (even more surprisingly) deeply influence several fields in mathematics has gone. Erdős was definitely one of the last of this kind. He (often in joint works with friends, co-authors) opened completely new branches of mathematics, literally becoming the father of many branches of today’s mathematics.

Paul Turán on Paul Erdős

On Erdős’ 50th birthday, Paul Turán, [9] one of his closest friends wrote a survey of Paul’s mathematical achievements. Turán wrote: “his works published so far relate roughly to the following topics: Number Theory, Probability Theory and Ergodic Theory, Graph Theory and asymptotical combinatorics, Constructive theory of functions, Set theory and set-theoretical topology, Theory of series, Theory of analytic functions, Geometry.”

He also wrote:

“... But to write [about Erdős’ work] has been made especially difficult by that reviewing his work and influence is hard to separate from his mathematical personality. This is partially indicated by the fact that he has joint papers with more than 90 coauthors from four continents. ... In a certain sense he is an occidental Ramanujan, with his strength and limits, a singular and unique phenomenon ...”

These lines were written more than 30 years ago. It is interesting to see the change in the number of papers and coauthors. ...

If someone asked me what I think was the most important feature of Paul Erdős’ mathematics, I would find it difficult to answer. I would probably emphasize the unbelievably deep and wide impact, the sometimes even defining, determining role of Paul in various subfields of Number Theory, Graph Theory, Interpolation Theory, Combinatorial Set Theory, Combinatorial Geometry, and yet another dozen subfields of mathematics.

ABOUT HIS MATHEMATICS

It is impossible to describe Paul's mathematics in a few pages: several survey papers appeared on the occasion of his 80th birthday and further ones are planned to be published now. Here I mention only a few, [1], [2], [7], and further, I warmly recommend the paper of Turán [9] and a paper of Erdős himself, [3], or my paper of his extremal graph theory, [8]. One could also learn a lot about his mathematics (primarily, of his combinatorics) from his Selected Writings, [4].

Erdős was a mathematician primarily interested in "concrete problems". He – in my view – never decided to build mathematical theories. Yet he had a strange relation to mathematics, which was formulated by András Hajnal as "Erdős wishes to have a complete list of theorems." First some atypical question occurred in his mind, a conjecture, then he proved it, and then he started varying it, asking more and more new questions, proving more and more theorems. Finally he ended up with a whole new, fascinating mathematical theory.

Number Theory

Erdős was very much interested in the distribution of primes. One of his first results was an elementary and fairly simple proof of Chebyshev's theorem on the existence of a prime between n and $2n$ for all n . As we know, many questions in Number Theory are fairly easy to formulate and extremely difficult to prove. Almost no definitions are needed to explain them and yet one has to study for years to understand the solutions (if they exist at all).

Gauss conjectured that the number of primes in $[2, n]$, denoted by $\pi(x)$, is asymptotically $n/\log n$. This is equivalent to that if p_n is the n th prime, then

$$p_n = n \log n + o(n \log n). \quad (1)$$

The standard proofs of this fact use analytical properties of the Riemann ζ -function defined by

$$\zeta(s) = \sum_{k \geq 1} \frac{1}{k^s}.$$

It had been assumed that no elementary proof of (1) could be given, where elementary means fairly complicated but not using analytical properties of $\zeta(s)$. It was a great surprise and an astonishing breakthrough when Erdős and Selberg (using the Selberg sieve) proved (1) in a completely elementary way.

Erdős was one of those who initiated investigations on the random-like behaviour of number theoretical functions. The conference he would have visited in the last week of September was just on this topic.

Interpolation Theory

The theory of interpolation was also among the favourite topics of Paul. Yet the explanation of his results would go much beyond our scope. These results try to clarify basic problems in the behaviour of Lagrange interpolation with various systems of nodes. Here I would emphasize only his joint paper with Turán [5] and formulate his theorem with Vértesi [6]:

Given any system of nodes in $[0, 1]$, then one can find a continuous function $f \in C[0, 1]$ for which the Lagrange interpolation polynomials diverge almost everywhere.

Random Graphs

I could write a long survey on Paul's (and Rényi's) role in developing Extremal Graph Theory, or theory of evolution of random graphs, but the time and space is limited for this here. So I mention only two results of Erdős. He proved, using random graph methods, that there exist graphs G_n on n vertices containing neither $\lceil 2 \log_2 n \rceil + 1$ vertices forming a complete subgraph nor $\lceil 2 \log_2 n \rceil + 1$ vertices forming an independent set. This was perhaps the first real triumph of the method where random graphs replaced constructions. Using "random graph constructions" he also proved that for any given positive integer ℓ there exist graphs G_n not containing cycles of length shorter than ℓ and having arbitrary high chromatic number.

Probability Theory

People know that Erdős is one of the fathers of using randomized constructions in Combinatorics, that he is one of the creators of the Theory of Random Graphs. Perhaps it is less well-known that he derived many results in probability theory as well. He generalized some results of Khintchin and Kolmogorov, and of Paul Lévy, on the distribution on the number of differences of the numbers of Heads and Tails in a random coin-tossing (iterated logarithm). In some of his papers with Mark Kac he proved some new types of central limit theorems (arcsin law). Their proofs also played an important role in the creation of the “invariance principle” in probability theory. Some of Erdős’ results concern Brownian Motion.

Combinatorial Geometry

One of Erdős’ favourite problems in combinatorial geometry was on the distance distribution: Assume that we have n points, P_1, \dots, P_n , in the plane. Fix a positive number, d , and provide sharp estimates on the number of occurrences of this distance: on the number of $\overline{P_i P_j} = d$. Erdős conjectured that among n points the distance d can occur at most $n^{\alpha(1)}$ times. In case of an appropriately scaled square grid the number of unit distances is $n^{\alpha(1)}$ and the conjecture says that this is the most one can have. Today the best estimate is $n^{4/3}$. The earlier problems are fairly natural for most mathematicians. Not so this last one: it was typical of Erdős to ask questions which surprised the others, seemed to be atypical, slightly awkward but later turned out to be just the right ones. Not too many mathematicians would ask these questions. Erdős had a very original way of posing unsolved problems, conjecturing completely new types of mathematical phenomena.

Combinatorial Set Theory

Assume we have a set S of some given cardinality m . Assume we colour the pairs of S by two colours, say, red and blue. How large a monochromatic complete graph must occur in every such 2-colouring? This is an infinite Ramsey problem, just indicating a large and important field of infinite combinatorics. Such questions were first investigated by Erdős and Rado, and also by Hajnal, and there is an extensive book on the topic, written by Erdős, Hajnal, Máté and Rado. It seems to be strange at the first glance that infinite combinatorial problems are sometimes much easier to solve than the corresponding finite ones. Further, they quite often lead to undecidable problems. Here I should mention that Erdős did not care that much for consistency results: his approach seemed to be as if a geometer knows that the Bolyai–Lobachevski geometry is as consistent as the Euclidean, yet tacitly believes that the Euclidean is the right description of the world.

ERDŐS, THE MAN

Erdős was a very friendly person. When he met somebody he had never seen before he would start asking questions about the other’s field of interest immediately and in a style which suggested that they had been friends for ages.

Erdős was many sided with a wide knowledge of politics, history, medicine and many other things. He liked discussing these topics. He liked Bach and Mozart.

He liked reading books on various topics. Sometimes, entering my room he picked up a book, read a few pages from it, asked if he might borrow the book and then sent back the book by mail from some other part of the world.

You could discuss Japanese literature with him over the dinner table, or the newest medicines appearing on the market. Or one could drive him home and while driving, have a debate about the ancient Greeks. Of course, quite often, out of the blue, he started asking mathematical questions.

His lifestyle changed after his mother died. One could say he became a workoholic. Within half a year he lost several pounds in weight, became thin, fragile, old-looking but not old. But even after this he played table-tennis and liked hiking in the mountains. His style of playing table-tennis was somewhat awkward but very successful. (Probably his eyes were weak but his reflexes were good.) He also was very good at playing chess and Go. He liked playing these games, and also playing cards.

Erdős cared for people. He helped them mathematically, and very often he helped them financially as well. He kept visiting old friends just to “keep them company”.

Here I would provide an example of his humanitarian behaviour: a young Hungarian mathematician who had finished university and had already proved some nice theorems in Number Theory. However, there was no position for him. Erdős suggested to the director of the Mathematical Institute of the Academy that he should employ this young man,

adding that he, Erdős, would pay his salary. Everybody was surprised at this idea and felt somewhat uneasy (all of us were paid by the state), but finally the central office of the Academy decided to grant an extra position to the Mathematical Institute). This young mathematician is today a successful researcher.

In the early hours of the morning, around 4am, September 20, 1996, Paul Erdős phoned the lobby of the hotel and told the receptionist that he had probably had a heart attack. An ambulance took him immediately to the hospital. Around 3pm he had a second, much more serious heart attack and this one killed him. It is a sad fact that we mathematicians only learned about this after his death.

A Giant has left and we will miss him very much.

Miklós Simonovits

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GENERAL ORIENTATIONS AND DECISIONS AFTER THE COUNCIL AND THE EXECUTIVE COMMITTEE MEETINGS

Budapest (Hungary) July, 1996

MESSAGE FROM THE PRESIDENT

The EMS exists through its actions, which should be identified as distinct from those of national societies. Although Europe presents so many various aspects, mathematics are more united than ever.

One of the main activities has been the creation and development of the server EMIS (European Mathematical Information Service), to be seen on the Web at <http://www.emis.de> with 14 other mirrors throughout the world. One of the projects of the Society is the "Diderot Mathematical Forums". The first one has been held on 24–25 September 1996 in Zurich, London and Moscow: the subject was "mathematics and finance" (see the report in the Newsletter).

Actions towards young people are very important: therefore, a programme of Summer Schools has been established. The first one in the series in pure mathematics was held in Hungary in July 1996, the first one in the applied series has been held in Russia in July 1996. The server will include a job bulletin board which should be a great help for young mathematicians.

Publicity for the Society is vital: the Newsletter has been very successful; the brochure has come out and is available for corporate members and congresses; systematic contacts with journalists throughout Europe will be developed.

There is a grim outlook for mathematics in many countries: positions are reduced, short-term policies of governments are contrary to mathematics. The importance of basic research and teaching of mathematics has to be stressed; therefore cooperation with other bodies has to be developed in more depth.

The EMS has three major projects:

◊ *An extension of the Zentralblatt für Mathematik into a European database*

The ZBL is a joint project of the Heidelberg Academy and the Fachinformationszentrum; it is based in Karlsruhe and has an office in Berlin where the entries in the database are produced. Springer-Verlag prints the paper version and distributes the CD-rom version. The scheme would be to transfer the scientific responsibility of the data base to the EMS, and to decentralise production to many countries in Europe. The first step already taken in this direction is the cooperation which has started between the Zentralblatt and the Cellule de Documentation Mathématique based at Institut Fourier (Grenoble), a structure supported by the French Ministry of Education and the CNRS. Having the Zentralblatt für Mathematik recognised by the European Commission as a "large facility" for Mathematics would be a major step in securing a strong foundation for the data base.

◊ *Recognition at the European level*

In the Fourth Framework Programme of the European Union, mathematics are only present in the Training and Mobility for Researchers Programme. The EU Fifth Framework Programme is being discussed at the political level and will start in 1998. It has to be influenced to have mathematics properly recognised. Efforts are made to have a programme on Mathematical Modelling to be taken into consideration. This can be achieved only in cooperation with other societies and research centres, private companies etc., to present some material at the EU level. The structure that is being put into place in this direction should be as informal as possible: the form of a club seems the most appropriate.

◊ *Press Agency*

Efforts are made to create a Mathematical Press Agency. It would collect material from national newsletters and disseminate it both to mathematicians and to major scientific newspapers in Europe.

REPORT OF THE TREASURER

The Treasurer presented the accounts for the years 1994 and 1995, together with the auditors' reports. In 1995 there were 47 corporate members, of which 33 had paid their membership fees, 2 had paid partly and 1 had been granted a waiver by the Executive Committee in accordance with Rule 29. The remaining 11 corporate members had not paid or asked for waiving the fee. In particular, the Yugoslavian and Spanish Societies had never paid their membership fees.

After presenting the budget for the years 1997 and 1998, the Treasurer noted that, because the income consists only on the membership fees, all new projects need separate funding. During the subsequent discussion the Council recommended that a separate body should be created in order to find new sources of funds for the Society.

Individual membership has remained at 1600, this figure is too low and quite disappointing. The following questions were raised: how can the member societies make it easier for individuals to join? Can the Society do anything to make the individual membership fee affordable to persons from countries with low income? The Zentralblatt has offered to collect part of the reviewing fees as fees for EMS if the reviewer so wishes. The delegates suggested that one should be able to download from the server the application form. Collecting fees by credit card should be considered,

as the cost is not very high. The possibility of mailing the Newsletter to all mathematics departments in Europe should be taken into consideration (with or without subscription price).

The Council agreed that the subscription unit fee x should be 315 Ecus and that the subscription unit fee y should be 15 Ecus for 1997 and 1998.

PUBLICATIONS

JEMS (Journal of the European Mathematical Society)

The journal of the Society, JEMS, published by Springer-Verlag, will have a paper version, then will be available after two or three years in electronic form, free. J. Jost has been appointed as the Editor-in-Chief; in addition, there will be four or five main editors and a larger editorial board. The journal is to be of a general nature.

Multilingual Newsletter

Following discussions with DMV and SMF, a version for the suggested multilingual Newsletter is contemplated. The Newsletter should contain articles from Newsletters of national societies when they are of wide interest and they could be published in the national language as well as an English translation. A pilot issue could be prepared with DMV, SMF and EMS, after consultations with the other EMS member societies. As to the distribution, the member societies would be asked, if they are willing, to share the printing and mailing costs. It was also suggested to make the pilot Newsletter as a special issue of the EMS Newsletter.

ECM (European Congress of Mathematics)

ECM3 in 2000

Four sites had applied: Barcelona, Copenhagen, Sussex and Torino. The Executive Committee had put in place a very thorough process to prepare the decision on the site, with site visits by a subcommittee. The Executive Committee acknowledged that all four candidate sites were able to provide adequate facilities and proposed Sussex as the site of ECM3. After discussion, the Council selected Barcelona as the site for the Congress in the year 2000.

ECM4 in 2004

The timetable for the Congress 2004 selection was agreed. The bids should reach the Secretariat by December 31, 1998.

CORPORATE MEMBERS

The Mathematical Society of Latvia and the Ural Mathematical Society were accepted as corporate members in Class 1. The Institute of Mathematics of the Academy of Sciences of Moldova and the Institut Non-Linéaire de Nice were accepted as institutional members.

The Council decided to terminate the membership of the Union of Societies of Mathematicians, Physicists and Astronomers of Yugoslavia on the basis on non-payment of fees. The Council decided that the Mathematical Society of Spain is not a member of the European Mathematical Society because it had never paid the fees, had never been present at meetings and never officially announced that it had accepted the membership of EMS.

ELECTIONS TO EXECUTIVE COMMITTEE

There were vacancies on the Executive Committee for the period 1997-2000 for one seat of Vice-President and four seats for ordinary members, to replace L. Márki, E. Bayer-Fluckiger, I. Labouriau, A. Pelczar and V.A. Solonnikov. Of these, E. Bayer-Fluckiger and L. Márki were not eligible for re-election.

Bodil Branner, Rolf Jeltsch, Marta Sanz-Sole, Andrzej Pelczar (Vice-President) and Anatoly Vershik were duly declared elected to the Executive Committee for the period 1997-2000.

Mireille Chaleyat-Maurel

PREPARATION OF THE FIFTH FRAMEWORK PROGRAMME FOR RESEARCH AND DEVELOPMENT

The programmes of the European Union supporting research are established every fourth year as result of a sophisticated exercise involving all components of the European Union and whose preparation extends over a 3-year period.

The Fifth Framework Programme for Research and Development is presently being prepared and will start in 1999. All bodies playing a role in European science policy have already expressed their views on how the present Fourth Framework Programme is running and on possible guidelines for the new programme. Some of them are connected with the Commission (e.g., the Commission itself, but also the European Science and Technology Assembly, ESTA, and the Industrial Research and Development Advisory Committee, IRDAC), others are independent from it, such as the European Science Foundation (which is based in Strasbourg and also involves countries outside the European Union such as Hungary) and of course the Ministries in charge of research in each of the EU countries.

The least to say is that the perspectives which have been drawn so far are not especially encouraging from the point of view of mathematicians. Indeed a strong emphasis has been put on short-term returns for the future programmes, and on the need to increase the role of industrial partners in the fine-tuning of ALL programmes.

Luc Lemaire, as EMS Liaison Officer with the European Union, has prepared a draft document that has been discussed at the Executive Meeting held in October in Cambridge. A position paper by the European Mathematical Society, now available on the EMIS server, has resulted from these discussions. Hereafter, you will find the table of contents and the executive summary of this document.

Table of contents

1. Research in European society : General Arguments
 - 1.1 Fundamental Research and Targeted Research
 - 1.1a) Training and Research
 - 1.1b) How to get competitive
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 - 1.2 Applied Research and Industrial Research
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2. Analysis of the Third and Fourth Framework Programmes
 - 2.1 The Human Capital and Mobility and the Training and Mobility for Researchers Programmes
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3. The Role of Mathematicians Today and Tomorrow
 - 3.1 Characteristic features of Mathematics
 - 3.2 Mathematics in the EU Programmes
 - 3.2a) Training and Mobility of Researchers
 - 3.2b) Large facilities
 - 3.2c) Targeted Programmes
 - 3.2d) International Cooperation

Executive Summary

The European Mathematical Society recommends that

- 1) *the Training and Mobility Programme be kept and amplified*, preserving its bottom-up character in order to encourage initiative, to leave the door open for unexpected new results and to create the appropriate environment for the training of researchers who will have to tackle completely new problems;
- 2) *the flexibility in the running of programmes be increased*, avoiding as much as possible horizontal rules which ignore characteristic features of disciplines; this is especially true for networks whose possible impact is most appropriately judged by panels which in turn should be given more possibilities to improve applications;

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- 3) *a mathematician in the panel of the Large Facilities component of the TMR programme be included* in order that applications by mathematical institutions be properly discussed; mathematicians have indeed the use of specific large facilities, e.g., widespread electronic data bases or libraries, or federative post-doctoral structures;
 - 4) *room be made for more long-term concerns in targetted programmes*, e.g., by supporting generic horizontal programmes or by introducing a long term component in specific projects; along this line, *a programme on Mathematical Modelisation should be created* with the aim of bringing closer more specific applications;
 - 5) *a mathematical component be re-introduced in programmes devoted to international co-operation* in order to take into account the presence of centres of excellence in countries looking for partners at the European level.

DIDEROT MATHEMATICAL FORUM

A cycle of conferences, called the "Diderot Mathematical Forum", will feature two conferences a year to take place simultaneously in three European cities exchanging information by telecommunication. Their programmes will address three different aspects of Mathematics: fundamentals, applications and its relation to society (e.g., ethical and epistemological dimensions).

FIRST DIDEROT MATHEMATICAL FORUM

MATHEMATICS AND FINANCE

LONDON, MOSCOW, ZÜRICH

September 24-25, 1996

The first Diderot Mathematical Forum has been held in London, Moscow and Zürich on the subject of Mathematics and Finance.

The London, Moscow, Zürich triangle was appropriate for this forum. All three cities are centres of research in probability theory, the mathematical discipline most closely associated with financial mathematics. London is Europe's leading financial centre, Zürich is the home of Switzerland's powerful banking sector and Moscow is the capital of a country in rapid transition towards a market based economy.

The three meetings went extremely well. The lectures were very diverse, substantial and of high quality. The audience of academics and practitioners was very attentive and interested, debating each topic.

Some steps have been made towards establishing the video-link: the discussions between London and Zürich were videotaped in advance and sent to the other sites but direct communication links between the three cities were not possible in spite of great last-minute efforts in each city.

LONDON : Organisers: Dr Mark DAVIS (Tokyo-Mitsubishi International) and Professor Terry LYONS (Imperial College, Londres)

Tuesday September 24 1996, 2.00pm - 7.30pm

Two hundred participants attended the forum which comprised five short lectures with questions followed by a more general panel discussion. Talks were given by leading practitioners and academics and concentrated on the problems faced by mathematicians within the financial industry together with specific areas of mathematics i.e. stochastic analysis, statistics and numerical analysis.

Lectures

Professor Chris Rogers (Bath University)

Just what is the Black and Scholes Formula?

Dr Riccardo Rebonato (Director, Head of Research, European exotic interest rate derivatives book, BZW)

Interest rates, are they infinite dimensional processes?

Dr Sam Howison (Oxford)

Beyond the Black Scholes paradigm; bubbles, crashes and non-linear forecasting.

Dr Lane Hughston (Director, Head of Research, Fixed income division, Merrill Lynch, London)

Foreign exchange rates complicate the issues

Professor Michael Dempster (Professor of Finance and Management Science, Cambridge University)

It is worthless if you cannot compute

The Panel Discussion enabled participants to interact with experts from the financial industry, regulators, the press and academia.

The full programme was recorded.

For more informations:

<http://www.ma.ic.ac.uk/diderot.html>

MOSCOW : Professor Albert SHIRYAEV (Steklov Mathematical Institut, Russian Academy of Sciences), Professor Alexei ZIZCHENKO (Department of Mathematics, Russian Academy of Sciences) and Professor Boris KASHIN (Actuarial-Financial Centre, Russian Academy of Sciences)

September 24-25 1996

One hundred and eighty participants attended the two days of the Forum. The choice of the programme (survey lectures without too much complicated mathematics) was made to take account of the varying backgrounds of the audience.

Lectures

Professor Albert Shiryaev

Financial Mathematics

I. Basic concepts, structures, tools, aims and problems. II. Models of dynamics of financial markets for securities, rates of exchange, financial indexes. III. Statistical analysis of financial indexes. IV. Financial market under the absence of arbitrage possibilities.

Professor A. Melnikov

Financial calculations and tools in complete markets

I. Options. Problems of pricing and hedging of European and American options. II. Forwards and futures contracts. III. Bonds.

Professor D. Kramkov

Financial calculations and tools in incomplete markets

I. Illustration of basic principles of pricing and hedging of contingent claims in incomplete markets for Black-Scholes model with stochastic volatility. II. Dual characterizations in incomplete markets. III. General methodology of "super" hedging. Risk-minimizing hedging. Hedging as an optimal investment.

For more informations:

root@shiryaev.msk.ru

ZURICH : Professor Ole BARNDORFF-NIELSEN (Aarhus), Professor Paul EMBRECHTS (ETH) and Dr Rüdiger FREY (ETH)

September 24-25 1996

This meeting was one in the series of Latsis Conferences and was organised under the auspices of the ISI and Bernoulli Society.

One hundred participants attended the conference whose purpose was to consider, in broad terms, the present, and possible future, character of financial mathematics and insurance both as scientific fields in their own right and as concerning their role in Society. The programme was structured to consist of a number of key-note talks, more specialised papers and several extensive discussions sessions.

Lectures

Professor Hans Bühlmann (ETH)

On value in Insurance and Finance

Professor Hans Föllmer (Berlin)

Interactions between Finance and Probability

Professor Neil Shephard (Oxford)

Interactions between Finance and Statistics

Professor Ragnard Norberg (Copenhagen)

After Black-Scholes: What is Insurance?

Professor David Heath (Cornell)

A characterization of measures of risk

Professor Stewart Hodges (Warwick)

New models of security price processes

Dr Richard Olsen (Olsen and Associates)

Views from the Frontier

More than four hundred Swiss college students and their teachers listened to an impressive general audience talk given by Hans Föllmer (Berlin) on the subject "Strategien gegen den Zufall oder wildes Wetten? Zur Mathematik von Börsenkursen und Optionen"

For more informations:

Conference Secretary: Mrs G. Baltes

tel. +411 632 3400

baltes@math.ethz.ch

REPORT ON THE PRAGUE MATHEMATICAL CONFERENCE

Prague, 8 – 12 July 1996

The Mathematical Institute of the Academy of Sciences, the Faculty of Mathematics and Physics of the Charles University, the Institute of Computer Science of the Academy of Sciences and the Union of Czech Mathematicians and Physicists, in cooperation with the Patriae Foundation, organized the Prague Mathematical Conference which ran from July 8–12, 1996.

The aim of the Conference was to bring together people from different disciplines who work in the fields of ordinary and partial differential equations, linear algebra, and functional analysis and people interested in the numerical treatment of problems from these fields and their applications.

Altogether about 140 scientists took part in the Conference. The scientific and social programmes were accomplished successfully. Invited lectures were given in honour of Professor Ivo Babuška, Professor Miroslav Fiedler, Professor Jaroslav Kurzweil, and Professor Vlastimil Pták, who had laid the foundations of several branches of modern mathematics, on the occasion of their 70th birthdays.

Ivo Babuška, after graduating from the Czech Technical University in Prague, studied mathematics and worked at the Mathematical Institute of the Czechoslovak Academy of Sciences. He was appointed Professor at Charles University in Prague in 1968 and from 1968 to 1995 he was Professor at the University of Maryland in College Park (U.S.A.). Since 1995 he has been a Chair Professor at the University of Texas at Austin (U.S.A.). His scientific work is focused on applied and numerical mathematics and computational mechanics. His results in the finite element method have become fundamental. He established the journal *Applications of Mathematics* (formerly *Aplikace matematiky*) in 1956. For his work, he received, among others, the Czechoslovak State Prize (1968), Medal of the Czech Society for Mechanics (1993), G. Birkhoff Prize (AMS - SIAM, 1994) and the J. von Neumann Medal (U.S. Association of Computational Mechanics, 1995).

Miroslav Fiedler graduated from Charles University in Prague and then took a position at the Mathematical Institute of the Czechoslovak Academy of Sciences. He was appointed Professor at Charles University in 1964. His principal scientific results belong to the theory of matrices. In particular, he was interested in positive semidefinite matrices, M-matrices and Hankel matrices. A survey of his lifetime work would reveal his efforts in elucidating the common general principles of linear algebra, combinatorics and graph theory, and geometry. He is the author of two monographs. For many years he has been the editor-in-chief of the *Czechoslovak Mathematical Journal* and the editor of *Linear Algebra and Applications*, *Mathematica Slovaca*, and *Numerische Mathematik*. In 1993 he received the H. Schneider Prize from the International Linear Algebra Society. He has served several terms as chairman of the Czechoslovak (now Czech) National Committee for Mathematics.

Jaroslav Kurzweil studied mathematics at Charles University in Prague and then in Poznan (Poland) with Professor Orlicz. He started his scientific career at the Mathematical Institute of the Czechoslovak Academy of Sciences in functional analysis and metrical theory of Diophantine approximations. However, the fields of mathematics in which he has achieved his greatest successes are the theory of ordinary differential equations (stability and control theory) and the theory of integration. His concept of the generalized differential equation was based on a new, Riemann-type definition of the Perron integral, now usually called the Kurzweil-Henstock integral. He is also deeply involved in problems of mathematical education not only at university level (where he wrote a monographic textbook on ODE's) but also at primary and secondary level.

Vlastimil Pták graduated in 1949 from Charles University in Prague, where his teachers included Čech and Katětov. He started his work at the Mathematical Institute of the Academy of Sciences. He became Professor in 1966. Besides functional analysis, which has been his main field of interest, his scientific activity involves linear algebra and operator theory, contributions to closed graph theorems (the Pták spaces), extensions of separately continuous functions, Hermitian algebras, and convergence of iterative processes. He laid down the fundamentals of the theory of the critical exponent and of nondiscrete induction. He has been an initiator of several international meetings and is the author of two monographs.

**Preliminary report on the
EMS Summer Schools I.
Algebraic Geometry**
29th July – 9th August 1996, Eger, Hungary

General comments

The instructional part of the summer school was really excellent. Each of the lecture series gave deep insight into an area of Algebraic Geometry, assuming the level of knowledge on the announced level. Proceedings will be prepared, which should be of general interest.

The tutorials could only partially serve their purpose (see below), but they proved to be useful in many cases. The six tutors prepared thoroughly; the difficulties arose from defining the purpose of the tutorials.

There were 65 students (see the attached list), 12 studying in the European Union, 4 in the USA, 28 coming from Central- and Eastern-Europe, and 21 coming from Hungary. The students came from 10 countries of Europe from Russia to Portugal - in this sense it was truly a European meeting. Most of the students stayed for the whole two weeks.

The main problem was housing. At the last moment we had to find an alternative Student Hostel to the one we had booked, and the replacement was unfortunately of very low quality.

Altogether, I think the Summer School served its purpose:

students could learn from eminent researchers in the field; Europe's young mathematicians could get to know each other, and realise the great benefit from working with European colleagues.

I would like to thank the EMS Council for accepting this event as the first EMS Summer School, and especially Jean-Pierre Bourguignon for working so hard on getting ESF support. The ideas of János Kollár, the programme organiser, made this summer school fruitful. Special thanks are due to each lecturer, Alberto Conte (Torino), János Kollár (Salt Lake City), András Némethi (Ohio), Bernard Teissier (Paris), and to each tutor, Evelia Garcia Barroso (Paris), Marina Marchisio (Torino), Gábor Megyesi (Cambridge), Patric Popescu-Pampu (Paris), Karen Smith (MIT), Endre Szabó (Bayreuth, Budapest). In addition, without the help of various people at the Mathematical Institute and in Eger the Summer School would not have taken place.

Formal Proceedings

Lecture series

The summer school covered a great part in Algebraic Geometry. Most of the students came for a specific lecture series, whose topic was close to her/his interest, but found interesting also some of the other talks.

Each lecturer was very well prepared and organized, and led the students to the problems of current research interest. They also tried to illustrate the importance of the technics used. The short abstracts are attached. The lecture series given by János Kollár on rationality was the highlight of the Summer School - he was also the most successful in getting the students working out the exercises.

Tutorials

Basically four type of tutorials took place:

- (1) Homework problems related to the lectures
- (2) Discussing in more detail some phenomenon mentioned in the lectures
- (3) Some applications of the machinery presented in the lectures
- (4) Additional informations, in a lecture format

The "extra lecture" format seemed to be less successful. There were some very useful tutorials which gave new insight either by illustrating some of the ideas coming from the corresponding lecture or by giving a beautiful illustration of the theory. Solving and discussing homework bring the students involved, and stimulate them to work on understanding the theory.

It seems to be almost as hard to find the right tutors (talented and good in teaching) as to find good lecturers. In this summer school, most of the best tutorials were given by lecturers. It does not reflect the input of the tutors - mostly by me, the importance of organizing the tutorials was not sufficiently recognized. On the other hand, the tutors did much additional help in personal discussions with the students.

Hospitality aspects

For the lecturers the housing was suitable, for tutors it was reasonable. On the other hand, the student hostel was of low quality and was somewhat too far from the campus where the talks were given. A mistake on the part of the

administration of the host College in Eger forced us to move out from the student hostel on the Campus which I had booked a year ago.

We had daily breakfast and lunch on working days on the campus. I think it is good idea to keep participants together.

The complementary social programme seemed to be popular and helped us to get to know each other.

Almost final Budget

Support

ESF	20 000 ECU
EMS	2000 ECU
Soros foundation	1300 ECU
OMFB	780 ECU
Total	24 080 ECU

Expenses

The budget is still not complete. It depends slightly on exchange rates, and the bills for copying, phone calls, etc. have not arrived yet.

Travel:

Central– East – European students	3800 ECU
students from European Union	450 ECU
Lecturers + Tutors	3000 ECU
Total	7250 ECU

Daily Allowance:

Students	1240 ECU
Lecturers + Tutors	670 ECU
Total	1910 ECU

Daily breakfast + lunch: 2330 ECU

Room:

students + tutors	5180 ECU
Lecturers + J – P Bourguignon	640 ECU
Total	5820 ECU

Lecture rooms: 520 ECU

Programs:

Reception	520 ECU
Organising dinner	60 ECU
Organ concert	50 ECU
Excursion to Aggtelek	450 ECU
Total	1080 ECU

Organizational personal expenses:

Károly Böröczky (computer, local organizational cost) - 190 ECU

Eszter Cséplő (assistance in financial matters) - 100 ECU

Ilona Dávid (local organization) - 130 ECU

Teréz Szilágyi (secretarial help) - 50 ECU

Total - 470 ECU

Copying + printing: approx. 1000 ECU

Proceedings: approx. 1000 ECU

Additional expenses (phone, money handling, etc): approx. 2700 ECU

Suggestions for future EMS Summer Schools

1. Choosing Central Europe as the location was very helpful in getting more students from Central and Eastern Europe. This way the support to be given to them, and also the organisational expenses, could be kept on a reasonably low level. In retrospect, many of the problems could have been overcome with more careful organisation. In our case, the reason behind many of our problems was that this was the first conference I ever organised. I would suggest an alternation between "East" and "West".
2. Advertising - much emphasis should be put on that. Especially getting suitable advertising on the "Electronic World", but also the schools around Europe of the chosen topic should be notified by e-mail, leaflet or personal contacts.
3. Two lecture series in the mornings and tutorials in the afternoons seemed to work well. There should be no additional talks.
4. Proceedings of these Summer Schools should be very useful for the larger mathematical community.
5. Two weeks is a suitable length for a summer school. When possible, it would be preferable if the two parallel series were coordinated.
6. For each lecture (and possibly for each tutorial), a student should be nominated to take notes. We did not really do that, but it seems to be equally beneficial both for the students and the proceedings.
7. The tutorials should be also well organised. It would be useful to give exercises in the lectures, and some of the tutorials should be used to discuss them.
8. Tutorials should be given to more or less homogeneous "subgroups" of students.
9. The lunch break should be approximately 3 hours; we had only 2 hours, and was insufficient for example for thinking about exercises.

Participants of the
EMS Summer Schools I
Algebraic Geometry
29 July – 9 August 1996, Eger (Hungary)

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Csaba Varga, csvarga@cs.ubbcluj.ro

Some topics on Enriques surfaces and Fano threefolds

Lecturer: ALBERTO CONTE

Tutor: MARINA MARCHISIO

Università degli Studi di Torino, Italy

The aim of the lectures and of the tutorials is to give a quick introduction to the theory and the classification of algebraic surfaces and threefolds by means of some examples of particular interest. We have chosen Enriques surfaces and Fano threefolds because their geometry is particularly interesting and they provide examples of the most relevant phenomena which may take place in the general theory.

The topics covered will be the following:

LECTURES

1. Introduction to the classification of algebraic surfaces
2. Enriques surfaces and their projective models
3. Fano threefolds
4. Classification of Fano threefolds I
5. Classification of Fano threefolds II

TUTORIALS

1. Examples of K3 and Enriques surfaces
2. The sextic going doubly through the edges of a tetrahedron
3. Prym varieties and the (non)rationality of conic bundles
4. Examples of Fano threefolds
5. The cubic and the quartic threefolds

BOOKS

- A. Beauville, Surfaces algébriques complexes, Astérisque n. 54
- A. Conte (ed.), Algebraic Threefolds, Springer LNM n. 947
- R. Cossec - I. Dolgachev, Enriques Surfaces I, Birkhäuser Prog. Mat. n. 76
- R. Hartshorne, Algebraic Geometry, Springer Verlag GTM 52

Rational and Nonrational Varieties

Lecturer: JÁNOS KOLLÁR

University of Salt Lake City, USA

Tutor: GÁBOR MEGYESI

Cambridge, UK

The simplest and most basic algebraic varieties are projective spaces. Therefore it is important to understand which varieties are very similar to projective spaces. A variety is called rational if it is birational to a projective space and unirational if it is dominated by a rational variety. In my lectures I will study several topics concerning rational and unirational varieties:

Describe some special properties of rational varieties, and use these to show that certain varieties are not rational or not unirational.

Give interesting examples of rational and of unirational varieties.

All of these questions will be studied over the field of complex numbers, where most of the questions are geometric, and also over the field of rationals, where arithmetical properties become important.

Invariants of Hypersurface Singularities

Lecturer: ANDRÁS NÉMETHI

Ohio State University, USA

Tutor: Endre Szabó

Universität Bayreuth, Germany

The five lectures comprise an introduction to the basic topological invariants of hypersurface isolated singularities. We define the analytic (respectively the topological) type of a singularity, we introduce its link, Milnor fiber, monodromy operator, intersection form, variation operator and Seifert form. We discuss some connections between these invariants, and exemplify them in a series of particular cases. In the written version of the lecture, the reader will find some additional, important results which will assure a better understanding of the subject, and also of the present state of the research in this field. Moreover, we present also some conjectures and open questions (e.g. Zariski's, S. S.-T. Yau's, Durfee's conjectures, Laufer's problem, etc.) as some of the leading problems in the field. The extended list of exercises provides important examples and facts. A large part of the examples is concentrated around "Thom-Sebastiani type theorems". At the end, we will connect the signature type (topological) invariants with some number theoretical objects, as generalised Dedekind sums, in order to exemplify the complementary arithmetical nature of the theory. For the proper understanding of (some parts of) the lectures, some knowledge of elementary algebraic topology is necessary ((co)-homology groups, intersection form, dualities).

Comparing singularities in Algebraic Geometry

Lecturer: BERNARD TEISSIER

Tutor: PATRICK POPESCU-PAMPU and EVELIA GARCIA BARROSO

École Normale Supérieure, France

The course will be an introduction to the study of singularities by algebraic and geometrical methods. I will introduce numerical invariants and geometric constructions which help to decide when one singularity is more complicated than another.

The prerequisites are some knowledge of analytic Geometry (normalisation, blowing-up, etc..) for which the book of Kaup, Kaup, and Barthel "holomorphic functions of several variables", De Gruyter 1983, is amply sufficient, and of the singularities of plane curves, as found in the book of R.J Walker, "Algebraic curves". Princeton U.P. 1950, reprinted by Dover, or in my notes "Introduction to curve singularities", in "Singularities", World Scientific 1995. A knowledge of commutative algebra (dimension, multiplicity theory) will be useful, as well as some elementary notions of symplectic Geometry.

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. For the year 1997, Professor Nigel J. Cutland (University of Hull) has been chosen as the second EMS Lecturer. He will give his lectures at the University of Helsinki and the University of Gothenburg.

The dates and title of the EMS Lectures will be announced later.

For more information, please contact

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EUROPEAN WOMEN IN MATHEMATICS 8th GENERAL MEETING

DECEMBER 13 - 17, 1997

First Announcement

The 8th general meeting of the European Women in Mathematics (EWM) is organized in collaboration with the International Centre of Theoretical Physics (ICTP) in Trieste, Italy, and will take place at this centre in the period December 13-17, 1997. Participants should plan to arrive on December 12, and leave on December 18.

The organizing committee consists of: Christine Bessenrodt (Germany), Bodil Branner (Denmark), Marie Demlova (Czech Republic), Emilia Mezzetti (Italy), Rosa-Maria Miro Roig (Spain), Marjatta Näätänen (Finland), Sylvie Paycha (France), Ragni Piene (Norway), Caroline Series (United Kingdom) and Inna Yemelyanova (Russia).

Participants will be housed at the ICTP Guest Houses and have their meals in the ICTP cafeteria. The approximate cost of living expenses will be 200 ECU. We encourage everyone to investigate different sources of support for travel and living expenses; for example it is important to find out early enough if your institution or state has some exchange agreements that can be used.

ICTP will give full financial support, including travel, for two women mathematicians from developing countries for a period up to two months, to participate in the conference.

Mathematical programme of the meeting:

1. A session on REPRESENTATIONS OF GROUPS, organized by Michele Vergne (France)
2. A session on p-ADIC NUMBERS, organized by Catherine Goldstein (France).
3. An interdisciplinary session on SYMMETRIES, organized by Ina Kersten (Germany) and Sylvie Paycha (France).

The "non-mathematical" topic of the meeting will be a round table discussion on WOMEN AND MATHEMATICS: EAST-WEST-NORTH-SOUTH, organized by Marie Demlova (Czech Republic) and Marjatta Näätänen (Finland).

A POSTER SESSION will also be organised, in which all participants are encouraged to present their work and to contribute an abstract to the proceedings of the meeting.

A second announcement, including application form, will be sent out in January 1997.

For further information, please contact

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email: branner@mat.dtu.dk
fax: +45 45 88 13 99

MATHS FILM WINS PRIZES

The film 'Arabescos y Geometría', scripted by Professor Antonio F. Costa of Universidad Nacional de Educación a Distancia, Madrid, and produced by Bernardo Gómez García has been awarded many prizes at scientific film festivals. It was awarded the prize for the best foreign film at 11ème Festival International du Film Scientifique de Palaiseau (France), and it won many similar prizes at film festivals throughout Spain. This 21-minute film explores the tessellations of the Alhambra and uses them to explain elementary concepts in Group Theory and Geometry. More details may be obtained from Professor Antonio F. Costa, Dpto. de Matematicas Fundamentales, UNED, 28040, Madrid, Spain.

EUROPEAN NEWS: Country by Country

CZECH REPUBLIC

SPRING SCHOOL 97 – BOUNDARIES AND CONVEXITY IN BANACH SPACES

First announcement

Following a longstanding tradition, the Faculty of Mathematics and Physics of Charles University, will organize a Spring School on Banach Spaces Theory. The School will be held at Paseky, in a chalet in the Krkonose Mountains, April 20 – 26, 1997. The program will consist of series of lectures on:

Convergence Problems for Equicontinuous Sequences of Linear Operators on Banach Spaces
delivered by: Francesco Altomare, University of Bari

Abstract Boundaries and Korovkin Theory for Function Spaces
delivered by: Heinz Bauer, University of Erlangen – Nürnberg

Education of Neurons and Education in Mathematics and Science
delivered by: Gustave Choquet, University of Paris VI

Convergence, Minimax and Monotonicity
delivered by: Stephen Simons, University of Santa Barbara, California

Boundaries and Smoothness in Banach Spaces
delivered by: V Zizler, University of Alberta, Edmonton

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 280,- US dollars. A reduced rate of 250,- US dollars will be offered, provided a letter guaranteeing participation reaches the organizers before February 15, 1997. The conference fee includes all local expenses (room and board) and transportation between Prague and Paseky. The fee is the same for accompanying persons.

The organizers may provide financial support to a limited number of students. Applications must be sent before February 15, 1997.

Payment of the fee should be made in cash at the registration desk in Paseky, or it may be remitted by a bank transfer to

Komerčníbanka, 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.

In case of any difficulty you should contact the organizers.

The village of Paseky lies in the slopes of the Krkonose Mountains, in North Bohemia. Accommodation consists of rooms for two or three people. There are excellent facilities and conditions for sporting activities: hiking trips, soccer, mini-golf and sauna. A special bus from Prague to Paseky will leave at 4 p.m. on April 20, 1997. The bus from Paseky will arrive in Prague on April 26, at 11.30 a.m.

In case of interest please fill out the enclosed preliminary registration form and return it before February 15, 1997. A final announcement with further details will be mailed in due time.

Due to the limited capacity of accommodation facilities the organizers may be forced to decline registration.

We look forward to meeting you in the Czech Republic.

Jaroslav Lukes, Jiri Kottas

Mailing address:

Katedra matematické analýzy

Matematicko-fyzikální fakulta UK

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Czech Republic

Phone/Fax: 42 - 2 - 232 3390

E-mail: paseky@karlin.mff.cuni.cz

WWW: <http://csmat.karlin.mff.cuni.cz/katedry/kma/ss97/ss97.html>

Kindly inform colleagues interested in this field !

SPRING SCHOOL ON ANALYSIS

Following a longstanding tradition, the Faculty of Mathematics and Physics of Charles University, will organize a Spring School on Analysis. The School will be held at Paseky, in a chalet in the Krkonose Mountains, June 1 - 7, 1997. The program will consist of series of lectures on:

Approximation and uniqueness properties of harmonic differential forms
delivered by: Victor Havin, University of St. Petersburg

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 280,- US dollars. A reduced rate of 250,- US dollars will be offered, provided a letter guaranteeing participation reaches the organizers before March 1, 1997. The conference fee includes all local expenses (room and board) and transportation between Prague and Paseky. The fee is the same for accompanying persons. The organizers may provide financial support to a limited number of students. Applications must be sent before March 1, 1997.

Payment of the fee 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.

In case of any difficulty you should contact the organizers.

The village of Paseky lies in the slopes of the Krkonose Mountains, in North Bohemia. Accommodation consists of rooms for two or three people. There are excellent facilities and conditions for sporting activities: hiking trips, soccer, mini-golf and sauna. A special bus from Prague to Paseky will leave at 4 p.m. on June 1, 1997. The bus from Paseky will arrive in Prague on June 7, at 11.30 a.m.

In case of interest please fill out the enclosed preliminary registration form and return it before March 1, 1997. A final announcement with further details will be mailed in due time.

Due to the limited capacity of accommodation facilities the organizers may be forced to decline registration.

We look forward to meeting you in the Czech Republic.

Jaroslav Lukes, Jiri Kottas

Mailing address:

Katedra matematické analýzy

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Kindly inform colleagues interested in this field !

**Preliminary registration form:
Spring School on Functional Analysis, Paseky 1997**

Name:

Address:

E-mail:

Fax:

Phone:

I plan on attending the Spring School: Yes/No

**Preliminary registration form
Spring School on Analysis, Paseky 1997**

Name:

Address:

E-mail:

Fax:

Phone:

I plan on attending the Spring School: Yes/ No

FINLAND**EUROCONFERENCE ON****CONFORMAL GEOMETRY AND COMPLEX DYNAMICS****SAARISELKÄ, FINLAND, JUNE 9 – 13, 1997**

The conference will take place at a congress and vacation resort in northern Lapland, well north of the polar circle: latitude 68.6°. The event is a continuation of the activity of the earlier EC Human Capital and Mobility network Conformal Geometry and Geometric Function Theory.

The program will consist of about 25 invited lectures 40 min each. A second announcement including prices for accomodation and travel arrangements will be delivered by the end of February, 1997. There will be a limited amount of resources for young participants from EC countries.

Organizers:

Kari Astala
astala@math.jyu.fi

Ilkka Holopainen
ih@geom.helsinki.fi

Seppo Rickman
rickman@cc.helsinki.fi

For more information you can contact either some of the organizers or the **secretary**

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FRANCE**THIRD EUROPEAN CONFERENCE ON ELLIPTIC AND PARABOLIC PROBLEMS**

The Third European Conference on Elliptic and Parabolic Problems will take place from 16–20 June 1997 in Pont-à-Mousson, France.

Organisers: A. Amann (Zürich), C. Bandle (Basel), M. Chipot (Zürich), F. Conrad (Nancy), I. Shafrir (Haifa)
For information contact: pontamou@amath.unizh.ch

HARMONIC MORPHISMS, HARMONIC ANALYSIS AND RELATED TOPICS**UNIVERSITE DE BRETAGNE OCCIDENTALE, BREST, FRANCE****7 to 11 July 1997****Scientific Committee**

James Eells (Cambridge), Luc Lemaire (Brussels), John C Wood (Leeds)

Organising Committee

Paul Baird (Brest), Sigmundur Gudmundsson (Lund), Andrea Ratto (Brest)

Programme

This will be the first international conference primarily devoted to harmonic morphisms between Riemannian manifolds and related topics.

Information

If you wish to attend, please contact P. Baird, Département de Mathématiques, Université de Bretagne Occidentale, B.P. 809, F-29285 Brest, France, fax: (+33) 2-98.01.67.90, e-mail: Paul.Baird@univ-brest.fr, phone: (+33) 2-98.01.67.20.

It would be helpful if you could indicate whether you would like to be considered for financial assistance with travel or subsistence expenses. Some financial help may be available.

ITALY

CENTRO INTERNAZIONALE PER LA RICERCA MATEMATICA

Centro Internazionale per la Ricerca Matematica
Istituto Trentino di Cultura
38050 Povo (TN), Italy

First Announcement-October 96

The C.I.R.M. is sponsoring a course to be held in *Trento-Italy* on *January 20-24, 1997* and titled

'Recent Advances in Continuum Mechanics'

The past decade has resulted in major advances in continuum mechanics, particularly in its application to materials science. New theories apply continuum mechanics at length-scales previously thought to be phenomenologically inaccessible. Conceptual frameworks have been developed that allow for the careful development of hierarchies of (fixed and free) boundary/initial value problems at various levels of generality.

In this course, these new theories of continuum mechanics, as well as the mathematics relevant to the study of corresponding problems, will be discussed. The central issue of the course is the characterization of microstructures that arise in such apparently disparate physical situations as solid-solid phase transitions, defect evolution, fracture dynamics, superfluidity and superconductivity.

The course will be given by four lecturers each giving four one-hour lectures, with all but the last day's lectures in the afternoon, and with the mornings reserved for discussion and interaction. The course will begin on the afternoon of Monday 20 January and will end at noon on Friday 24 January. The course will be directed toward graduate students and young research workers.

Main lecturers will be the following:

- Halil M. Soner, Carnegie Mellon University, U.S.A.
Asymptotic analysis of Ginzburg-Landau type evolutionary equations
- Morton E. Gurtin, Carnegie Mellon University, U.S.A.
New concepts of force in continuum mechanics
- Paolo Podio-Guidugli, Università di Roma 'Tor Vergata', Italy
The dynamics of fracture and defect structures
- Jakob Rubinstein, Technion, Haifa, Israel
Ginzburg-Landau vortices

Location: The course will take place in Povo (Trento, Italy), at the Istituto Trentino di Cultura.

Reply: We can provide support for a limited number of young researchers. If you are interested in participating (or if you need more information), please contact

*Mr. Augusto Micheletti, Secretary of CIRM, Istituto Trentino di Cultura, I- 38050 POVO (Trento), Italy
Tel. Italy+461-881628 Fax: Italy+461++810629 e-mail: michelet@science.unitn.it*

The organizing committee consists of:

M.E. Gurtin (Carnegie Mellon Univ.) - P. Podio-Guidugli (Univ. di Roma 'Tor Vergata')

To the Secretary of
C.I.R.M.
Istituto Trentino di Cultura
38050 POVO (TN)
Italy

APPLICATION FORM

'Recent Advances in Continuum Mechanics'

Trento, January 20-24, 1997

First and Family Name

Sex M F

Address

e-mail

Telephone

Telefax

Research interests

I will attend the course

I need financial support Yes No

Participants who receive financial support should expect to share a double room.

Arrival date

Departure date

I would like to book a room at Hotel Villa Madruzzo

double room (Lit. 100.000 per person) single room (Lit. 110.000)

I would like to share the room with:

Date

Signature

UNIVERSITA' DEGLI STUDI DI NAPOLI "Federico II"

Intensive Trimester of study and research on "Variational Problems and Applications" Napoli, May - July and September 1997

An intensive period of study and research on recent results on Calculus of Variations and PDE will take place in the period May 12 - July 18 and two weeks in September 1997, at the Dipartimento di Matematica e Applicazioni "R. Caccioppoli" dell' Universita' di Napoli. This activity, sponsored by Istituto Nazionale di Alta Matematica "F. Severi" in Rome, will be organized by Prof. A. Alvino, L. Carbone and C. Sbordone.

There will be some courses at doctorate and post-doctorate level and some talks and seminars.

At the moment the following mathematicians have agreed to participate:

Acerbi, Attouch, Aubin, Ball, Biroli, Boccardo, Bouchitte, Brezis, Brock, Buttazzo, Caffarelli, Cioranescu, Dal Maso, Damlamian, De Giorgi, Donato, Fonseca, Fusco, Gallouet, Garofalo, Iwaniec, Kawohl, Leaci, Marcellini, Marino, Mosco, Mossino, Murat, Perez, Rabinowitz, Spagnolo, Talenti, Tartar, Tomarelli, Trudinger, Vazquez.

There will be 40 scholarships of 750.000 it. lire for two weeks which will be assigned to encourage young researchers.

For more informations, please send an e-mail to sbordone@matna2.dma.unina.it or fax to 0039-81-675692

SPAIN

CENTRE DE RECERCA MATEMATICA

Invited people for the academic year 96-97

- N. Fagella (Berkeley) 01.09.95 - 30.06.97, Sistemes Dinàmics
M. Crossley (Aberdeen) 01.10.95 - 30.09.97, Topologia Algebraica
E. Dubtsov (St. Petersburg) 01.10.95 - 31.12.96, Anàlisi Harmònica
P. Kropholler (London) 21.08.96 - 17.09.96, Algebra
B. Edixhoven (Rennes) 26.08.96 - 24.09.96, Teoria de Nombres
S. Bosch (Münster) 26.08.96 - 24.09.96, Teoria de Nombres
D. Lorenzini (Georgia) 26.08.96 - 24.09.96, Teoria de Nombres
B. de Weger (Rotterdam) 26.08.96 - 24.09.96, Teoria de Nombres
D. Flath (Mobile) 01.09.96 - 31.08.97, Teoria de Nombres
P. Tzermias (Bures-sur-Yvette) 01.09.96 - 31.07.97, Teoria de Nombres
A. Facchini (Udine) 01.09.96 - 31.08.97, Algebra
D. Scevenels (Leuven) 01.09.96 - 31.08.97, Algebra
D. Logachev (Moscou) 01.09.96 - 31.12.96, Teoria de Nombres
J.M. Anderson (London) 02.09.96 - 31.12.96, Anàlisi
E. Dror Farjoun (Jerusalem) 02.09.96 - 30.09.96, Topologia Algebraica
D. Ravenel (Rochester) 02.09.96 - 14.09.96, Topologia Algebraica
A. Pethoe (Debrecen) 05.09.96 - 30.09.96, Teoria de Nombres
J. Zapletal (Berkeley) 16.09.96 - 22.09.96, Lògica
A. Kaminska (Memphis) 01.10.96 - 30.11.96, Anàlisi
H. Hudzik (Poznań) 02.10.96 - 30.11.96, Anàlisi
M. Mastyo (Poznań) 02.10.96 - 20.12.96, Anàlisi
Ch. Thomas (Cambridge) 26.10.96 - 31.10.96, Topologia
J. Seimenis (Samos) 01.11.96 - 31.12.96, Sistemes Dinàmics
S. Jackwoski (Warsaw) 04.11.96 - 01.12.96, Topologia Algebraica
S. Zarati (Tunis) 01.12.96 - 22.12.96, Topologia Algebraica
R. Roy (New Delhi) 07.01.97 - 31.12.97, Estadística
S. Todorovic (Toronto) 07.01.97 - 31.01.97, Teoria de Conjunts
Vl. Stepanov (Khabarovsk) 07.01.97 - 30.03.97, Anàlisi
H. Heinig (Hamilton) 07.01.97 - 31.01.97, Anàlisi
S. Kolyada (Kiev) 07.01.97 - 31.01.97, Sistemes Dinàmics
L. Snoha (Banská Bystrica) 07.01.97 - 31.01.97, Sistemes Dinàmics
J. Porti (Lyon) 07.01.97 - 31.01.97, Topologia
A. Millet (Angers) 12.01.97 - 11.02.97, Anàlisi Estocàstica
I. Dejter (Rio Grande) 03.02.97 - 28.02.97, Combinatòria
N. Privault (Evry) 01.02.97 - 31.08.97, Probabilitats
L. Pick (Praha) 01.02.97 - 31.03.97, Anàlisi
N. Krugljak (Yaroslavl) 15.02.97 - 30.03.97, Anàlisi
I.J. Gyongy (Budapest) 15.03.97 - 31.03.97, Probabilitats
J. Vaananen (Helsinki) 01.04.97 - 30.06.97, Teoria de Models
D. Pigozzi (Ames) 01.04.97 - 30.06.97, Lògica Algebraica
K. Meyer (Cincinnati) 01.04.97 - 31.05.97, Sistemes Dinàmics
M. Ziegler (Freiburg) 01.04.97 - 30.04.97, Teoria de Models
X. Caicedo (Bogota) 01.04.97 - 30.04.97, Teoria de Models
J. Flum (Freiburg) 01.04.97 - 15.04.97, Teoria de Models
E. Bouscaren (Paris) 15.04.97 - 15.06.97, Teoria de Models
F. Delon (Paris) 01.05.97 - 30.06.97, Teoria de Models
R. Cignoli (Buenos Aires) 01.05.97 - 30.06.97, Lògica Algebraica
A. Pillay (Notre Dame) 01.06.97 - 30.06.97, Teoria de Models
W. Blok (Chicago) 15.05.97 - 15.07.97, Lògica Algebraica
J. Czelakowski (Kedzierzyn-Kozle) 15.05.97 - 30.06.97, Lògica Algebraica
D. Lascar (Paris) 15.06.97 - 15.07.97, Teoria de Models
D. Mundici (Milano) 15.06.97 - 15.07.97, Lògica Algebraica
I. Martin (Berkeley) 01.07.97 - 31.07.97, Teoria de Nombres

The 3rd Barcelona Logic Meeting (January 30-31, February 1, 1997)

Place: Centre de Recerca Matemàtica

Organizing Committee: Enriquet Casanovas, Ràimon Elgueta and Rafel Farre

Invited Mathematicians: J. Adamek (Technical University of Braunschweig), J. Bagaria (Universitat de Barcelona), J. Barba (Universidad de Valladolid), A. Borovik (UMIST, Manchester), R. Jansana (Universidad de Barcelona), I. Neeman (University of California at LA) and B. Poizat (Universite de Lyon).

Analysis Semester (October 1st, 1996 - March 31st, 1997)

Place: Centre de Recerca Matemàtica

Organizing Committee: Joan Cerda

Invited Mathematicians: H.Heinig (McMaster University), H.Hudzik (A.Mickiewicz University), A.Kaminska (The University of Memphis), N.Krugljak (Yaroslavl State University), M.Mastylo (A.Mickiewicz University), L.Pick (Czech Academy of Science) and V.Stepanov (Russian Academy of Science).

Algebraic Logic and Model Theory Semester (April 1, 1997 - July 10, 1997)

Place: Centre de Recerca Matemàtica

Organizing Committee: J.Ma. Font i Enriquet Casanovas

Invited Mathematicians: E.Bouscaren (Universite Paris VII), X.Caicedo (Universidad de los Andes), F.Delona (Universite Paris VII), A.Pillay (University of Notre Dame), D.Lascar (Universite Paris VII), D.Pigozzi (Iowa State University), R.Cignoli (Universidad de Buenos Aires), W.Blok (University of Illinois at Chicago), J.Czelakowski (Polonia), D.Mundici (Universita di Milano) and J.Flum (Universitat Freiburg).

ADVANCED COURSE ON STOCHASTIC ANALYSIS

Dates: September 1 to September 10, 1997

Place: Centre de Recerca Matemàtica Campus of the Universitat Autònoma de Barcelona Bellaterra, Spain

Speakers: G. da Prato, Scuola Normale Superiore da Pisa 'Stochastic Partial Differential Equations by Semigroup Methods'; M. Yor, Université Paris VI 'Some Recent Martingale Problems'

The course will consist in two series of 9 lectures and they will be held in the morning; afternoons will be devoted to complementary activities (expository talks and seminars).

Coordinators: David Nualart, Marta Sanz-Solé.

Registration

Fee: 20.000 pta.

Deadline: June 20, 1997

The CRM can offer a limited number of grants covering the registration fee. The deadline for applying is May 31, 1997.

Payment for registration should be made by June 20, 1997.

Further information

www <http://crm.es> or <ftp://crm.es> or mail crm@crm.es

UNITED KINGDOM

GROUPS ST ANDREWS 1997 IN BATH

Date: Saturday 26 July to Saturday 9 August 1997

Location: University of Bath, England

Sponsors: The London Mathematical Society and the Edinburgh Mathematical Society

Programme: Topics are group theory and related areas. The invited speakers will give courses of about four lectures during the first week of the conference. During the second week there will be a special day of lectures dedicated to Professor R C Lyndon. A programme of seminars and invited lectures will also be arranged in the second week.

Programme Committee: C M Campbell (St Andrews), E F Robertson (St Andrews) and G C Smith (Bath).

Speakers: Professor L Babai (Chicago), Dr M R Bridson (Oxford), Dr C J B Brookes (Cambridge), Professor C E Praeger (Western Australia) and Professor A Shalev (Jerusalem).

Second week special days led by Professor E Zelmanov (Yale) and Professor C F Miller III (Melbourne).

For further information please contact: Dr C M Campbell and Professor E F Robertson, Mathematical Institute, University of St Andrews, North Haugh, St Andrews KY16 9SS, Scotland.

email: groups97@dcs.st-and.ac.uk

WWW: <http://www.bath.ac.uk/~masgcs/gps97/home.html>

Problem Corner*Paul Jainta, Werkvolkstr. 10, D-91126 Schwabach, Germany**For reasons beyond our control, the problems in this article have not been edited in the usual way.***An Ice-Breaker Called Mathematics****The Austrian-Polish Mathematics Competition**

The international language of Mathematics and its universality are surely understood. Accordingly, Mathematics can serve as a means of encouraging contact between people of different nations, particularly the young, and surely that is something to be applauded. There are currently many examples showing how Mathematics can serve as such an ice-breaker.

In August 1991, for instance, when the Soviet Union was opening up, 311 American science educators held a convention at Moscow State University attended by 600 Soviet teachers. Some had travelled all the way from Siberia. Sessions were all provided with simultaneous translation, using electronics and interpreters. Many Americans visited Russian homes and everyone found the joint meeting to be one of the finest experiences of their lives. One goal of that convention was to make new friends and help the indigenous colleagues form a science teachers association in Russia. The desired effect was to give a boost to encourage exchanges and other forms of co-operation.

Other forward-looking meetings of minds, enjoying increasing popularity all over the world, are the so-called Friendship Mathematics Competitions. One of the most notable representatives of them is the SHANGHAI-DUNEDIN competition, the third of which took place in early November 1994. What makes this competition different from all others that we know of is the emphasis put on the cultural relationship between the two cities.

Of course, international co-operation in maths competitions can be implemented in more than one way on a regional basis. It seems to me that four different types of competitions can be distinguished, each taking place in a specific environment:

- (1) two countries with different languages organise an annual contest for their teams and take turns to host it (the Israeli-Hungarian Mathematics Competition)
- (2) several countries from one relatively compact region, all sharing the same language, join in a biannual contest organised by one of them (Gulf Mathematical Olympiad)
- (3) one small country's team participates in a larger neighbouring country's contest (Luxembourg at the Belgian Olympiad) and
- (4) several countries with different languages, spread over a large geographical region, co-operatively prepare an examination paper that students sit in their home countries (Asian Pacific Mathematics Olympiad).

The epitome of mathematical co-operation according to type 1 is the Austrian-Polish Mathematics Competition (A-PMC), which I'm going to describe below. I am indebted to Dr Marcin E Kuczma, Warsaw University, who provided me with some information on this kind of contest. Dr Kuczma is devoted to teaching and to mathematics competitions alike. He has been active in the Polish Mathematical Olympiad for about twenty years and is identified throughout the world of mathematics as a research mathematician, creator of intriguing problems and as one who possesses unusual mathematical ability. In fact, he has contributed to the problem sections of *The American Mathematical Monthly*, *Crux Mathematicorum*, *Journal of Recreational Mathematics*, *Elemente der Mathematik* and the Polish mathematical magazine for students, *Delta*.

The competition in question arose from a bilateral agreement on cultural exchange between the Polish and Austrian Ministers of Education. The event takes place annually in July, or late June, in Austria or in Poland alternately, the host country being Poland in even-numbered years. The Polish town of Koszalin in coastal Pomerania hosted the first A-PMC, and the 1988 contest was also held there. In 1989, Eisenstadt, the provincial capital of Burgenland, Austria, situated not far from the border between Austria and Hungary, was chosen for the second A-PMC. Poznan, capital of the Polish province Poznan hosted the contest in 1990.

The A-PMC consists of two parts: the individual contest and the team contest. The rules of the individual part resemble those of the IMO: normally on two successive days the competitors, secondary-school students, have to sit a paper comprising three problems and extending over four and a half hours. Normally, the top six students at the national mathematics Olympiads of both countries go to the IMO and the next-to-top six form the A-PMC team. Students must work independently and submit solutions in their own languages. They may ask questions during the first half hour of an examination. The team size is six. The A-PMC differs slightly from the IMO by offering eight points per problem rather than seven.

One day after the conclusion of the individual contest, a team contest is held in which team members are given

PROBLEM CORNER

four hours to solve three problems without invigilation. For the duration of the contest the teams occupy separate rooms. In the light of experience, special attention is now being paid to the selection of problems for the team contest. In the early years of the competition, teams had managed to solve the problems with relative ease. Since in the A-PMC there are only two countries (hence only two languages) involved, the jury attempts to formulate the problems in such a way that the Polish version should be the literal translation of the German version, and vice versa. The nine problems for the competitions are chosen from a pool containing eighteen, assembled by the leaders of the delegations. Traditionally, five problems from the guest country are selected by the head of the host country, and four from the host country are selected by the leader of the guest country. After the delegations arrive, the jury devotes two days to preparations in the course of which the nine contest problems are selected. The contests and the evaluation of the students' solutions take place on the ensuing three days.

Scoring of the students' papers is obtained without an elaborate marking scheme. A jury consisting of leaders and deputy leaders makes all decisions concerning problems, scoring, prizes etc. A prominent mathematician from the host country assumes the office of Honorary Chairman of the jury and, in particular, has to act as the tie-breaker if the jury is dead-locked. Depending on the points-total accrued, the number of winners varies in the individual contest between five and eight. The jury announces the winners and also decides upon the result of the team contest.

The A-PMC, including a recreational programme, lasts eight to nine days altogether. Each time, the three days of contests have been followed by a complementary programme of sight-seeing and excursions. Also a football match between the teams is sometimes held (but the results of those meets are not recorded). The Austrian-Polish Mathematics Competition concludes with an award ceremony on the last day.

There is one pleasing fact common to these mathematical competitions: the cultural aspect is at least as significant as the mathematical aspect. Advocates of these friendship competitions in Mathematics believe that it is important for students to know more about other people and their customs and so they have encourage cultural links, for example, the interchange of letters between the students of the two cities or the countries. These letters give a fascinating view of what students of this age do and what their interests are. In this manner the youth of the world is helping a little to foster international understanding. That has to be worth-while.

Now is the time to offer some hard nuts to crack from former meetings of the Austrian-Polish competition, reflecting particularly the long-standing tradition associated with Polish mathematics.

Q 57. Let $P(x)$ be a polynomial with integer coefficients. Show that if $Q(x) = P(x) + 12$ has at least six distinct integer roots, then $P(x)$ has no integer roots.

Q 58. Determine all natural numbers N whose decimal representation satisfies the following conditions:

- (1) $N = (aabb)_{10}$, with $(aab)_{10}$ and $(abb)_{10}$ prime numbers ;
- (2) $N = p_1 p_2 p_3$, where p_k ($1 \leq k \leq 3$) is a prime consisting of k (decimal) digits.

Q 59. Prove: In a convex quadrilateral of area 1, the sum of the lengths of all sides and diagonals is not less than $4 + \sqrt{8}$.

Q 60. Find the greatest natural n for which there exist positive integers x_1, x_2, \dots, x_n and a_1, a_2, \dots, a_{n-1} with $a_1 < \dots < a_{n-1}$ such that $x_1 \cdot x_2 \cdot \dots \cdot x_n = 1980$ and $x_i + \frac{1980}{x_i} = a_i$ for $i = 1, 2, \dots, n-1$.

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

Q 62. Let Z be the set of all integers. Consider a function $f: Z \rightarrow Z$ with the properties:

- (1) $f(92+x) = f(92-x)$
- (2) $f(19 \cdot 92+x) = f(19 \cdot 92 - x)$ and
- (3) $f(1992+x) = f(1992 - x)$ for all $x \in Z$.

Is it possible that all positive divisors of 92 occur as values of f ?

Q 46. A regular tetrahedron has edges of unit length. Denote by S the intersection of the six balls having the edges of the tetrahedron as diameters. Show that the volume of S is at least $\frac{1}{54\sqrt{2}}$.

First solution: First, we scale up the problem. Consider the regular tetrahedron with vertices $(1,1,-1)$, $(1,-1,1)$, $(-1,1,1)$ and $(-1,-1,-1)$ and edge length $2\sqrt{2}$. The centroid of this tetrahedron is the origin $(0,0,0)$. Thus S , the intersection of the six spheres with the edges of the tetrahedron as diameters, is symmetric about $(0,0,0)$. The centers of the spheres are the midpoints of the edges of the tetrahedron: $(1,0,0)$, $(0,1,0)$, $(0,0,1)$, $(-1,0,0)$, $(0,-1,0)$ and $(0,0,-1)$. Moreover, the common radius of the spheres is $\sqrt{2}$ (= half the edge length).

A bit of thought now convinces us that S is a solid with the three coordinate axes as axes of symmetry. Thus we can look for the largest cube with center at the origin and sides oriented along the coordinate axes which can fit inside S . That is, if a is half the side length of the cube, we must have $(a,a,a) \in S$.

Now S is the intersection of the solid spheres described by the following inequalities:

$$x^2 + y^2 + z^2 - 2x \leq 1; \quad x^2 + y^2 + z^2 - 2y \leq 1; \quad x^2 + y^2 + z^2 - 2z \leq 1; \quad x^2 + y^2 + z^2 + 2x \leq 1;$$

$$x^2 + y^2 + z^2 + 2y \leq 1 \quad \text{and} \quad x^2 + y^2 + z^2 + 2z \leq 1.$$

The first three inequalities give us

$$(*) \quad 3a^2 - 2a \leq 1 \quad \text{or} \quad -\frac{1}{3} \leq a \leq 1$$

and the second three yield

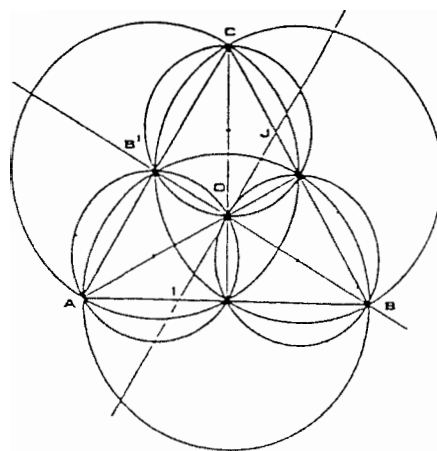
$$(**) \quad 3a^2 + 2a \leq 1 \quad \text{or} \quad -1 \leq a \leq \frac{1}{3}.$$

Thus we have $-\frac{1}{3} \leq a \leq \frac{1}{3}$. That is, the largest such cube has side length $\frac{2}{3}$ and volume $\frac{8}{27}$. Scaling down by $(2\sqrt{2})^{-1}$ to obtain a tetrahedron of side length 1 gives a cube with volume $(54\sqrt{2})^{-1}$, which must be strictly less than the actual volume of S .

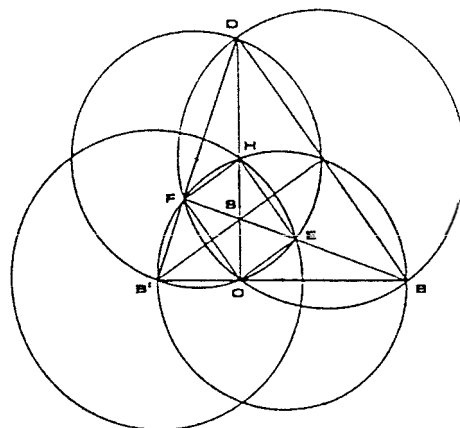
Second solution: (Dr Z Reut, London)

Let us consider a regular tetrahedron with vertices A, B, C and D , and centres of balls at midpoints of edges. We present here three planar sections of the object:

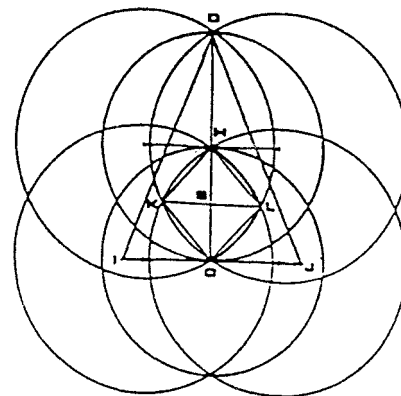
- i) In the plane of one side, e.g. ABC , there are: equilateral triangle ABC with sides equal to 1; three circles with centres at midpoints of sides and radii equal to 0.5; three circles with centres at midpoints of lines OA, OB and OC , and radii equal to $\frac{\sqrt{3}}{6}$;



ii) In the section BB' there are: isosceles triangle $BB'D$ with side BD equal to 1, and other two sides, BB' and DB' , equal to $\frac{\sqrt{3}}{2}$; two circles, one with centre at B' , other with centre at the midpoint of edge BD , with radii equal to 0,5; two circles with centres at midpoints of sides BB' and DB' , and radii equal to $\frac{\sqrt{3}}{4}$, formed by intersection of four spheres with the plane. The height OD is equal to $\frac{\sqrt{6}}{3}$.



iii) In the section IJ there are: isosceles triangle IJD with basis IJ equal to $\frac{2}{3}$, and sides ID and JD equal to $\frac{\sqrt{7}}{3}$; four circles with radii equal to $\frac{\sqrt{33}}{12}$, and two circles with radii equal to $\frac{\sqrt{6}}{6}$. The centres of these circles are on the line IJ and a line parallel to it at height OH equal to $\frac{\sqrt{6}}{6}$.



The intersection S of six balls is in the sections

- i) the central point O ;
- ii) quadrilateral $OEHF$ with convex sides and
- iii) quadrilateral $OLHK$ with convex sides.

The volume of S can be estimated by inscribing or embedding a prism in S . The straight-line segments OE and FH are equal to $\frac{\sqrt{2}}{6}$, and we take this value for the height of prism. The segments OF and EH are equal to $\frac{1}{3}$, and we take this value for one diagonal of basis; the other diagonal KL is equal to $\left(\frac{\sqrt{3}-1}{2}\right) > \frac{1}{3}$. In the case of a prism with square basis we take for the diagonal of basis $\frac{1}{3}$ corresponding

to side $\frac{\sqrt{2}}{6}$; the volume of prism is equal to $\left(\frac{\sqrt{2}}{6}\right)^2 \cdot \frac{\sqrt{2}}{6} = \frac{1}{54\sqrt{2}}$.

Q 48. Prove that for positive a, b, c and d the following inequality is valid:

$$\frac{a+c}{a+b} + \frac{b+d}{b+c} + \frac{c+a}{c+d} + \frac{d+b}{d+a} \geq 4 .$$

Solution: (Nico Lorentz, Howald/Luxembourg)

$$\begin{aligned} \text{Notons } S &= \frac{a+c}{a+b} + \frac{b+d}{b+c} + \frac{c+a}{c+d} + \frac{d+b}{d+a} \\ &= (a+c) \cdot \frac{a+b+c+d}{(a+b)(c+d)} + (b+d) \cdot \frac{a+b+c+d}{(b+c)(d+a)} \\ &= (a+b+d) \left(\frac{a+c}{(a+b)(c+d)} + \frac{b+d}{(b+c)(d+a)} \right). \end{aligned}$$

Soit $mn = \max\{(a+b)(c+d); (b+c)(d+a)\}$, $m \in \{a+b; b+c\}$, $n \in \{c+d; d+a\}$. Alors $m+n = a+b+c+d$. Comme

$$a, b, c, d \text{ sont positifs, on obtient } S \geq (m+n) \left(\frac{a+c}{m \cdot n} + \frac{b+d}{m \cdot n} \right) = \frac{(m+n)(a+b+c+d)}{m \cdot n} = \frac{(m+n)^2}{m \cdot n} \geq 4$$

(car $(m-n)^2 + 4mn = (m+n)^2 \Rightarrow (m+n)^2 \geq 4mn$).

Also solved by J.N. Lillington, Dorchester.

Q50. Let O be the center of the inscribed circle of a triangle ABC.

$$\text{Show that } |AB|^2 \cdot |OC|^2 + |BC|^2 \cdot |OA|^2 > |AC|^2 \cdot |OB|^2.$$

Solution: (J.N. Lillington, Winfrith Technology Centre, Dorchester)

To show the given inequality it is equivalent to proving

$$\left(\frac{AB \cdot OC}{OB \cdot AC} \right)^2 + \left(\frac{BC \cdot OA}{OB \cdot AC} \right)^2 > 1. \Leftrightarrow$$

$$\frac{\sin^2\left(\frac{A+B}{2}\right)}{\sin^2\left(\frac{A+C}{2}\right)} + \frac{\sin^2\left(\frac{B+C}{2}\right)}{\sin^2\left(\frac{A+C}{2}\right)} > 1 \quad (\text{by sine rule on tri-}$$

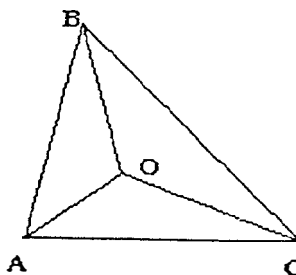
angles). Now $A+B+C = \pi \Rightarrow \cos^2\frac{C}{2} + \cos^2\frac{A}{2} >$

$$\sin^2\left(\frac{A+C}{2}\right).$$

We show the last inequality.

$$\begin{aligned} \sin^2\left(\frac{A+C}{2}\right) &= \sin^2\frac{A}{2} \cos^2\frac{C}{2} + \sin^2\frac{C}{2} \cos^2\frac{A}{2} + 2 \sin\frac{A}{2} \sin\frac{C}{2} \cos\frac{A}{2} \cos\frac{C}{2} \\ &= \cos^2\frac{C}{2} + \cos^2\frac{A}{2} - 2 \cos^2\frac{A}{2} \cos^2\frac{C}{2} + 2 \sin\frac{A}{2} \sin\frac{C}{2} \cos\frac{A}{2} \cos\frac{C}{2} \\ &= \cos^2\frac{C}{2} + \cos^2\frac{A}{2} - 2 \cos\frac{A}{2} \cos\frac{C}{2} \cos\left(\frac{A+C}{2}\right) < \cos^2\frac{C}{2} + \cos^2\frac{A}{2}, \end{aligned}$$

since $0 < \frac{A}{2}, \frac{C}{2}, \frac{A+C}{2} < \frac{\pi}{2}$. Q.e.d



Q 51. An automatic light switches on at 6 p.m., remains on for a whole number of minutes, then switches off and remains off for three times as long as it was on. Then it switches on again, repeats the cycle with the same periods as before and continues. It is seen to be off five seconds before 6.11 p.m., to be on five seconds after 9.03 p.m. and on again at 10.15 p.m.

Was it on or off at 11.18 p.m. ? Give your reasons.

PROBLEM CORNER

Solution: (Nico Lorentz)

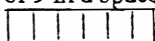
Notons $n \in \mathbb{N}^*$ le nombre de minutes pendant lesquelles la lampe reste allumée à chaque fois, $t \in \mathbb{N}$ le nombre de minutes écoulées depuis 6 p.m. Des données il découle que $n \leq 10$ et que la lampe s'allume si et seulement si $t \equiv 0 \pmod{4n}$.

Pour $t \equiv k \pmod{4n}$, $0 \leq k \leq 4n-1$, notons $t^{ON} = t - k$. De $t_1 = 183 \equiv 3 \pmod{4}$ et $t_2 = 225 \equiv 3 \pmod{4}$ on déduit $n \geq 4$.

Ainsi $4 \leq n \leq 10$, d'où $t_1^{ON} \in \{176; 180\}$ et $t_2^{ON} \in \{248; 252\}$. Comme $n \mid \left(\frac{t_1^{ON}}{4}\right)$ et $n \mid \left(\frac{t_2^{ON}}{4}\right)$ et

$4 \leq n \leq 10$ on obtient $n = 9$. Finalement $t_3 = 318 \equiv 30 \pmod{36}$ et $30 > 9$ permet de conclure que la lampe est éteinte à 11.18 p.m.

Q 52. Two players A and B play the following game. A positive integer N is agreed beforehand. A and B in turn insert a digit 0,1,2,3,4,5,6,7,8 or 9 in a space in the following diagram:



A starts and only one digit is placed in each space. If the resulting 6-digit number is divisible by N , then B wins; otherwise A wins.

For which choices of N can B make certain of winning by adopting a suitable strategy? [A digit may be used more than once and initial zeros are permitted.]

Solution: (Nico Lorentz)

Notons $a \cdot 10^5 + b \cdot 10^4 + c \cdot 10^3 + d \cdot 10^2 + e \cdot 10 + f$, le nombre inscrit à la fin du jeu, où a, b, c, d, e, f non nécessairement distincts, sont choisis parmi 0,1,2,3,4,5,6,7,8,9.

- Si $N \equiv 0 \pmod{2}$ ou si $N \equiv 0 \pmod{5}$, B perd à condition que A choisit d'abord $f \in \{1; 3; 5; 7; 9\}$ respectivement $f \notin \{0; 5\}$.
- Si $N = 1$, il est évident que B gagne.
- Si $N = 3$ ou $N = 9$, B peut toujours choisir le dernier chiffre à inscrire de telle façon que $a+b+c+d+e+f \equiv 0 \pmod{9}$.
- Si $N = 7$ ou $N = 11$ ou $N = 13$, B gagne s'il inscrit les mêmes chiffres que A aux positions déterminées par les égalités $d = a$, $e = b$ et $f = c$. Le nombre ainsi obtenu est divisible par 7, 11 et 13 car $a \cdot 10^5 + b \cdot 10^4 + c \cdot 10^3 + a \cdot 10^2 + b \cdot 10 + c = 100\ 100a + 10\ 010b + 1\ 001c = 7 \cdot 11 \cdot 13 \cdot (100a + 10b + c)$.

Ainsi B peut toujours gagner si $N \in \{1, 3, 7, 9, 11, 13\}$.

In the end I just want to repeat some remarks on problems posed in the Newsletter nos. 20 and 21. The differing versions proposed all have a more straight aim than those originally published.

Maurice Brémond, Avignon, refers to Newsletter no. 21, page 10, Q 42:

On a: $1 \leq x \leq 3 \Leftrightarrow 0 \leq x-1 \leq 2$, d'où: $\left\{ \begin{array}{l} 1 \leq x \leq 3 \\ 0 \leq x-1 \leq 2 \end{array} \right\} \Rightarrow \left\{ \begin{array}{l} 0 \leq x(x-1) \leq 6 \\ x^2 - x \in N \end{array} \right\} \Rightarrow x^2 - x \in \{0, \dots, 6\}$, soit sept solutions que l'énoncé ne demandait pas d'expliciter.

Concerning to Q 44, page 11, Monsieur Brémond suggests the following speedier attempt:

$$\sum_{k=0}^n \sin k\alpha = \sum_{k=1}^n \sin k\alpha = \frac{\sum_{k=1}^n 2 \sin k\alpha \sin \frac{\alpha}{2}}{2 \sin \frac{\alpha}{2}} = \frac{\sum_{k=1}^n \left[\cos(2k-1)\frac{\alpha}{2} - \cos(2k+1)\frac{\alpha}{2} \right]}{2 \sin \frac{\alpha}{2}} = \frac{\cos \frac{\alpha}{2} - \cos(2n+1)\frac{\alpha}{2}}{2 \sin \frac{\alpha}{2}}$$

$$= \frac{\sin \frac{(n+1)\alpha}{2} \sin \frac{n\alpha}{2}}{\sin \frac{\alpha}{2}}. \quad \text{Q.e.d.}$$

Nico Lorentz, Howald/Luxembourg, has taken exception to the solution of Question 45 in the same number.

Voici une variante „moins artificielle“ de la solution proposée par M. Brémond.

En remarquant que $\sin 18^\circ = \cos(90^\circ - 18^\circ) = \cos(4 \cdot 18^\circ)$ et à l'aide des égalités $\cos 2a = -1 + 2\cos^2 a = 1 - 2\sin^2 a$, on obtient: $\sin 18^\circ = -1 + 2\cos^2(2 \cdot 18^\circ) = -1 + 2(1 - 2\sin^2 18^\circ)^2 = 1 + 8\sin^4 18^\circ - 8\sin^2 18^\circ = 1 + 8\sin^2 18^\circ(-1 + \sin^2 18^\circ) = 1 + 8\sin^2 18^\circ(1 + \sin 18^\circ)(-1 + \sin 18^\circ)$.

D'où $-1 + \sin 18^\circ = 8\sin^2 18^\circ(1 + \sin 18^\circ)(-1 + \sin 18^\circ)$.

Comme $\sin 18^\circ \neq 1$, il suffit de diviser les deux membres de cette dernière égalité par $8(-1 + \sin 18^\circ)$ pour obtenir l'égalité exigée.

That's all the space I have this issue. Send me your contest materials, your regional and national Olympiads, comments, suggestions, and your nice solutions to problems posed in the *Corner*.

Finally, propose problems for which readers will send in solutions. Proposals should, whenever possible, be accompanied by a solution, references, and other insights which are likely to be of help for the editor. They can be anything from elementary to advanced, from easy to difficult. Original problems are particularly sought. So, please submit any interesting problems you come across, especially those from (problem) books and contests that are not easily accessible. But other interesting problems may also be acceptable provided they are not too well-known and references are given as to their provenance. I hereby invite my readers to share them with their colleagues and students.

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

Paul Jainta, Werkvolkstr. 10, D-91126 Schwabach

BRIEF REVIEWS

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

J.Diestel, H.Jarchow, A.Tonge: Absolutely Summing Operators, Cambridge Studies in Advanced Mathematics vol.43, Cambridge University Press, Cambridge, 1995, xv+474 pp., GBP 40.00, ISBN 0-521-43168-9

The aim of the authors was to collect and arrange basic facts concerning summing operators and their relatives which are spread through the literature since the fifties. This fascinating subject which has grown during recent decades is processed in an almost encyclopaedic way. Needless to say the book reflects new approaches, methods and also results of the authors. The first chapters give an accessible introduction to the unconditional and absolute summability in Banach spaces (including the Dvoretzky-Rogers theorem, Khinchin's and Grothendieck's inequality), p -summing operators and summing operators on \mathcal{L}_p -spaces, p -integral operators, operators on Hilbert spaces and trace duality. Further chapters concern ultraproducts and local reflexivity, p -factorable operators, the notion of type and cotype (Rademacher sums), randomized series and almost summing operators (the Maurey-Rosenthal theorem), K -convexity and B -convexity, weakly compact operators on $\mathcal{C}(K)$ -spaces, type and cotype in Banach lattices, local unconditionality, summing algebras, Dvoretzky's theorem and factorization of operators. Each chapter ends with abundant Notes and remarks showing further results and connections. The authors must have expended an enormous effort in order to publish such a book and really made a great contribution for a wider mathematical community. Everybody working in the field of functional analysis should include this monograph in his private bookcase. (jl)

K.L.Chung, Z.Zhao: From Brownian Motion to Schrödinger's Equation, Grundlehren der mathematischen Wissenschaften, vol.312, Springer-Verlag, Berlin, 1995, xii+287 pp., 7 fig., DM 148.00, ISBN 3-540-57030-6, ISBN 0-387-57030-6

This is an interesting book on the Schrödinger equation $(\Delta + q)\phi = 0$ written from the point of view of the theory of Brownian motion. The notion of the Feynman - Kac process plays, of course, the central role in the probabilistic treatment of this problem. The presented book treats all the probabilistic aspects of the Schrödinger equation in a great depth and clarity. The central theme of the book is the notion of a "gauge" (also the more general notion of a conditional gauge in Chapter 7), i.e. the expectation of the function $\exp(\int_0^{\tau_D} q(X_s) ds)$ where τ_D is the hitting time of the boundary of the given region D and the integral is over all Brownian paths X starting at a given point

of D . The gauge theorem (Chapter 5 of the book) formulates the following dichotomy: either the gauge is infinite everywhere in D or it is bounded there. This result enables a unified treatment of all the remaining topics (Green functions, principal eigenvalues, special onedimensional problems) of the book. The book is very carefully written, very readable and contains nice illuminatory Notes at the end of each chapter. Undoubtedly, it will become an indispensable book for anybody interested in the subject. (mz)

T.Jackson: From Polynomials to Sums of Squares, Institute of Physics Publishing Ltd., Bristol, 1995, xii+184 pp., GBP 17.50, ISBN 0-750-30364-6, ISBN 0-750-30329-8

According to the author, the purpose of the booklet is to "describe a journey through some of the beautiful foothills of algebra and number theory based around the central theme of factorization". Actually, the booklet presents a very readable elementary introduction to the arithmetic of some quadratic algebraic number fields, starting from the very first concepts such as polynomials and their properties and culminating in splitting of rational primes in such fields. The latter fact explains the second half of the title of the booklet. In my opinion the booklet can be successfully used as an underlining reading or exercise extension to the common curriculum of classical secondary schools as well as a suitable introductory reading for all the novices in the subject seeking the answer to the question regarding the kind of problems to whose solution algebraic number theory could contribute. Appendices containing necessary definitions and results from abstract algebra and related number theory make the booklet self-contained and thus also suitable for the self-study. Moreover, the booklet is accompanied by a diskette with a small program running on IBM PC's, which can be used to reduce the necessary "tedious" hand computations in the course of solving of "problems" and "activities" spread throughout the text. This may seem a bit controversial, since the details of concrete computations form a substantial ingredient of every generic approach to the algebraic number theory. However, the program is mostly designated to support verifications of results, e.g. to multiply the factors of a factorization of a polynomial rather than to the factorization itself. Nevertheless a vision of a computer assistant may attract just the less passionate reckoners for this beautiful part of classical mathematics, which nowadays in the field of computer aided factorizations makes waves. However, due to the slim character of the booklet the reader cannot expect that it touches more than the very basic facts about quadratic fields mostly

demonstrated on concrete examples. This disadvantage is compensated by the very lucid style used. The contents of the booklet can be best described by the titles of the chapters: 1. Polynomials in one variable (31 pp.); 2. Using polynomials to make new number fields (19 pp.); 3. Quadratic integers in general and Gaussian integers in particular (20 pp.); 4. Arithmetic in quadratic fields (23 pp.); 5. Composite rational integers and sums of squares (26 pp.); Six Appendices (43 pp.) are devoted to (a) the basic algebraic notions as groups, divisibility in domains, Euclidean domains; (b) primitive polynomials; (c) the factorization of cyclotomic polynomials; (d) Rouché's theorem; (e) Dirichlet's theorem and Pell's equation; (f) quadratic reciprocity. Each chapter ends with an additional list of exercises. A pleasant feature of the booklet are the summaries following each chapter. (šp)

J.Marsden, T.S.Ratiu: Introduction to Mechanics and Symmetry. A Basic Exposition of Classical Mechanical Systems, Texts in Applied Mathematics, vol.17, Springer-Verlag, New York, 1994, xv+500 pp., 43 fig., DM 69.00, ISBN 0-387-94347-1, ISBN 3-540-94347-1

The importance of symmetry in physical problems was apparent already in time of Newton, Euler, Lagrange and others and is ever increasing since. Its importance is also clearly visible in the development of mechanical problems in last decades, especially in connection with integrable systems. It is a typical interdisciplinary area, where analysis and geometry are combined effectively together. The book presents a geometric approach to problems in physics which have a certain symmetry. A key role is played by a concept of a Poisson manifold and a momentum map and it covers as special cases a lot of different physical situations, e.g. the motion of a rigid body, incompressible fluid, the Maxwell-Vlasov equations in plasma physics, integrable and chaotic systems. The book contains theoretical parts where necessary mathematical tools are developed (manifolds and forms and vector bundles, Lie groups, a Poisson structure on a manifold, momentum maps, coadjoint orbits and reduction procedures) as well as many specific applications in various physical problems. The book contains a substantial amount of various exercises (both theoretical and computational), a solution manual is available by post. There are many pleasing historical remarks scattered throughout the text. A comprehensive bibliography can be found at the end. The book will certainly find a broad spectrum of readers among mathematicians, physicists and engineers and can be heartily recommended to all of them. (vs)

K.H.Hofmann, M.W.Mislove (Eds.): Semigroup Theory and its Applications. Proceedings of the 1994 Conference Commemorating the Work of Alfred H. Clifford, London Mathematical Society Lecture Note Series, vol.231, Cambridge University Press, Cambridge, 1996, ix+165 pp., GBP 19.95, ISBN

0-521-57669-5

The volume contains 8 survey papers and all of them require little preliminary knowledge. The themes covered include totally ordered semigroups, bands of semigroups, consequences of Isbell's zigzag theorem, the role of topology, partial order and categories for the structural description of semigroups, and topological models of the untyped lambda calculus. All surveys are clearly written and the volume can well supplement an introductory text on semigroups. It is dedicated to the memory of the late Alfred H. Clifford and contains also two articles explicitly referring to his work and life. (ad) **W.Y.Hsiang: A Concise Introduction to Calculus**, Series on University Mathematics vol.6, World Scientific, Singapore, 1995, vii+157 pp., \$ 39.00, ISBN 9-810-21900-8, ISBN 9-810-21901-6

In no more than 157 pages, the author aims at answering the question "What is the calculus about and what is it good for?" The book is a well-written illustration of the idea saying that "...calculus is the basic setting and fundamental theory of the mathematics of variable quantities which provides basic tools and the general framework for analyzing all kinds of correlations among variable quantities..." Starting from three preparatory chapters (1: Numbers, Variables and Functions, 2: Basic Properties of Functions, 3: Approximation and Limit) the author gives in the fourth chapter (Foundational Framework and Fundamental Theory of Calculus) a lucid explanation of the main topics of calculus and their mutual relations. The conclusive Chapter 5 is devoted to the introduction of elementary functions and to the analysis of 15 well-chosen examples illustrating the large possibility of applications of calculus to various important questions arising in mathematics and in natural sciences as well. (Eg. Kepler's laws, simple harmonic motion, Snell's law of refraction etc.) As a long-time teacher of calculus, I have found the reading of this book both inspiring and useful. (oj)

J.Krajčiček: Bounded Arithmetic, Propositional Logic, and Complexity Theory, Encyclopedia of Mathematics and its Applications, vol.60, Cambridge University Press, Cambridge, 1995, xiv+343 pp., GBP 40.00, ISBN 0-521-45205-8

The purpose of the book is to explain relations and deep connections between bounded arithmetic, propositional logic and complexity theory. A short basic account of logic, complexity theory including Boolean complexity, propositional proof systems and first order systems of bounded arithmetic is presented. It is then followed by more advanced topics such as characterizations of definable functions in various systems of arithmetic (witnessing theorems), second order systems of bounded arithmetic, propositional translations of arithmetical formulas and polynomial simulations, finite axiomatizability problem of bounded arithmetic, problems of polynomial size proofs of all tautologies in proof systems, finitistic consistency

statements, the issue of hard tautologies and optimal proof systems, combinatorics and Boolean complexity within bounded arithmetic. The book is not intended as a textbook. The aim is to present the main aspects of current research in the mentioned areas. Short bibliographical and other remarks are given at the end of chapters. It can be strongly recommended especially to mathematicians and computer scientists working in the field and to graduate students. (ak)

S.C.Ferry, A.Ranicki, J.Rosenberg: Novikov Conjectures, Index Theorems and Rigidity. Volume 1. Oberwolfach 1993, London Mathematical Society Lecture Note Series 226, Cambridge University Press, Cambridge, 1995, x+372 pp., GBP 24.95, ISBN 0-521-49796-5

S.C.Ferry, A.Ranicki, J.Rosenberg: Novikov Conjectures, Index Theorems and Rigidity. Volume 2. Oberwolfach 1993, London Mathematical Society Lecture Note Series 227, Cambridge University Press, Cambridge, 1995, x+364 pp., GBP 24.95, ISBN 0-521-49795-7

The Novikov conjecture is one of the central problems of the topology of manifolds. In September 1993, there was a conference organized in Oberwolfach devoted to this conjecture and to related problems. Altogether 38 participants with interests in topology, analysis and geometry participated in the conference. The Proceedings of the conference are presented in two volumes. The contents of the proceedings can be divided into the following parts. A. Detailed historical survey of the Novikov conjecture and a bibliography of the subsequent developments. B. The texts of unpublished classic papers by Milnor, Browder and Kasparov relevant to the Novikov conjecture. C. Several papers related to the Novikov conjecture with new results and having also the survey character. D. Research papers which bring different techniques used to study the Novikov conjecture from the point of view of analysis, geometry and topology. These proceedings will be useful for all who are interested in related fields of mathematics such as topology, geometry and analysis and especially for those who are attracted by problems related to the topology of manifolds. There are also 12 pages of open problems presented by participants of the conference. (jbu)

J.W.Thomas: Numerical Partial Differential Equations. Finite Difference Methods, Texts in Applied Mathematics 22, Springer-Verlag, New York, 1995, xx+437 pp., 70 fig., DM 78.00, ISBN 0-387-97999-9

This textbook was developed from a graduate course taught regularly by the author at Colorado State University. It offers a clear, complete and rigorous account of applications of finite difference methods to numerical solution of PDE's. The book is suitable for a broad spectrum of students, ranging from first year mathematics graduate students to third year

engineering graduate students. Prerequisites are at least one semester of PDE's and some programming capability. The text of the course is divided into two parts. This book contains only the first part subtitled "Finite Difference Methods". It includes most of the basic material on time dependent equations including parabolic and hyperbolic problems, multi-dimensional problems, systems and dissipation and dispersion. The book provides a review of a large range of methods. The goal is to gain both theoretical knowledge and numerical experience for these methods. Some methods are used to solve nonlinear problems (Viscous Burgers' Equation, Inviscid Burgers' Equation, Stack Tube Problem and Thin Disturbance Transonic Flow Equation). The first chapter contains an introduction to finite difference grids and a finite difference approximation of a PDE and, in addition, a finite volume derivation of difference equations. The goal of the second chapter is to give basic definitions of convergence of finite difference equations to PDE's (consistent and stable scheme, Lax Theorem). The stability of difference schemes is fully discussed in the third chapter. The tools that can be used to prove stability of difference schemes are given (discrete Fourier transform, Gerschgorin Circle Theorem). In the next two chapters, difference schemes for two and three dimensional parabolic and hyperbolic PDE's are discussed. Many applications of PDE's involve systems of partial differential equations. The aim of the sixth chapter is to analyze difference schemes for these systems. In the final chapter several techniques for analyzing numerical schemes are developed. In the book a complete problems are discussed, including the physical setting, the mathematical description, the numerical scheme and computer results. The new technologies, namely algorithms for symbolic computations and graphics, are used extensively. Throughout the text there is a strong emphasis both on theory and on implementing the schemes. When theorems are used without proof, careful references are included for these results. The text includes also homework problems that implement different aspects of most of the schemes discussed. (janov)

C.T.J.Dodson, E.A.Gonzales: Experiment in Mathematics Using Maple, Springer-Verlag, Berlin, 1995, xix+465 pp., 146 fig., DM 48.00, ISBN 3-540-59284-9

This book is another member of the family of textbooks which use the computer algebra system - Maple - to achieve better understanding of mathematics. The book is divided into two basic parts. The first one (Pre-Calculus Mathematics) covers such topics as functions or sequences and series. The second part of the book is named Beginning Calculus and the topics of this part correspond to this name. We can meet there, for instance, limits, derivatives of functions or integration. The book is designed for use in school computer labs or

with home computers. It is a hardcopy version of the worksheets, in fact. But the book contains additional explanatory text, bibliography and index, too. The answers to exercises are presented at the end of the book, but there are also open-ended experiments in the text. The book can be used for independent study or as a supplement to a course book. The book is recommended to all. (ml)

A.V.Bitadze: Integral Equations of First Kind, Series on Soviet and East European Mathematics vol.7, World Scientific, Singapore, 1995, vii+265 pp., \$ 55.00, ISBN 9-810-22263-7

The book is devoted to the study of linear integral equations of the first kind. Integral equations for functions of one variable are treated on the basis of Cauchy-type integrals. Various types of kernels for integral equations of the first kind are studied. Simple examples are presented for illustration. Analytic methods for investigating integral equations of the first kind are given, they represent a fairly good account of this diversified field where a unified theory is not present as in the case of equations of second kind. (ss)

A.Joyal, I.Moerdijk: Algebraic Set Theory, London Mathematical Society Lecture Note Series 220, Cambridge University Press, Cambridge, 1995, viii+123 pp., GBP 17.95, ISBN 0-521-55830-1

The book perceives the universe of sets by a structure of algebraic nature. This structure is called a Zermelo-Fraenkel algebra and its operations correspond to the usual operations on sets. The authors are not formalizing properties of the membership relation, however this relation can be easily derived. The theory is developed constructively and in this way it arrives at the description of ordinals and the method of transfinite induction. Algebraic notions and tools: free algebras, generators, identities etc., are applied, and the free Zermelo-Fraenkel algebras and different algebras of ordinals are constructed explicitly with the use of simulations on forests and the theory of open maps. In the book some of the possible areas accessible by the presented approach to set theory are outlined. It involves intuitionistic set theory and contains some views regarding forcing models of set theory, realizability models or sheaf construction. For reading background in topos theory is useful. (rb)

R.W.R.Darling: Differential Forms and Connections, Cambridge University Press, Cambridge, 1994, x+256 pp., GBP 30.00, ISBN 0-521-46259-2, ISBN 0-521-46800-0

The basic language of modern differential geometry — manifolds, differential forms and their integration, vector bundles and connections are becoming more or less standard part of basic mathematical education. The book brings a careful exposition of them together with a classical surface theory described using moving frames approach. Basic notions are explained first in the case of submanifolds of a Euclidean space. As an

application, in the last chapter, the author describes how connections are treated as gauge fields in elementary particle physics, main example being instanton solutions of self-dual Yang-Mills field equations. The book is practically oriented, especially valuable is a set of almost two hundreds of exercises (there is a shortage of them in literature). Prerequisites needed are small, just linear algebra and standard vector calculus in three dimensions. It is a very good complement of existing literature suitable also for physicists and engineers. (vs)

R.J.Plymen, P.L.Robinson: Spinors in Hilbert Space, Cambridge Tracts in Mathematics, vol.114, Cambridge University Press, Cambridge, 1994, xiv+165 pp., GBP 25.00, ISBN 0-521-45022-5

The classical (finite-dimensional) Clifford algebras, their representations and related topics as Spin groups, spinors and Dirac operators belong to the important objects in geometry, topology and mathematical physics. Their infinite-dimensional version originated in the quantum physics of a free fermion field and is the main topic of the presented book. More concretely the book contains description of various Clifford algebras over a real Hilbert space, as C^* Clifford algebra and von Neumann Clifford algebra, Fock representations and parity and their transformation properties. The infinite-dimensional analogy of Spin groups are introduced and discussed here. The book is self-contained and well written. (jbu)

L.A.Petrosjan, N.A.Zenkevich: Game Theory, Series on Optimization, vol.3, World Scientific, Singapore, 1996, xi+352 pp., GBP 46.00, ISBN 9-810-22396-X

The book addresses several areas of the broad mathematical discipline called theory of games, including also authors' results of their own. The chapter "Matrix games" deals with two-person zero-sum finite games, introducing also mixed strategies. This is further generalized to "Infinite zero-sum two-person games" for which the existence of optimal mixed or (in the convex/concave case) pure strategies is shown, and examples of special games like pursuit, search or poker are studied. The third chapter deals with "Nonzero-sum games", performing a classical proof of the existence of Nash equilibria by means of Kakutani's fixed-point theorem and introducing also refined concepts like perfect or proper equilibria. The "Positional games" form the fourth chapter, including in particular multistage zero-sum games, hierarchical games, games with incomplete information, etc. The last chapter, entitled "Differential games", deals with games involving an initial-value problem for (a system of) ordinary differential equations. Classical areas including zero-sum games, pursuit and evasion, Isaacs-Bellman equation, and optimality principles are addressed there. Each chapter is accompanied by many exercises and problems. The book will be useful both for experts in Game theory and for advanced students interested in optimization in general. (trou)

V.P.Havin, N.K.Nikol'skij (Eds.): Commutative Harmonic Analysis III. Generalized Functions. Applications, Encyclopaedia of Mathematical Sciences vol.72, Springer-Verlag, Berlin, 1995, vii+266 pp., 34 fig., DM 148.00, ISBN 3-540-57034-9, ISBN 0-387-57034-9

This volume of Encyclopaedia of Mathematical Sciences contains three parts. The first part written by V.P. Palamodov has the title Distributions and Harmonic Analysis. It contains basic information on distributions, less known parts of the theory on distributions on a manifold, harmonic analysis with applications in hyperbolic problems of mathematical physics and in integral geometry. This part of the book represents an excellent survey of topics needed for the field of harmonic analysis. The second part Optical and Acoustic Fourier Processors, prepared by V.S. Buslaev describes physical devices based on Fourier transform and the mathematics behind them. A nice description of the principles on which devices of this kind are operating is presented. The final part The Uncertainty Principle in Harmonic Analysis is written by V.P. Havin and B. Jöricke. The main idea is based on the fact that for a function different from zero the function itself and its Fourier transform cannot both be very small. A collection of mathematical facts illustrating this assertion is given for real and complex functions. This volume gives the relevant basic information on the three topics described above and will be useful for specialists as well as for applied scientists. (ss)

S.B.Cooper, T.A.Slaman, S.S.Wainer (Eds.): Computability, Enumerability, Unsolvability. Directions in recursion theory, London Mathematical Society Lecture Note Series, vol.224, Cambridge University Press, Cambridge, 1996, vii+347 pp., GBP 24.95, ISBN 0-521-55736-4 vii+347 pp., GBP 24.95, ISBN 0-521-55736-4

The book contains 15 research articles commemorating the Leeds Recursion Theory Year 1993-94. The papers provide a picture of current results and methods both in Recursion Theory as well as in some directions of Theoretical Computer Science motivated by fundamental ideas of computation and recursion. The topics range over computable functions, computably enumerable sets, degree structures, complexity, subrecursiveness, domains an inductive inference. They illustrate achievements in the area in recent years. Some of the papers provide also a good background material. An appendix contains an informal list of open problems. (ak)

D.Laugwitz: Bernhard Riemann 1826-1866. Wendepunkte in der Auffassung der Mathematik, Vita Mathematica. Band 10, Birkhäuser, Basel, 1996, 346 pp., DM 88.00, ISBN 3-764-35189-6

This book written in German is an excellent survey of the life and work of Bernhard Riemann. Riemann's work in complex and real analysis is described in full detail together with the historical background of all

his mathematical achievements. Geometry and physics in the work of Riemann is evaluated in the same way. The author recommends using Riemann's collected papers published in 1990 by R. Narasimhan when reading the present book. The author is looking for a unified concept and philosophical views in the work of B. Riemann. Riemann's personality is a very good reason for presenting the changes in mathematics of the last century. The main changes concern the methods mathematics is using e.g. for proofs. In the work of Riemann all the basic methodological and philosophical development can be followed in a clear way. The contribution of D. Laugwitz is not only a contribution evaluating Riemann's life and work. It is mainly a view of the development of mathematics in the last century and of all changes which have formed mathematics of our times. The book is a thrilling reading for mathematicians interested in history and development of ideas. (ss)

D.R.Adams, L.I.Hedberg: Functions Spaces and Potential Theory, Grundlehren der mathematischen Wissenschaften 314, Springer-Verlag, Berlin, 1996, xi+366 pp., DM 148.00, ISBN 3-540-57060-8, ISBN 0-387-57060-8

This book is devoted to an interplay of potential theory and function spaces. In the classical potential theory of harmonic functions one obtains the solution of the Dirichlet problem by minimizing the

Dirichlet integral and this is closely related to taking projections in a certain Hilbert space. A short step further leads to the study of Sobolev spaces which are basic means for an extension of the classical theory to the nonlinear potential theory. The authors introduce some background such as Sobolev spaces and Bessel potentials in the first chapter. Then they define (α, p) -capacities and the associated nonlinear potentials. Further chapters are devoted to estimates for Bessel and Riesz potentials and Besov and Lizorkin-Triebel spaces. There follow chapters on metric properties of capacities, continuity properties, trace and imbedding theorems, Poincaré type inequalities and an approximation theorem. Chapter 10 contains new results of Yu.V. Netrusov. The final chapter gives complete solutions in terms of capacities to some approximation problems for holomorphic and harmonic functions. Each chapter ends with Notes and Further Results where the reader can find references to the literature and results that complement the main body of the text. The monograph is warmly recommended to everybody working in the field and/or to those who like nice mathematics. (jl)

A.N.Shiryayev: Probability. Second Edition, Graduate Texts in Mathematics, vol.95, Springer-Verlag, New York, 1996, xvi+621 pp., 54 fig., DM 89.00, ISBN 0-387-94549-0

The book presents a systematic treatment of probability starting with its discrete models in Chapter I and gradually developing the theory to more complex

subjects, such as martingales and Markov chains or weak convergence of probability measures. Supported by the apparatus of probabilistic measure theory, the concise and up to date treatment of which is presented by Chapter II, the author leads his reader through all important discrete time stochastic models to leave him (her) well prepared to enter difficult and complex areas of continuous time stochastic models and their important applications that range from physics to financial modelling. I do not hesitate to recommend Shiryayev's book not only to students of probability and statistics but also to any mathematician who looks for some adequate source of information about probability theory and its models. The following brief excursion through the contents may support the reviewer's opinion that Professor Shiryayev wrote a good and useful book: *Convergence of Probability Measures*. Central Limit Theorems, Rapidity of Convergence, Strong Representations, Contiguity, Hellinger Distance *Independent random variables*. Law of Large Numbers, Law of the Iterated Logarithm, Zero-One Laws. *Stationary and ergodic sequences*. Ergodic Theorems, Mixing. *Stationary* (in the wide sense) *sequences*. Spectral representations and densities, Estimation of Spectral Density, Kalman Filter. *Martingales*. Inequalities, Convergence Theorems, Central Limit Theorem, Discrete Itô formula, Probability of Ruin in Insurance. *Markov Chains*. Classification of States, Arithmetic and Asymptotic properties of the Transition Probabilities $p_{ij}^{(n)}$, Stationary Distributions. *Exercises and Problems* given at the end of each section provide a reader with a material for an independent study. (jste)

D.Salomon: The Advanced TeXbook, Springer-Verlag, New York, 1995, xx+490 pp., DM 68.00, ISBN 0-387-94556-3

The book is aimed at readers having some experience with TeX and wanting to become TeXperts. It contains also introductory material but most of the contents lies rather deep; some things are treated in even more depth than in Knuth's TeXbook. Of course, the book did not intend to *replace* the TeXbook; it complements it with many examples and exercises (with answers), with rather detailed discussion of many advanced topics. Important places are specially noted: where a reader will profit from making some experiments on a computer or where there are rather important definitions. A part of the Preface is formed by a short overview of the book which helps a potential reader determine the attention paid to subjects he wishes to master. The book offers also a means for the reader to test his knowledge, the depth of understanding of important TeX features. Those who follow things a bit and TeX-related issues will be aware of the author's excellent articles in TUGboat where some parts of material treated in the book were published. The book is strongly recommendable for being available at any site where TeX is used for the preparation of articles, books and journals or other complicated texts

to be printed. (jive)

A.Browder: Mathematical Analysis. An Introduction, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1996, xiv+333 pp., 5 fig., DM 58.00, ISBN 0-387-94614-4

This is a very nice textbook, aimed at graduate beginners or, more likely, at advanced undergraduate students of mathematics. It contains much more material than for a year-long course in analysis. The author's choice fully corresponds to his opinion expressed in the preface: "Analysis might be described as the mathematics that deals with the ideas of the infinite and infinitesimal; more specifically, it is the word used to describe the great web of ideas that has grown in the last three centuries from the discovery of the differential and integral calculus." The author names among those textbooks which he considers as model analysis textbooks Rudin's *Principles of Mathematical Analysis* and Spivak's *Calculus on Manifolds*. The book is relatively condensed, but it contains some historical comments and things are occasionally repeated whenever the author considers that the situation requires it. His comment: redundancy is the key to successful communication in a noisy channel. I consider the book very readable. On about 320 pages it deals with Real numbers, Sequences and series, Continuous functions on intervals, Differentiation, Riemann integral, Topology, Function spaces, Differentiable maps, Measures, Integration, Manifolds, Multilinear algebra, Differential forms and Integration on manifolds (these are titles of 14 chapters). Every chapter contains exercises. Highly recommended for the work with students. (jive)

K.A.Petersen, I.A.Salama (Eds.): Ergodic Theory and its Connections with Harmonic Analysis, London Mathematical Society Lecture Note Series 205, Cambridge University Press, Cambridge, 1995, xiii+437 pp., GBP 24.95, ISBN 0-521-45999-0

The lecture note presents proceedings of the conference on the subject held in Alexandria in 1993. It is divided into two parts. The first part consists of three survey articles. First of them, 'Pointwise ergodic theorems via harmonic analysis' by J. M. Rosenblatt and M. Wierdl presents a lecture notes by itself; its length is 148 pages(!). It concerns ergodic theorems for subsequences (good and bad sequences, universally good and universally bad sequences, Bourgain's entropy method, ...). The second, 'Harmonic analysis in rigidity theory' by R.J. Spatzier will please specialists in smooth dynamics. It concerns rigidity properties of discrete Lie groups and their actions on manifolds. The third one, J.-P. Thouvenot's 'Some properties and applications of joinings in ergodic theory' presents a bunch of results on actions of groups on Lebesgue spaces. The next part consists of thirteen research papers written by P.J.Bose, L.Ciach, T.Downarowicz, A.H.Forrest, E.Glasner, G.Goodson, P.Grzegorzcyk,

D.A.Hendrick, R.Jajte, E.Lesigne, R.McCutcheon, J.H.Olsen, A.Paskiewicz, D.J.Rudolph, and B.Weiss. (dvol)

P.J.Davis, R.Hersh, A.E.Marchisotto: The Companion Guide to the Mathematical Experience. Study Edition, Birkhäuser, Boston, 1995, vi+120 pp., DM 28.00, ISBN 0-817-63849-0, ISBN 3-764-33849-0

This Guide is published for the first time. The book "The Mathematical Experience" by the same authors is considered to provide a layman a unique chance to visit mathematical world. It was used in seminars for non-math university students and by teachers of mathematics at secondary schools. To help both teachers and students the authors decided to provide them with a unique collection of ideas, suggestions and hints related to the chapters of the book designed for the active use of the material presented. A user of the book would probably not find it difficult to invent an efficient way of using it in a seminar. The guide represents a considerable help in this direction and could save a lot of time. Recommended to all teachers who like to make their students active participants of the learning process. (jive)

W.S.Anglin, J.Lambek: The Heritage of Thales, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1995, x+327 pp., 23 fig., DM 58.00, ISBN 0-387-94544-X

The book is intended as a textbook on the history, philosophy and foundation of mathematics for students of mathematics. The authors have realized an attempt to teach some good mathematics in a historical context. On the other hand, they wish to welcome interested students from the sciences, humanities and education. The publication consists of two parts. The first one, *History and Philosophy of Mathematics* (171 pp.), contains 31 short sections in which many looks into the history of mathematics are given and various kinds of interesting mathematical problems (up to about 1800) are discussed (Egyptian mathematics, Prime numbers, Pythagoras and his school, Perfect numbers, Euclid, Archimedes, The cubic and quartic equations, Leibniz, The law of quadratic reciprocity, etc.). The second part of this book, *Foundation of Mathematics* (134 pp.), consists of 35 sections and deals with selected topics from the nineteenth and twentieth centuries (Natural numbers - Peano's approach, Complex numbers, Quaternions, Cardinal numbers, Pythagorean triangles and Fermat's Last Theorem, Intuitionistic type theory, Gödel's theorem, etc.). In the last sections, there are briefly sketched more universal aspects of contemporary mathematics, such as categories, functors, graphs, natural transformations, etc. The book includes exercises (to each section), bibliographical references (165 titles) and an index. This publication is well written, nicely organized, easy to read. It can be used in seminars as a good teaching text and can be recommended to students, teachers of

mathematics at secondary schools as well as to university teachers. (jbe)

S.D.Chatterji (Ed.): Proceedings of the International Congress of Mathematicians (ICM), Zürich 1994, 2-Vols-Set, Birkhäuser, Basel, 1995, 1676 pp., DM 348.00, ISBN 3-764-35153-5, ISBN 0-817-65153-5

The Proceedings contain papers which were presented at the International Congress of Mathematicians (August 3-11, 1994, Zürich, Switzerland). In the introductory part of the first volume, there are an account of the organization of the Congress and other information (the organizing committee, list of donors, opening and closing ceremonies, scientific program, list of participants - 2476 ordinary members from 92 countries, list of past congresses, list of past Field medalists and Rolf Nevanlinna prize winners, photographs). In the next part (26 pp.), in five brief reports, there are achievement of the four Field medalists (Jean Bourgain, Pierre-Louis Lions, Jean-Christophe Yoccoz, Efim Zelmanov) and the Rolf Nevanlinna prize winner (Avi Wigderson) are presented. The fourteen invited one-hour addresses at the plenary sessions of the Congress constitute the next part of the Proceedings (234 pp.). For example, we can find here the papers *Progress on the four-colour theorem* of Paul Seymour (13 pp.) and *Modular forms, elliptic curves and Fermat's Last Theorem* of Andrew Wiles (3 pp.). Invited forty-five minute addresses were divided into 19 section meetings: Logic (3 papers), Algebra (7), Number theory (7), Geometry (11), Topology (10), Algebraic geometry (7), Lie groups and representations (10), Real and complex analysis (10), Operator algebras and functional analysis (5), Probability and statistics (8), Partial differential equations (11), Ordinary differential equations and dynamical systems (9), Mathematical physics (10), Combinatorics (6), Mathematical aspects of computer science (4), Numerical analysis and scientific computing (6), Applications of mathematics in the sciences (7), Teaching and popularization of mathematics (3), History of mathematics (3). An author index is included in both volumes. The publication can be very recommended as a very deep and extensive look into the contemporary mathematical research. There is no doubt that Proceedings of the ICM containing papers of all mathematical branches written by leading experts in the world should belong to every mathematical library. (jbe)

D.M.Akhiezer: Lie Group Actions in Complex Analysis, Aspects of Mathematics, vol. E27, Friedrich Vieweg & Sohn, Braunschweig, 1995, viii+201 pp., DM 68.00, ISBN 3-528-06420-X

It is always important to have a suitable set of good test examples in any theory. In complex analysis and theory of complex spaces, homogeneous spaces of complex Lie groups and associated homogeneous vector bundles form a distinguished set of important examples.

The book offers a description of a role of a Lie group action in complex analysis, basic facts on analysis on homogeneous spaces of complex Lie groups as well as the role of these homogeneous spaces and homogeneous bundles in representation theory (e.g. Bott-Borel-Weil theorem describing an important geometrical realization of finite dimensional representations of these groups). It is a nice introduction to a modern important topic. (vs)

S.Axler: Linear Algebra Done Right, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1996, xvii+238 pp., DM 42.00, ISBN 0-387-94596-2, ISBN 0-387-94595-4

The book is intended for a second course in linear algebra (a first course usually emphasizes matrices and computation); it consistently uses language of vector spaces and linear maps and leads to a deeper understanding of the main ideas of linear algebra. Standard books of the subject use determinants to prove some principal theorems, for example, that every operator on finite-dimensional complex vector space has an eigenvalue. In this publication, determinants have been shifted to the end. Hence, we find in this textbook only determinant-free proofs and methods. The publication has 10 chapters. In the first three, the basic properties of vector spaces and linear maps are developed. The fourth chapter presents some results about polynomials. In the fifth chapter, without defining determinants or characteristic polynomials, some principal results of linear algebra are proved. For example, each operator on a complex vector space or on an odd-dimensional real vector space has an eigenvalue. In chapter 6, the standard results on inner products are presented. In what follows, the questions of the operators on inner-product spaces and on complex and real vector spaces are investigated (linear functionals, normal operators, positive operators, isometries, the characteristic and the minimal polynomials, Jordan form, etc.). In the last chapter, the notions of trace and determinant in terms of the characteristic polynomial are defined and investigated; the standard results about determinants are easily proved. An important part of the book consists of a large number of theoretical exercises, symbol index and index. The book can be recommended not only as a text but also as a reference. (jbe)

J.Jost: Riemannian Geometry and Geometric Analysis, Universitext, Springer-Verlag, Berlin, 1995, xi+401 pp., DM 78.00, ISBN 3-540-57113-2, ISBN 0-387-57113-2

The present textbook is a nice introduction into geometry and analysis on Riemannian manifolds. It is self-contained and the material presented here covers main topics from the modern theory. At the end of every chapter a short section called "Perspectives" is added, where further results and directions concerning the theory are presented. There are also numerous exercises for interested readers. The main themes discussed in the book are basic properties of differentiable manifolds

and vector bundles, de Rham cohomology and harmonic forms; connections, geodesics and Jacobi fields; an introduction to Morse Theory, basic facts on symmetric spaces and Kähler manifolds and the theory of harmonic maps. There is also a special chapter containing a short survey on curvature and topology and two Appendices, the first about linear elliptic PDE's and the second on fundamental group and covering spaces. (jbu)

H.Bauer: Probability Theory, de Gruyter Studies in Mathematics 23, Walter de Gruyter, Berlin, 1995, xv+523 pp., DM 148.00, ISBN 3-110-13935-9

"This book is intended to serve as a guide to the student of probability" is a sentence that opens the preface to the author's *Probability Theory and Elements of Measure Theory* published by Holt, Rinehart and Winston in 1972 and by Academic Press in 1981. And again, in 1996, we welcome his *Probability Theory* as a reliable, precise and beautifully written textbook. It leads a reader safely through the classical standards of probability theory (*Probability Space, Random variables, Independence, Laws of Large Numbers, Characteristic Functions, Central Limit Theorems, Conditional Expectations*) to more advanced topics (*Law of the Iterated Logarithm, Martingales*) closing itself with elegant and mathematically sophisticated two chapters on continuous time processes (*Construction of Stochastic Process, Semigroups of Kernels, Modifications, Markov, Gaussian, Poisson and Brownian Processes, Elements of Stochastic Analysis*). The text is accompanied by a rich collection of stimulating, and sometimes even challenging, examples to test the reader's understanding and to open for him or her windows to the contemporary developments of probability theory. The author wrote this book (unlike its predecessors) for a student with a good background in measure theory, its sophistication for Borel measures on metric spaces included. One may of course hesitate a little about some of the author's notational and terminological innovations (*dist(X)* instead of $\mathcal{L}(X)$ and "an independent sequence of random variables" instead of "a sequence of independent random variables"), nevertheless the reviewer with an experience of his own as the author of a textbook on probability can do no other than to recommend strongly Heinz Bauer's *Probability Theory* to all who need, or better, wish to enter the world of stochastics. (jos)

J.D.Monk: Cardinal Invariants on Boolean Algebras, Progress in Mathematics, vol.142, Birkhäuser, Basel, 1996, ix+294 pp., DM 78.00, ISBN 3-764-35403-X, ISBN 0-817-65402-X

After van Douwen's article in *Handbook of Boolean Algebras* (1989) and author's "Cardinal Functions on Boolean Algebras" (1990), this is the third attempt to comprehend the subject which has recently developed so rapidly. The book is a systematic exposition of cardinal invariants of Boolean algebras. Of course, Stone duality ties the subject to cardinal invariants of topological spaces, however, the book definitely convinces the

reader that the Boolean setting has also its rights and advantages, namely when the topological counterpart does not have so apparent meaning (e.g., cofinality, incomparability). J. D. Monk was careful to include a lot of important new results, which, together with a long list of open problems and a summary of properties of the most common/typical/very special examples makes this book at least as useful as was Juhász' "Cardinal Functions in Topology" twenty five years ago. (psi)

I.Gohberg, P.Lancaster, P.Shivakumar (Eds.): Recent Developments in Operator Theory and Its Applications. International Conference in Winnipeg, October 2-6, 1994, Operator Theory: Advances and Applications, vol.87, Birkhäuser, Basel, 1996, ix+435 pp., DM 178.00, ISBN 0-817-65413-5, ISBN 3-764-35413-5

This volume contains the proceedings of the Conference devoted to the topics like infinite matrices and projection methods, inverse scattering problem, the theory of linear operators on indefinite scalar product spaces, perturbation theory of differential operators (Schrödinger type, Wiener Hopf, Mathieu, operators arising in hydrodynamics and elasticity), spectral representations, mathematical systems theory and control. The book will be interesting to a wide audience in Mathematics and Engineering Sciences. It is linked to another volume "Lectures on Operator Theory and its Applications" published by the AMS for the Fields Institute, Ontario, 1995. (mza)

J.Johnson, B.Evans: Discovering Calculus with Derive. Second Edition, J.Wiley & Sons, Inc., New York, 1995, x+314 pp., GBP 14.95, ISBN 0-471-00972-5
This book is parallel to the book Discovering Calculus with Maple by K.Harris and R.J.Lopez. The only important difference between these two books consists of the computer algebra system used. Otherwise, they are very similar. It means that this book covers again topics of a traditional calculus course and that it treats them in the same way. The structure of chapters has a similar form. Firstly, a list of new DERIVE topics and calculus concepts is presented. Then a collection of solved problems follows. Finally, sections Practice Problems and Laboratory Exercises are included. Practice Problems are not very difficult exercises. They help students to be familiar with DERIVE. The solutions of these problems are provided. The Laboratory exercises are more complex. The first chapter of the book is devoted to an introduction to DERIVE. Therefore, no a priori knowledge of this computer algebra system is required. The book contains the indexes of Solved Problems and Laboratory Exercises. The book follows the flow of the fifth edition of Calculus with Analytic Geometry by H.Anton and the seventh edition of Calculus One and Several Variables by S.L.Salas, E.Hille and revised by G.J.Etgen. Therefore, the key for use with these two textbooks is included. However, this book can be used with any traditional

calculus textbook. (ml)

Z.M.Ma, M.Röckner, J.A.Yan (Eds.): Dirichlet Forms and Stochastic Processes. Proceedings of the International Conference held in Beijing, China, October 1993, Walter de Gruyter, Berlin, 1995, xi+443 pp., ISBN 3-110-14284-8

This book contains 38 selected papers related to lectures given by the authors at the "International Conference on Dirichlet Forms and Stochastic Processes" and the "School on Dirichlet Forms", both held in October 1993 in China. The theory of Dirichlet forms was developed over the last two decades and is a very fruitful area of mathematics. It established a link between certain parts of potential theory, probability and differential equations and is connected with various fields as e.g. functional analysis, theory of semigroups, differential geometry, both analytic and probabilistic potential theory, pseudo-differential operators, Markov processes, martingale theory and stochastic differential equations. (jl)

N.J.Hitchin, P.E.Newstead, W.Oxbury (Eds.): Vector Bundles in Algebraic Geometry, London Mathematical Society Lecture Note Series 208, Cambridge University Press, Cambridge, 1995, ix+345 pp., GBP 24.95, ISBN 0-521-49878-3

The book is based on lectures and discussions presented at the 1993 Durham Symposium *Vector Bundles in Algebraic geometry* and brings an overview of the key areas of the research involving vector bundles over algebraic varieties. There are contributions on various topics: Floer homology (S.K.Donaldson), Horrocks-Mumford bundle (K.Hulek), semistable sheaves (J. Le Portier), conformal field theory (K.Ueno), combinatorics of the Verlinde formulas (A.Szenes), the deformation theory of moduli spaces of vector bundles (V.Balaji, P.A. Vishwanath), stable augmented bundles over Riemann surfaces (S.Bradley at al.), submanifolds in projective spaces (W.Decker, S.Popescu), exceptional bundles and moduli spaces of stable sheaves on P^5 (J.-M Drzet) and spin polynomials of an algebraic surface (A.Tyurin). (jbu)

M.B.Subrahmanyam: Finite Horizon HG^∞ and Related Control Problems, Systems & Control: Foundations & Applications, Birkhäuser, Boston, 1995, x+120 pp., DM 78.00, ISBN 3-764-33811-3, ISBN 0-817-63811-3

This book of the Birkhäuser series "System & Control: Foundations & Applications" is devoted to the state space approach to finite horizon H_∞ -optimal and suboptimal control problems. Approximate solutions to robustness problems are also proposed. Throughout the book, the state spaces are finite dimensional, the governing equations are nonautonomous systems of linear ordinary differential equations and the costs are quotients of quadratic functionals. The book consists of five theoretical chapters which are based on the author's investigations. The last chapter contains an interesting

application to a design of the F/A-18A Automatic Carrier Landing System which is accompanied by numerical simulations. A reader of the book should be familiar with special terminology used in this field and should have basic knowledge of general control theory. (jmil)

J.V.Rauff: Math Matters, J.Wiley & Sons, Inc., New York, 1996, xv+491 pp., GBP 22.50, ISBN 0-471-30452-2

Math Matters is a textbook for those whose intention is to learn or to teach what is often called mathematical literacy. In each of twelve chapters the subject is presented in special problem situations (36 of them in total) which anybody can, and very likely will, encounter in his normal, non-professional life. The problem situations are about interesting subjects such as shopping, installment buying, saving and borrowing money, quality control, testing of hypotheses, optimization, mathematics of games and mathematics of reasoning – to name at least the most challenging ones. Solution of every problem situation and the explanation of the mathematical theory attached to it is done in several stages grouped into sections. Several exercises are appended to every stage and their solutions are listed at the end of the chapter. Also each of the chapters ends with a collection of exercises to all items of the theory and application introduced in the chapter. The solutions to the odd-numbered exercises can be found at the end of the book. The problem situation serves as an incentive for a reader to get interested in an adequate portion of mathematical theory which is apparently indispensable to understand the situation and to solve it. The situation-strategy seems also to be an excellent method for the development of the techniques for mathematization of the real life situations. The aforementioned portion of the mathematical theory is so well weighed up that even the complicated problems like mortgage payment or quality control could be understood by almost all junior secondary-school pupils. For the sake of the practical knowledge, not all the sophisticated theories related to the problem situations are presented. In several cases, the theory is developed only to the stage of an understanding to the problem and then the useful formula is given (with references to sources of more profound information) to be taken for granted. (jtro)

D.Quinney, R.Harding: Calculus Connections. A Multimedia Adventure. Volume 1, Laboratory Workbook & Program Documentation, J.Wiley & Sons, Inc., New York, 1996, 120 pp., GBP 22.50, ISBN 0-471-02111-3

This laboratory workbook was written for undergraduate students studying mathematics via the Calculus Connections software. The book contains eight chapters which provide a basic information on functions, limits, derivatives, finding maxima and minima, areas, fundamental theorem of calculus and mean-value theorem for

integrals. Each one of these chapter uses software modules to enable better understanding. The other chapters deal with program documentation. The book includes testing questions and many figures. Unfortunately, the book contains a lot of misprints, confusing explanations and false assertions (see for example the definition of double root of function and the assertion on double roots on p. 15, the example 2.3 on p. 20, fundamental theorem of calculus on p. 94). (zel)

V.N.Sachkov: Combinatorial Methods in Discrete Mathematics, Encyclopedia of Mathematics and its Applications, vol.55, Cambridge University Press, Cambridge, 1996, xiii+306 pp., GBP 45.00, ISBN 0-521-45513-8

This is an English translation of enlarged and updated 1977 Russian text. It is divided in 6 chapters: 1. Combinatorial Configurations, 2. Transversals and Permanents, 3. Generating Functions, 4. Graphs and Mappings, 5. The general combinatorial scheme, 6. Polya's theorem and its applications. The highlight of the book is a good survey of some enumerative techniques, generating functions and asymptotic analysis. The other (and thus most) parts of combinatorial analysis are very sketchy (or absent) and to claim that the book could serve as a textbook is an exaggeration (this holds for most of chapters 1,2 with a notable exception of the proof of Van der Waerden conjecture on permanents). The good features of the book (chapters 4 and 5) are obscured by some casual writing (translation?) as manifested e.g. in the definition of general combinatorial scheme. Since 1977 Combinatorial mathematics has gone a long way. It appears that the text was updated and complemented superficially and the bibliography is very incomplete. (jneš)

J.Lukeš, J.Malý: Measure and integral, Matfyzpress, Praha, 1996, 178 pp., ISBN 80-85863-06-5

The introductory part, where the abstract theory of measure and integral is discussed, is followed by a chapter on integration in locally compact spaces. This culminates with the Riesz representation theorem. A brief introduction to measure theory on groups (Haar measure) is appended to this chapter. The study of integration on the real line contains the Lebesgue differentiation theorem and the Henstock-Kurzweil integral. From the topics on measure and integration on R^n , the covering theorems, differentiation of measures, density topology and approximately continuous functions are included. New proofs of the Rademacher and Besicovitch theorems are presented. A part of the book is devoted to the study of the theory of distributions, Fourier transform, approximation in function spaces and degree theory. The presentation of line and surface integrals is based on k -dimensional measures (possibly Hausdorff measures) and change of variables for Lipschitz surfaces. The chapter proceeds from an elementary approach (gradient, divergence,

rotation) to more advanced one (differential forms on manifolds). The book ends with integration of Banach space valued functions, where the Bochner, Pettis and Dunford integrals are discussed. Each chapter contains notes and remarks. An ample list of references is included at the end of the book. The text is intended for graduate and senior undergraduate students and young researchers. (jl)

L.N.Childs: A Concrete Introduction to Higher Algebra. Second Edition, Undergraduate Texts in Mathematics, Springer-Verlag, New York, 1995, xv+522 pp., 9 fig., DM 78.00, ISBN 0-387-94484-2

The book is an introduction to abstract algebra and its applications for students with some calculus background. It is the second edition of the book, which appeared in 1979 with many sections rewritten, new examples and applications and, also, a new chapter on the fundamental theorem of algebra included. The study of algebra is developed from integers and its congruences. The basic properties are examined for the ring of integers and for the rings of polynomials over field successively. Congruences and quotient structures are used extensively. The book contains thirty chapters such as Euclid's Algorithm, Fermat's and Euler's Theorems, Matrices and Codes, Factoring in $\mathbb{Q}[x]$, Primitive Roots, Pseudoprimes and, finally, Classifying Finite Fields. A number of exercises and applications to cryptography, error-correcting codes, Latin squares or computational number theory is offered. Hints to selected exercises can be found in an appendix. The presented book is a very well written and motivating introduction to algebra. (rb)

L.Kadison, M.T.Kromann: Projective Geometry and Modern Algebra, Birkhäuser, Boston, 1996, xvi+208 pp., DM 78.00, ISBN 0-817-63900-4, ISBN 3-764-33900-4

The book provides a reader with a thorough treatment of projective geometry in a course as concise as possible. Historical, philosophical, as well as rigorously mathematical viewpoint are presented by the authors. To give to the reader something to build upon, the introduction of projective plane is made by extension of an affine plane for a line of ideal points and a relationship between affine and projective plane is established. Early enough the homogeneous coordinates are used to describe the analytic model of a real projective plane. It seems that the basic idea of the authors was to present the axiomatic, deductive approach to projective geometry and to illustrate it on

the analytic models of various kinds, while observing the Klein's group-theoretical viewpoint. When geometry of a real projective plane and that of a Möbius plane are explored briefly, division rings are defined and the relation between algebraic properties of division rings and the geometric properties of the corresponding projective planes are derived (namely, that Pappus' axiom holds when the rings characteristic is distinct from 2 and Pappus' theorem is equivalent to the commutativity of multiplication in the corresponding ring). Using the group of dilatations in an affine plane an associated division ring is described and more general concept of affine coordinates is defined which is then extended to a projective plane over the division ring. A chapter on projective collineations topped by the Ceva's theorem concludes the most essential part of the book. The last part of the book (about one quarter of it) contains five chapters named appendices, wherein the concept of projective geometry is furthermore generalized and some interesting topics from algebraic geometry, non-Euclidean geometry and geometry of ternary rings are presented to arouse the curiosity of the reader and to encourage him to try to learn more about it. (jtro)

G.J.Székely (Ed.): Contests in Higher Mathematics. Miklós Schweitzer Competition 1962-1991, Problem Books in Mathematics, Springer-Verlag, New York, 1996, vii+569 pp., 39 fig., DM 94.00, ISBN 0-387-94588-1

Miklós Schweitzer was a young Hungarian mathematician who died in the Second World War. He was successful in High School competitions of the Mathematical Society of Hungary in 1941, but the fascist regime of that time prevented his admission to college. In 1949 the Mathematical Society founded a college-level contest and named it after Miklós Schweitzer. The problems of this contest from the years 1949 to 1961 were published in the book *Contests in Higher Mathematics*, Akadémiai Kiadó, Budapest 1968. In this book one chapter is presented also about the mathematical work of Schweitzer. The book reviewed is a continuation of that volume and it contains the problems and their solutions from the Schweitzer Competitions from 1962 to 1991. The problems are divided into 11 sections, from Algebra to Set Theory. The solutions were worked out by prominent Hungarian mathematicians, for example the Section Algebra was written by József Pelikán, who is well known also as a member of the Committee of the International Mathematical Olympiad. (lbo)

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Academy of Sciences of the Czech Republic
Prague**

announces two positions for
VISITING SCHOLARS for 1997/98

Pending final budgetary approval, the Mathematical Institute plans to open two positions for visiting scholars in the period September 1997 - August 1998.

The positions are intended for research-oriented mathematicians from any field of pure or applied mathematics and they carry no teaching duties. Recent PhD's will receive special consideration. A position may be divided among several candidates but the minimum duration of a stay is at least three months (by mutual agreement).

Candidates, who must possess a PhD, should submit a letter of application accompanied by a curriculum vitae and a list of publications to:

Prof. Karel Segeth
Director
Mathematical Institute
Academy of Sciences of the Czech Republic
Žitná 25, CZ-115 67, Praha 1

Candidates should further arrange for three letters of recommendation (one can be from a Czech mathematician) to be mailed directly to Prof. Segeth.

Deadline for applications is January 31, 1997. The review process will be conducted soon afterwards.

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Applications should be sent to:

Prof. Dr. E. Zeidler, Acting Director
Max-Planck-Institute for Mathematics in the Sciences
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The deadline for applications is January 31, 1997.

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Applications are invited for the positions at the two Universities in Rome.

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- the date at which the applicant would like to start activity in Rome
- any information relevant to the duration
- indications of any other universities in the network to which applications have been or are about to be made.

There is no deadline for applications but prospective candidates are advised to signal their interest soon by e-mail. The salaries vary from country to country to allow for the different costs of living. The gross salary in Rome should be roughly 2,200 Ecu/month. The manner in which the 36 months of salary will be divided will depend upon the applications received. Applications for La Sapienza should be sent to Sergio Doplicher and those for Tor Vergata to John Roberts.

Sergio Doplicher
Dipartimento di Matematica
Universita' di Roma "La Sapienza"
Piazzale A. Moro 2
00185 Roma Italy
fax +396 44701007

John E.Roberts
Dipartimento di Matematica
Universita' di Roma "Tor Vergata"
Via della Ricerca Scientifica
00133 Roma Italy
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Relevant E-mail addresses in the network:

gkped@math.ku.dk
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