European Mathematical Society

NEWSLETTER No. 8

1st June 1993

European student exchanges

Eduard Čech, 1893 - 1960

What is Research in Mathematics Education?

Euronews

Book Reviews

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EXECUTIVE COMMITTEE MEETING

ERDOTARCSA, HUNGARY

26-28 March 1993

Correspondence to and from the EMS seems to be growing apace. Letters have been despatched to give support to the Institute of Pure and Applied Mathematics in Rio de Janeiro and to offer congratulations to the Mathematical Institute at Oberwolfach on its 50th anniversary. A friendly letter has been received from the American Mathematical Society expressing a wish for cooperation between the two societies.

By means of a so-called Letter of Intent the Committee has agreed to give moral support to the Banach Center, Warsaw, in order to assist its mathematical activity. Under the agreement there will be an International Scientific Committee of the Banach Center of no more than ten members each serving no more than two terms of four years. The Executive Committee would have the right to nominate three members of the Council and has already so nominated the President, the Treasurer and Professor Eva Bayer.

The Committee is keen to promote links with the European Community (EC) authorities and is pleased to be gaining some influence in Brussels. But influence must be exerted wisely. In what ways, for example, should the Committee seek to modify the rules governing EC programmes? Answers to this question are requested elsewhere in this Newsletter!

Problems of Eastern Europe, including those of the former Soviet Union, loom large in the conscience of the Committee. A subcommittee has been set up with a modest budget to coordinate financial support for travel for East European mathematicians. The Committee is concerned that the support should foster contacts and contribute to maintaining the high level of the mathematical work in Eastern Europe. Developing countries are not being neglected and a subcommittee has also been set up to consider their rather different needs.

The Committee's presence in Hungary, by kind invitation of the Janos Bolyai Mathematical Society, gave an opportunity to meet Professor A. Hajnal, President of the Society, and Dr. A. Balog, Secretary of the Organising Committee of the Budapest Congress in 1996. Both survived a gentle cross-examination on financial and organisational matters! It was agreed that the highly successful Paris Congress, including the Round Tables, afforded a model which the Budapest Congress would be likely to follow.

Much discussion took place in regard to the European Science Foundation (ESF). The Committee is continuing with efforts to draft applications to the ESF to run Euroconferences - the success rate of the applications is at present unknown! But if the biologists, chemists physicists etc. can do it - why should not the mathematicians?

Publications of various sorts occupied the Committee's attention. One significant positive decision concerns the European Mathematical Newsletter (EMN) which has previously been produced and distributed, without charge, to the mathematical community by the Institute in Oberwolfach. The EMN, which lists meetings etc., is to cease production in 1994. In a way yet to be determined, the information of the EMN will be incorporated in the EMS Newsletter. Do tell the non-EMS members among your colleagues that if they wish to preserve access to the information they will need to obtain the Newsletter! Another incentive to join the EMS!

EUROPEAN COMMUNITY PROGRAMMES

ERASMUS, HUMAN CAPITAL AND MOBILITY, TEMPUS

The success of these programmes is well known. But is the success achieved at a bureaucratic cost? Would the programmes be even more successful if some of the rules of their operation were to be modified or changed? Are the rules appropriate for mathematics? Or, on the other hand, should matters be left as they are?

The Executive Committee of the EMS believes that the authorities in Brussels may presently be receptive to suggestions which would serve to improve the operations of these programmes. The Executive Committee therefore wishes to be appraised of any difficulties which may have been experienced and to be informed of constructive suggestions for improvements in the programmes.

Accordingly the members of the EMS or, more generally, readers of this Newsletter are strongly requested to communicate any pertinent comments to the Acting Secretary as soon as possible. Following due consideration of the responses the Executive Committee would expect to make appropriate representations in Brussels for the benefit of the community of European mathematicians.

D.A.R. Wallace
Acting Secretary

(The article on the next page also concerns European student exchanges)

European Student Exchanges

David L Salinger

School of Mathematics, University of Leeds, UK

Most members of the European Mathematical Society will be aware of the increased number of student exchanges in Europe due to the European Community ERASMUS and TEMPUS schemes. In a few countries, there was a prior tradition of student mobility, but, for many European countries, the new schemes have provided the first major opportunity for first degree students to study for a while in a foreign country.

The political motivation for ERASMUS is clear (and different from that of TEMPUS amidst the collapse of the old order in the East). As part of building the new Europe what better way to create a European identity than to give young people, particularly those who might become leaders in their fields, the experience of studying in another country, learning its ways, and making the necessary social connections. But, beyond that, what about its attractions for the mathematical education of our students? Are the exchanges worth the time and effort we, as organisers of ERASMUS and TEMPUS schemes, put into it?

For my part, as the co-ordinator (that is, principal contractor) of a large ERASMUS scheme that has been running since 1988, it is not the Brussels bureaucracy which is the major consumer of time. The form-filling is kept, almost, to a minimum and I am allowed sufficient flexibility in spending the grant. Correspondence with my colleagues in the other universities in the scheme (Copenhagen, Paris-Sud, Paris VII, Roma "La Sapienza", Saarland and Utrecht, to be joined, from July, by Oulu (Finland) and Complutense, Madrid) is now mainly by email. What cannot be dealt with that way is sorted out at our annual meeting, which circulates around the constituent universities.

What takes the most time is dealing with the students themselves. This year 13 Leeds students are studying abroad for the year and we have welcomed 22 students from other universities who are here for the whole year or half the year. In addition, the students back here for their final year have had to have their examination results from abroad translated into our system. A non-trivial task, since those results can count towards their degree classification. The students going abroad or coming from abroad next year have to have their questions dealt with. Accommodation is dealt with, mainly, by the host university and incoming students slot into our university's efficient allocation system. Lastly, there is the task of recruiting and selecting first year students for the scheme. We require them to get a reasonable result in their first year exams and then we interview all who qualify.

So far, most of the students who have taken the plunge and spent a year studying abroad feel they have benefited tremendously. They have all learned to communicate in a foreign language. They have formed friendships in a different land, friendships that may be lifelong. They have learned mathematics in a different system and are able to see their education in their home university in a different light.

However, on paper, their exam results will not necessarily be as good as those they would have got at their home university. Added to the difficulty of incompatible grading systems is that of taking an exam in a language which is not their mother tongue, a language that, in some cases, they may have been learning for only a year before going abroad. How their home university can take this into account is a major problem.

What is in it for us? Both ERASMUS and TEMPUS programmes can involve exchanges of staff as well as of students. But, mostly through dealing with the students' practical problems, we learn about different teaching methods, different examination systems, different curricula. We learn about how things work out in practice. We find there are features of other universities' teaching that we can, with modifications, incorporate in our own. The recent decision by the English and Welsh mathematical communities to lengthen the degree to four years for some students has been influenced, to some extent, by the experience of teaching fourth- and higher-year students from abroad, as well as by the envious perusal of the syllabuses from the universities they come from.

I don't want to see a uniform system of European higher education imposed on us by some outside authority. However, if, by the intermingling of staff and students, the various national traditions grow together to form a new synthesis, we shall all be the better for it.

Eduard Čech, 1893–1960

Václav Koutník

This year we observe the 100th anniversary of the birthday of Eduard Čech, one of the leading world specialists in topology and differential geometry. To these fields he contributed works of fundamental importance.

He was born on June 29, 1893 in Stračov in northeastern Bohemia. During his high school studies in Hradec Králové he became interested in mathematics and in 1912 he entered the Philosophical Faculty of Charles University in Prague. At that time there were very few opportunities for mathematicians other than to become a high school teacher. For a position of a high school teacher two fields of study were required. Since Čech was not much interested in physics, the standard second subject, he chose descriptive geometry. During his studies at the university he spent a lot of time in the library of the Union of Czech Mathematicians and Physicists and read many mathematical books of his own choice.

In 1914 the First World War broke out and in 1915, after three years of study, Čech had to leave the university for the army of the Austro-Hungarian Empire. He stayed in the army for three years and used this lost time to learn languages, namely German, Italian and Russian. He completed his studies in the school year 1918–1919 and passed the state examination which entitled him to teach mathematics at high schools. In the years 1919–1923 he taught mathematics at several Prague high schools. In 1920 he received a Ph.D. from Charles University.

In the year 1921 his first paper appeared and so began the first Čech's research period devoted to projective differential geometry. It lasted till 1930. It is an important feature of Čech's research activity that he always worked in new, developing fields. Of course, a lot of other people did the same; however, Čech always very soon obtained major results whose importance is not diminished by passing years.

Upon request Čech obtained some funds from the Ministry of Education, took a leave of absence, and spent the school year 1921–1922 in Torino with Guido Fubini. Čech must have impressed Fubini considerably since he offered Čech to become a coauthor of a book on projective differential geometry. Bear in mind that it was an offer made by a well-known scientist to a young Ph.D. who was only a provisional high school teacher at that time. The cooperation between Čech and Fubini was very fruitful. In 1926 and 1927 the two volumes of the book Geometria proiettiva differenziale were published in Bologna. In 1931 they published another joint book, Introduction à la géométrie différentielle des surfaces, this time in Paris. Altogether Čech published in this period 37 papers on differential geometry and 3 books. Besides the two joint publications with Fubini his Projektivní diferenciální geometrie (Projective differential geometry) appeared in 1926.

After his return from Italy Čech submitted his habilitation thesis and in 1922 he became a docent of Charles University. This was just an academic title so he continued teaching at a Prague high school.

At this time Professor Lerch of Masaryk university in Brno died. Brno is the second largest city of the Czech republic, the capital of Moravia, and after the Czechs gained independence from Austria in 1918 the second Czech university was established there in 1919, named after the first president of the republic Tomáš Garrigue Masaryk.

Čech was offered and accepted the vacant position and in 1923 became extra-ordinary professor at the Faculty of Natural Sciences of Masaryk University; he became a full professor in 1928. Lerch had held the chair of analysis and the chair of geometry was held by Professor Seifert. Hence, although geometry was Čech's field of research, Čech had to take over courses in analysis and algebra. He proceeded to master these two fields.

We may observe here one of Čech's basic characteristics. Whenever he was doing something in mathematics, he always strove to achieve thorough understanding of the subject. The result was that even outside of his fields of research he had extensive knowledge and deep insight in many other areas of mathematics.This feature of his personality also had some other consequences. While he was not conceited and talked easily to people with little formal education, he expected in his fellow professors the same qualities he himself possessed. This did not contribute to smooth relations with some people as he was not diplomatic, but, on the contrary, quite forthright in expressing his opinions.

His study of algebra and analysis brought his attention to other fields of mathematics. In particular, he became interested in topology. From 1930 to 1947 he worked in topology and published 31 papers, 29 in algebraic and 12 in general topology. Let us mention his participation at the International Congress of Mathematicians in Zürich in 1932 where he presented the complete definition of higher homotopy groups which were later independently introduced by Hurewitz. In 1935 he was invited to attend the prestigious Moscow conference on combinatorial topology and he spent the school year 1935–1936 at the Institute for Advanced Study in Princeton.

After he returned from the U.S.A. he started his famous topological seminar in 1936. Why famous? Up to Čech's seminar, seminars in Czechoslovakia were held only for undergraduate students as part of their studies and mathematical research was done by individuals. The now standard form of small groups working together was started here by Čech. The seminar on general topology was very successful; its participants published 27 papers in the three years it existed. Its work ended in 1939 when the Nazis closed the Czech universities. Čech then continued to meet with the two principal participants, B. Pospíšl and J. Novak, in Pospíšl's flat until Pospíšl was arrested by the Gestapo in 1941. Pospíšl died soon after his release from Nazi prison in 1944. Thus Čech lost his best student.

During the war, Čech worked on his book Topologické prostory (Topological Spaces) which was later rewritten and published in 1959. At this time he also became deeply interested in high school mathematics. He held seminar for high school teachers and he wrote several high school textbooks on algebra and geometry which are even now remembered for their superior qualities. After the war he became very much involved in a reform of schools which introduced a unified high school similar to the English comprehensive school. He chaired the commission charged with instruction in mathematics.

After the war Čech moved to Prague and was appointed professor at Charles University in 1945. He remained at the University till the end with the exception of the years 1950–1953 when he was granted a leave of absence.

He became the leading personality in Czech mathematics. In 1947 the Czech Academy of Sciences and Arts established the Mathematical Institute and Čech was appointed its director.

This institute had only a secretary and one research assistant, the members of the Institute were employed by the University or by the Czech Technical University. In 1950 the government created the Central Mathematical Institute and Čech again became its director. This institute replaced the former one but this time it was a regular research institute with many research workers and graduate students. When the Czechoslovak Academy of Sciences was founded in 1952, this institute became the Mathematical Institute of the Academy.

In 1953 Čech realized he could not do much more for the Institute and returned to the University. He had indeed done enough. The Institute was well established, its structure and purpose fully determined, and many of the students who would later on become leading Czech scientists already admitted to graduate study at the Institute.

In 1950 Čech started publishing again and he returned to his most favored topic, differential geometry. He published during this last period 21 papers. That does not mean he neglected the welfare of Czech mathematics. Already in 1953 he initiated the creation of the Mathematical Institute of Charles University; the institute was established in 1956 with Eduard Čech as its first director. Unfortunately, his health started to deteriorate and he died on March 15, 1960. Even when already gravely ill, he performed two further important services for Czech mathematics. He founded the journal Commentationes Mathematicae Universitatis Carolinae, the first issue appeared in 1960, and he came up with the idea of organizing in Prague an international topological conference. The conference took place in 1961 under the name Symposium on General Topology and its Relations to Modern Analysis and Algebra. Since then, every five years there has been a Prague Topological Symposium.

In spite of the heavy load created by his involvement in the organization of Czech mathematics he published altogether 94 research papers and 11 books.

Another feature of Čech's personality is that philology was his hobby. He greatly influenced Czech mathematical terminology and he learned many languages. He wrote papers in French, Italian, German, English and Russian and he continued the study of languages till the very end; before his death he started to learn the Romanian language.

Finally let us mention some of the honors that came his way: he was a member of the Polish Academy of Sciences, he received honorary doctorates from the University of Warsaw and the University of Bologna, he was a member of the Royal Czech Society of Sciences, Czech Academy of Sciences and Arts, Czechoslovak Academy of Sciences and honorary member of the Union of Czechoslovak mathematicians and physicists. He twice received the State Prize and was awarded the Order of the Republic.

As you may have noticed there are few things in present Czech mathematics which are not due to the activity of Professor Eduard Čech. There are two reasons for his unique position in the history of Czech mathematics, his deep and extensive understanding of modern mathematics and the fact that his decisions were based on the needs of Czech mathematics and not on his personal preferences.

EUROPEAN NEWS: Country by Country

AUSTRIA

CONFERENCE ON INVERSE PROBLEMS

June 26 - July 2 1994 **LAKE ST. WOLFGANG, AUSTRIA**

Contact: Heinz W. Engl
Johannes Kepler Universität
A-4040 Linz, AUSTRIA
e-mail: engl@indmath.uni-linz.ac.qt

This conference will be the first one in a series of conferences on inverse problems to be organized for SIAM and GAMM by

D. Colton (Delaware), H.W. Engl (Linz), A. Louis (Saarbräcken) and W. Rundell (Texas A of M).

GERMANY

JOINT AMS-DMV MATHEMATICS MEETING

1 - 3 October 1993 **HEIDELBERG, GERMANY**

The first joint meeting of the American Mathematical Society (AMS) and the Deutsche Mathematiker-Vereinigung (DMV) will be held at the University of Heidelberg, Germany. The scientific program starts on Friday, October 1, 1993, at 14.15 and ends on Sunday, October 3, at 18.00. To a large extent, this meeting follows the pattern of the Joint AMS-LMS Meeting at Cambridge, U.K., in 1992. There are six Invited Addresses and twelve Special Sessions. The Invited Addresses will be given by

G. FALTINGS (Princeton Univ.), **G. HARDER** (Bonn), **H. HOFER** (Bochum), **M. HOPKINS** (MIT), **V.F.R. JONES** (Berkeley), **R.P. LANGLANDS** (I.A.S., Princeton).

As of March 15, we have the following list of Special Sessions (and organizers): Arithmetic algebraic geometry (N. Schappacher), Automorphic forms (J. Franke and G. Harder), Homotopy theory (H.-W. Henn, M. Hopkins), Operator algebras (J. Cuntz), Geometry and computer visualization (G.K. Francis), Complex analysis (K. Diederich, J.E. Fornaess), Optimization (H.G. Bock, M. Grötschel), Mathematical physics (J. Fröhlich, E.H. Lieb), Modelling in science (W. Jäger, P. Fife), Commutative algebra (R. Buchweitz), Recursion theory (K. Ambos-Spies, S. Lempp), Stochastics (H. Rost, R. Williams).

The registration fee is DM 50 for members of AMS or DMV, payable by July 15. For further details contact: Mathematisches Institut der Universität, Tagungsbüro DMV-AMS-Tagung, Im Neuenheimer Feld 288, D-W-6900 Heidelberg, Germany.

CZECH REPUBLIC

What am I if I will not participate?
Antoine de Saint-Exupéry

2nd Summer School on Banach Spaces, Related Areas and Applications

15-18 August 1993 **PRAGUE AND PASEKY (CZECH REPUBLIC)**

A EUROPEAN INTERUNIVERSITY COOPERATION PROGRAM

SUPPORTED BY TEMPUS AND ORGANIZED BY

DEPARTMENT OF MATHEMATICAL ANALYSIS CHARLES UNIVERSITY

Intensive mini-courses will be offered at a graduate level by

Gustave CHOQUET (Paris)
Mathematical Discovery and the Formation of Mathematicians
Miroslav HUŠEK (Prague)
Čech's Contributions to Analysis
Stelios NEGREPONTIS (Athens)
The title will be announced later)
Robert R. PHELPS (Washington)
Monotone Operators
Vlastimil PTÁK (Prague)
Geometry of the Space and Spectrum of Operators
Stanimir TROYANSKI (Sofia)
Extreme Points and Their Generalization in Banach Spaces
Lior TZAFRIRI (Jerusalem)
The Kadison - Singer Extension Property
The Paving Property in ℓ^p

The total duration of the meeting will be two weeks, but it is possible to register for each week separately. The conference fee will be 240,- US dollars for each week. A reduced rate of 210,- US dollars will be offered, provided a letter guaranteeing participation reaches the organizers before May 15, 1993. The conference fee includes all local expenses (room and board) and local transportation. The fee is the same for accompanying persons.

The purpose of this Meeting is to bring together mathematicians 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 main participants will be Tempus students and teachers, but some other contributors will be welcome.

The first week of the conference will be sited in Prague, and the second at Paseky in the Krkonoše mountains.

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

In case of interest please fill out the enclosed registration form and return it before July 15, 1993. A final announcement with further details will be mailed in due time.

Mailing address: Katedra matematické analýzy
Matematicko-fyzikální fakulta
Sokolovská 83
186 00 Praha 8
Czech republic

Phone/Fax: 42-2-231 76 62 E-mail: jlukes@cspguk11.bitnet

The Summer School is dedicated to the centenary of the birth of **EDUARD ČECH** (1893 - 1957)

FRANCE

C I R M

Centre International de Rencontres Mathématiques

Société Mathématique de France

Colloques mathématiques 1993

1-4 juin	**Rigidité et déformation pour les systèmes hyperboliques** P. Foulon (Ecole Polytechnique, Palaiseau)
7-11 juin	**Colloque international en l'honneur de G. Freiman. La méthode additive inverse et ses applications** J.-M. Deshouillers (U. de Bordeaux II)
14-18 juin	**Homologie des algèbres et applications** P. Blanc (U. Aix-Marseille II), JL. Cathelineau (U. de Nice), D. Guin (U. de Montpellier III); A. Legrand (U. Toulouse III)
21-26 juin	**Homogénéisation et méthodes de convergence en calcul des variations** G. Bouchitté (U. de Toulon & du Var), P. Suquet (LMA-CNRS, Marseille)
28/6-2 juillet	**Géométrie arithmétique et théorie des codes** M. Perret (ENS-Lyon), S. Vladut (IPPI-Moscou & CNRS-Luminy), R. Pellikaan (U. d'Eindhoven)
5-9 juillet	**Communications et réseaux d'interconnexion** D. Sotteau (U. de Paris-Sud)
12-17 juillet	**Colloque Takeuti : Théorie de la démonstration et applications en informatique** J.-P. Ressayre (U. de Paris 7), P. Clote (Boston)
19-23 juillet	**Singularités** C. Sabbah (CNRS, Palaiseau), JP. Brasselet (CNRS, Marseille)
26-30 juillet	**Groupes ordonnés et groupes de permutations infinis** M. Giraudet (U. du Mans), F. Lucas, D. Gluschankof (U. d'Angers)
30/8-3 septembre	**Représentations des groupes et analyse complexe** M. Raïs, P. Torasso (U. de Poitiers)
6-10 septembre	**Nombre de points entiers dans les polyèdres et applications** J.-M. Kantor (Univ. Paris 7), D. Zagier (M.P.I. Bonn)
20-24 septembre	**Méthodes numériques dans la théorie des surfaces de Riemann** R. Silhol (U. de Monptellier II)
27/9-1 octobre	**Orbites périodiques des systèmes dynamiques** J.-P. Françoise (U. de Paris 6), R. Roussarie (U. de Dijon)
6-8 octobre	**Games, Logic and Process** Y. Lafont (LMD, Marseille))
11-14 octobre	**Gestion de projets statistiques** R. Teekens (TES, Luxembourg)
20-22 octobre	**Stage de bibliothécaires de mathématiques** Mr. Barbançon (CNRS, Strasbourg)
15-19 novembre	**Systèmes d'équations algébriques** J.-P. Dedieu (U.Toulouse 3), D. Duval (U. Limoges), J.P. Merlet (INRIA, Sophia Antipolis)
22-26 novembre	**Systèmes complètement intégrables en dimension finie ou infinie** P. Dazord (U. de Lyon I), L. Niglio (U. d'Avignon)

UNIVERSITE PAUL SABATIER TOULOUSE III

MATRA MARCONI SPACE

PRIX FERMAT DE RECHERCHE EN MATHEMATIQUES

Le **prix FERMAT de Recherche en Mathématiques 1993** a été décerné

à Monsieur Jean-Michel CORON

Professeur à l'Université de Paris-Sud à Orsay,
détaché au C.N.R.S., Centre de Recherches Mathématiques
et de leurs Applications, E.N.S. de Cachan

pour ses contributions à l'étude de Problèmes Variationnels et de la Théorie du Contrôle

Le Jury réuni à Toulouse, le 26 Mars 1993.

La remise du Prix et la conférence du lauréat auront lieu à Toulouse à une date qui sera annoncée ultérieurement.

PRIX FERMAT JUNIOR DE MATHEMATIQUES

Le Prix FERMAT JUNIOR DE MATHEMATIQUES 1993 a été décerné

à Monsieur Denis AUROUX

Elève en classe de Mathématiques Spéciales au Lycée Louis-le-Grand (Paris 5e)

pour son travail sur le coloriage des faces d'un hypercube

Le Jury réuni à Toulouse, le 7 Avril 1993

La remise de ce Prix FERMAT JUNIOR aura lieu à Toulouse, en même temps que le Prix FERMAT de Recherche en Mathématiques 1993, à une date qui sera annoncée ultérieurement.

J.B. HIRIART-URRUTY
Créateur et Organisateur des Prix FERMAT
Professeur de Mathématiques
Université Paul Sabatier de Toulouse

SPAIN

SIXTH INTERNATIONAL WORKSHOP ON STOCHASTIC GEOMETRY, STEREOLOGY, AND IMAGE ANALYSIS

21 - 24 September 1993 **VALENCIA**

Contact: F. Montes
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CATALONIA

The Ferran Sunyer i Balaguer Prize 1993

Ferran Sunyer i Balaguer (1912 - 1967) was a self-taught Catalan mathematician who, in spite of a serious physical disability, was very active in research in classical Mathematical Analysis, an area in which he acquired international recognition.

Each year in honor of the memory of Ferran Sunyer i Balaguer, the Institut d'Estudis Catalans awards an international mathematical research prize bearing his name. This prize has been awarded for the first time in April 1993. The competition is open to all mathematicians, subject to the following conditions:

1. The prize will be awarded for a mathematical monograph of an expository nature presenting the latest developments in an active area of research in Mathematics, in which the applicant has made important contributions.

2. The monograph must be original, written in English, and of at least 150 pages. In exceptional cases, manuscripts in other languages may be considered.

3. The prize, amounting to 12,000 ECU, is provided by the Ferran Sunyer i Balaguer Foundation. The winning monograph will be published in Birkhäuser Verlag's series "Progress in Mathematics", subject to the usual regulations concerning copyright and author's rights.

4. The winner of the prize will be chosen by a Scientific Committee consisting of:

   Prof. Gerhard Frey (Universität Essen);
   Prof. Joan Girbau (Universitat Autònoma de Barcelona);
   Prof. Paul Malliavin (Université de Paris VI);
   Prof. Joseph Oesterlé (Université de Paris VI);
   Prof. Alan Weinstein (University of California at Berkeley)

5. Monographs, preferably typeset in TEX, should be sent to the following address, and must arrive there before January 15, 1994 in order to be considered:

   Institut d'Estudis Catalans
   Carme, 47
   08001 Barcelona
   SPAIN
   e-mail: icrm0@cc.uab.es

6. The name of the prize-winner will be announced in Barcelona in April, 1994.

7. The submission of a monograph implies the acceptance of all of the above conditions.

Barcelona, April 1993.

The Future for First Degree Courses in Mathematics in British Universities

P.M. Neumann

Queen's College, Oxford

British universities are presently considering a major change to the structure of their degree courses in mathematics. The following sketch of what is happening applies to the universities of England, Wales and Northern Ireland. Since the educational system in Scotland is separate and somewhat different it does not apply directly there.

In 1960 there were in this country some twenty universities offering degree courses to about 8% of each age group. Now there are nearly a hundred universities and higher education is available to about 27% of the population. Many mathematics courses, particularly those in the newer universities, have adapted to the change. Others, that is to say those that have evolved over a large number of years, are still at their best when catering for the ablest mathematics students. Nevertheless, it is generally recognised that universities now have a much wider range of commitments and that their graduates are expected to proceed to a much wider range of employment than before.

Universities are also having to adapt to changes in their intake. Thirty years ago a student who wished to study mathematics at the university would have spent perhaps half his learning hours studying mathematics during his last 2 years at school. Now there is less specialisation at school; moreover, students with an interest in mathematics come to university with a broader but shallower knowledge of the subject than hitherto.

In order to adapt to this changes what is needed is greater flexibility and a wide range of courses available to suit the different abilities and the different tastes of a very wide range of students. Some students, those who wish for a career as mathematicians or statisticians in industry or in government research establishments or in universities, need highly focussed mathematical training (as well as a good education). Those who wish to proceed to careers as managers or accountants or the various other possibilities in industry, commerce and education need a degree-level education of a numerate kind, an education which is just as good as what a degree in English, History, Law, Chemistry, Physics, ... provides, but one which bases that education on their interest and abilities in mathematics.

What is presently under discussion in British universities is the possibility of offering two different degrees. One would be a four-year vocational training for those students who are seeking a specifically mathematical career. This is not a new idea. The former polytechnics have been offering four-year vocational courses closely integrated with commerce and industry for twenty years or more. What is new is the extent to which it is hoped to extend this facility. The alternative would be a three-year course, rather more broadly based and producing a high-level education, based on mathematics.

The proposed changes have three main aims. First it is important that British students should be educated and trained to a level comparable with that reached in other European countries. Secondly, our degree courses should be at least as attractive as degree courses in other subjects, so that numbers choosing mathematics increase. Thirdly, once we have attracted a broad range of students to mathematics we must be able to offer them a broad range of courses appropriate to their needs and ambitions.

What is Research in Mathematics Education? and What Are Its Results?

Discussion Document for an ICMI Study

The following people have contributed to the present document: N. Balacheff, A.G. Howson, A. Sfard, H. Steinbring, J. Kilpatrick, and A. Sierpinska.

As mathematics education has become better established as a domain of scientific research (if not as a scientific discipline), exactly what this research is and what its results are have become less clear. The history of the past three International congresses on Mathematical Education demonstrates the need for greater clarity. At the Budapest congress in 1988, in particular, there was a general feeling that mathematics educators from different parts of the world, countries, or even areas of the same country often talk past one another. There seems to be a lack of consensus on what it means to be a mathematics educator. Mathematics education no longer means the same as *didactique des mathématiques* (if it every did). French *didacticiens* refuse to translate their *didactique des mathématiques* into "mathematics education".: a special English edition of the journal *Recherches en Didactique des Mathématiques* bears the title "Research in *Didactique* of Mathematics." *Die Methodik* (or the Polish *metodyka*, the Slovak *metodika*, and the like) have become obsolete. Does *research* mean the same as *recherche* or *investigación*? How do these words translate into other languages? Standards of scientific quality and the criteria for accepting a paper vary considerably among the more than 250 journals on mathematics education published throughout the world.

Despite this lack of consensus, publications appear that endeavor to depict the "state of the art" in mathematics education research. Individuals try to construct didactical theories. But reviewers never have trouble demonstrating the one-sidedness or incompleteness of such publications. Attempts to describe research in mathematics education or *didactique des mathématiques* or whatever other name is used many resemble the accounts of the legendary blind men exploring the legs of a huge elephant.

The ICMI study *What is research in mathematics education, and what are its results*? does not seek to describe the state of the art. Nor does it intend to tell anyone what research in mathematics education is or is not, or what is or is not a result. Instead, the organizers of the study propose to clarify the different meanings these ideas have for mathematics educators - to pinpoint the different perspectives, goals, research problems, and ways of approaching problems. The study will bring together representatives of the different groups of researchers, allow them to confront one another's views and approaches, and seek a better mutual understanding of what we might be talking about when we speak of research in mathematics education.

Some Questions About Research

Such a wide-ranging discussion is badly needed in a community increasingly divided into specialized groups and cliques that are not always tolerant of each other. Besides mutual understanding within the community, however, there is also a need to explain the domain to representatives of other scientific communities, among which the community of mathematicians seems to be the most important. Nicolas Balacheff has observed:

> Most of us want to develop this research field within the academic community of mathematicians; this implies both the explanation of our purpose on a social ground (is there any need to develop such research?) and its relevance within the narrow academic world. For this reason, although it is not my sole concern, I have in mind the question of scientific standards, theses, publications, congresses, the employment of young academics in the field, and the connection between our research and research done in other fields.

Thus we need an "inner" identification of the research domain of mathematics education, as well as an outer vision from the perspective of other domains.

One external domain, for example, is sociology. How is mathematics education organized and institutionalized? Where is research on mathematics education conducted? Where are theses on mathematics education defended? If a mathematics educator employed by a mathematics department has acquired his or her habilitation degree in, say, a department of pedagogy or philosophy (such a degree being unavailable at the employing institution), is he or she accepted as a full member of the community of mathematicians that awards doctoral or master's degrees in mathematics? Are mathematics educators viewed as a part of the mathematics community? Similar questions arise when research in mathematics education is surveyed from other domains, including history, philosophy, anthropology, and psychology.

An approach from both within and outside the field of research in mathematics education raises the following questions, among others, to be discussed:

1. What is the specific object of study in mathematics education?

The object of study *(der Genenstand)* in mathematics education might be, for example, the teaching of mathematics; the learning of mathematics; teaching/learning situations; didactical situations; the relations between teaching, learning, and mathematical knowledge; the reality of mathematics classes; societal views of mathematics and its teaching; or the system of education itself.

If a mathematics educator studies mathematics, is it the same object for him or her as it is for a mathematician who studies mathematics? What is mathematics as a subject matter? What is "elementary mathematics"? Analogous questions could be asked concerning the learner of mathematics as an object of study. Is it the same object for a mathematics educator as it is for a psychologist or a pedagogue? Is the mathematics class or the process of learning in the school viewed in the same way by a mathematics educator and a sociologist, anthropologist, or ethnographer? Are questions of knowledge acquisition viewed the same way by a mathematics educator and an epistemologist?

The variety of activities offered at the ICMEs certainly distinguishes these congresses from, say, the international congresses of mathematicians. ICME 7 was compared by some to a supermarket. Is there a unity in this variety? What gives unity to different kinds of study in mathematics education? Is this the object of research? Or is the object of research perhaps not even something held in common? Might the commonality lie in the pragmatic aims of research in mathematics education?

2. What are the aims of research in mathematics education?

One might think of two kinds of aims: pragmatic aims and more fundamental scientific aims. Among the more pragmatic aims would be the improvement of teaching practice, as well as of students' understanding and performance. The chief scientific aim might be to develop mathematics education as a recognized academic field of research.

What might the structure of such a field be? Would it make sense to structure it along the lines of mathematical subject matter (e.g., the didactics of algebra or the didactics of geometry), of various theories or approaches to the teaching and learning of mathematics, or of specific topics or *problématiques* (research on classroom interaction and communication, research on students' understanding of a concept, etc.)?

Both kinds of aims seem to assume that it is possible to develop some kind of professional knowledge, whether that of a mathematics teacher, a mathematics educator, or a researcher in mathematics education. The question arises, however, whether such professional knowledge can exist at all. Is it possible to provide a teacher, say, with a body of knowledge that would, so to say inevitably, ensure the success of his or her teaching? In other words, is teaching an art or a profession *(un métier)*? Or is it perhaps a personal conquest? As Luigi Campedelli used to say, "*La didattica é, e rimane, una conquista personale.*"

What does successful teaching depend on? Are there methods of teaching so sure, so objective, that they would work no matter who the teacher and students were? Are there methods of teaching that are teacher-proof and methods of learning that are student-proof? If not, is there anything like objective fundamental knowledge for a researcher in mathematics education - something that any researcher could build upon, something accepted and agreed upon by all? Or will the mathematics educational community inevitably be divided by what is considered as belonging to this fundamental knowledge, by philosophies and ideologies of learning, by what is considered worth studying?

Many mature domains of scientific knowledge have become highly specialized into narrow subdomains. Is this the fate of mathematics education as well? Or rather, in view of the interdisciplinary nature of mathematics education, must every researcher necessarily be a "humanist," knowing something of all domains and problems in mathematics education?

Although we aim at clarifying the notion of research in mathematics education as an academic activity, we would be careful not to fall into needlessly "academic" debates. After all, the ultimate goal of our research may be for a specific teacher in a specific classroom to be better equipped to guide his or her students as they seek to understand the world with the help of mathematics.

3. What are the specific research questions or *problématiques* of research in mathematics education?

Mathematics education lies at the crossroads of many well-established scientific domains such as mathematics, psychology, pedagogy, sociology, epistemology, cognitive science, semiotics, and economics, and it may be concerned with problems imported from these domains. But mathematics education certainly has its own specific *problématiques* that cannot be viewed as particular cases or applications of those from other domains. One question the ICMI study might address is that of identifying and relating to each other the various *problématiques* specific to mathematics education.

There are certainly two distinct types of questions in mathematics education: those that stem directly or almost directly from the practice of teaching and those generated more by research. For example, the question of how to motivate students to learn a piece of mathematics (inventing interesting problems or didactical situations that generate a meaningful mathematical activity), or how to explain a piece of mathematics belong to the first kind. The question of identifying students' difficulties in learning a specific piece of mathematics is also directly linked to practice. But questions of classifying difficulties, seeing how widespread a difficulty is, locating its sources, or constructing a theoretical framework to analyze it already belong among the research-generated questions. The problem is, however, that a difficulty may remain unnoticed or poorly understood without an effort to answer questions of the latter type; that is, without more fundamental research on students' understanding of a topic. Is it, therefore, possible to separate so-called practical problems from so-called research-generated problems?

Is it possible to admit the existence of two separate types of knowledge: the theoretical knowledge for the scientific community of researchers and the practical knowledge useful in applications for teachers and students? It might be helpful to reflect on the nature of these two types of knowledge, on relations between them, and on whether it would be possible to have a unified body of knowledge encompassing them both.

4. What are the results of research in mathematics education?

Any result is relative to a *problématique*, to the theoretical framework on which it is directly or indirectly based, and to the methodology through which is was obtained. This relativity of results, though commonplace in science, is often forgotten. One often interprets findings from biology, sociology, or mathematics education as if they were a kind of absolute truth. The reason may be that in these domains we really want to know the truth and not simply whether, if one proposition is true, some other proposition is also true. questions of biology, sociology, or mathematics education can be of vital importance and fundamental to our survival and well-being.

Two types of "findings" can be distinguished in mathematics education: those based on long-term observation and experience and those founded on specially mounted studies. Are the former less "scientific" than the latter? Geoffrey Howson offers an example:

> In the seventeenth century, Spinoza set out three levels of understanding of the rule of three (which, incidentally, can be viewed as an elaboration of the instrumental-relational model of Skemp and Mellin-Olsen expounded over three centuries later). This, like the well-known levels of the van Hieles, was based on observation and experience. On the other hand, for example, CSMS [Concepts in Secondary Mathematics and Science] used specially mounted classroom studies to develop and investigate similar hierarchies of understanding. Do we rule out the work of Spinoza as research in mathematics education? If we do, then we lose much valuable knowledge, especially that resulting from curriculum development. If we do not, then it becomes difficult to find a workable definition [of research in mathematics education].

Balacheff points out that it may be difficult to contrast, in this way, the hierarchies obtained by the van Hieles and the CSMS group. Besides the different ways in which these hierarchies were obtained, the van Hieles and the CSMS group may not have been asking the same kind of question. "What are these questions?" asks Balacheff. "What is the validity of the answers they provide? How is it possible to relate them?"

Can a new formulation of an old problem be a research result? Can a problem be a result? Or a questioning of the theory related to a problem, a methodology, or a whole *problématique*? Can a concept be a result? It might be useful to have a definite categorization of the things we do in mathematics education, and of the things we thereby "produce."

Most people would probably agree that *making empirical investigations* is research. But is the *doing of practical things* research? Is *thinking* research? Can these activities be separated? Can a result be obtained without thinking and the doing of practical things? Should mathematics education be considered a science? Perhaps it is a vast domain of thought, research, and practice. What qualifies a domain of activity as scientific is the kind of validation and justification methods it uses. Proofs and experiments are considered scientific. But there are thoughts not validated in either of these ways that are valuable because they are filled with meaning.

What examples are there of what we consider results in mathematics education to be? What do we know today that we did not know before? What have we learned about the processes of learning and teaching? What do we know about mathematics that mathematicians were not aware of before?

Can we identify some categories of results? One category might be *economizers of thought*. Any facts, laws, methods, procedures, or theories that are general enough to direct our experience and predict its results will give us increased power over our teaching and learning. Another category might be *demolishers of illusions*. Results that undermine our beliefs and assumptions are always valuable contributions to the field. A third category might be *energizers of practice*. Teachers welcome research that helps them understand what they teach and provides them with ideas for teaching. The development of teaching materials, activities, and challenging problems belongs to this category. Other categories of results might emerge from epistemological, methodological, historical, and philosophical studies.

5. What criteria should be used to evaluate the results of research in mathematics education?

How do we assess the validity of research findings? How do we assess their worth? Should we use the criterion of relevance? What about objectivity? Or originality? Should we consider the influence research has had on the practice of teaching? What other criteria should we use?

The first problem is to clarify the meaning of terms such as *truth, validity,* and *relevance* in the context of mathematics education. A related issue is the question of what is knowledge as such. This is an even more fundamental question than that of validation. We knew what kind of knowledge mathematics education aims at, we would be better equipped for answering the question of methods of validation.

It is also useful to understand the ways in which research results are used. How have the results of research in mathematics education been applied? How do teachers use the research? How do policy makers use it? by clarifying the uses to which research is put, can we develop better criteria for assessing its validity?

Call for Papers

An ICMI Study on Research in Mathematics Education and Its Effects will investigate the questions above, as well as other raised by various contributors, over the next year or so. The study will have two components: an invited *study conference* and a *publication* to appear in the ICMI Study series that will be based on contributions to and outcomes of the conference. The conference will be held in the spring of 1994 at a site to be determined (two possibilities are Japan and the USA), and the major outcomes of the study will be presented at the International Congress of Mathematicians in Zürich the following summer.

The International Program Committee (IPC) for the study invites readers to submit papers on specific problems or issues stimulated by this discussion document no later than **1 September 1993.** Contributors may wish to address either questions raised in the document or questions that arise in response to it.

Papers, as well as suggestions regarding the content of the study and the conference program, should be sent to *both* co-chairs of the IPC:

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COMPUTER AIDED TEACHING OF GEOMETRY

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Computers have invaded our world and we cannot afford to neglect them in any sphere of human activity. The only question is how to make best use of them. In particular, computer graphics have extended considerably the range of available means of expression, and have influenced our knowledge of and approach to geometry. The provision of easy movement simulation on interactive computer graphics devices enables us to examine complex geometrical structures in space. We can think of geometry in terms of an amazing family of geometrical figures that transform one into the other, appearing and disappearing according to the laws of some group of geometric transformations, or in accordance with quite new creative principles made possible by computer graphics interpolation processes, rather than as a rigid logical structure derived from a sophisticated system of axioms.

With these ideas in mind, the team of geometry teachers in the Department of Mathematics of the Faculty of Mechanical Engineering at the Slovak Technical University in Bratislava have revised the teaching methods and curricula for courses of geometry offered to students of building and industrial design. After five years of enthusiastic effort, we have devised new and enriched curricula for computer aided geometric study in two subjects - Constructive Geometry and Computer Geometry - covering two terms of study.

In the first term of their study students should acquire and develop basic 3-D perception and a basic knowledge and skill in 3-D space projections onto the plane (at least in two projection methods - Monge orthogonal projection onto two orthogonal planes and parallel axonometric projection). In this course we use mostly classical synthetic methods and stress sketching more than accurate drawing with ruler and compass. Geometric figures are chosen according to their importance in the student's future professional practice, and they range from basic elementary curves, surfaces and solids up to curves and surfaces widely used in technical practice such as surfaces of revolution, developable surfaces, quadratic surfaces, helical and envelope surfaces, and also interpolated curves and surfaces.

We not only solve synthetically construction problems connected with incidence and intersection, but later on, in the second term, we also speak about the creative law of these figures, their analytic representations (as a vector equation) and study features of these geometric figures using methods of differential geometry.

The theoretical background is, in fact, a newly formed geometric space, creative space, defined as an ordered pair **K** = **(U,G)**, in which **U** is the set of figures (subsets of 3-dimensional Euclidean space) and **G** is the set of generating principles (group of projective transformations - collineations of this Euclidean space united with the set of interpolations). Each figure **V** in **U** can be represented in two ways - analytically and synthetically. Synthetic representation of a figure **V** is an ordered pair **(U,G)**, where **U** is a basic figure from **U** and **G** is a generating principle from **G**, such that applying **G** on **U** we generate **V**. Analytic representation of any geometric figure **U** is its 4-component vector equation of none (constant vector function, homogeneous coordinates of a point), one (curve segment), two (surface patch), three (solid) or four and more (animation, movement of a solid in certain time intervals) variables. Non-geometric figures, that is to say non-continuous subsets of the Euclidean space consisting of discrete geometric figures, for instance a discrete set of points, vectors, curve - segments, surface patches, solids, etc., can be analytically represented by a matrix-map of figure, whose elements are analytic representations of the constituent geometric figures. Generating principles can be easily represented by square matrices of rank 4 (in the case of geometric transformations), functional matrices of the same type with elements in the form of real functions of one real variable satisfying certain conditions (in the case of a class of transformations) or interpolation matrices of type $1 \times n$ whose elements are interpolation polynomials widely used in Computer Graphics (Hermite's, Coons', Bezier's polynomials, etc., in the case of interpolations). The analytic representation of any newly created geometric figure **V** can be easily obtained by a simple multiplication of matrices, analytic representations of a basic figure **U** and a generating principle **G** in its synthetic representation **(U,G)**, defining its creative law.

Creative law of the geometric figure can be followed analytically and synthetically as well, using computers. Our team has worked out a complete package of computer programmes, based on the given theory, containing more than 20 programmes. They are divided into 3 groups - demonstrative, creative and didactic. In demonstrative programmes (used during exercises in the computer room) students can watch animated creation of all geometric figures that are studied and their final projection in a chosen projection method. In creative programmes (also used during exercises) students create their own geometric figures defined by their creative law. They work in both ways, synthetic - forming a synthetic representation **(U,G)** of the created figure choosing a basic figure **U** and a generating principle **G** from the provided menu, or analytic - calculating the analytic representation of the created figure and checking the result. The last group consists of programmes which students use in the computer room during their free time for individual study. Programmes include theoretical text describing the concrete type of geometric figures and their creative law and features, visualisation and the possibility to input specific data to create particular geometric figures of this type for the purpose of checking the attained level of understanding (for instance cycloid curves, helical surfaces, etc.). There are also programmes for checking homework concerned with calculations of various differential features of geometric figures (for instance tangent, normal and binormal vectors and curvatures in a given point of an interpolated curve segment, normal and twist vector of a surface patch in a given point, etc.).

After two years of practising computer aided geometry teaching supported by this pedagogical software we can speak about some experience. The survey carried out among students has proved that they appreciate this new way of teaching. According to their own words they can understand space geometry better. Examination results have also shown definite improvement. The most important fact of all is that students have become more interested in the study of geometry, are looking forward to their Geometry exercises (namely those carried out in the computer room) and have found out that a good deal of theoretical geometric knowledge as a part of their mathematical education is necessary for their future successful professional activity as builders and industrial designers.

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, 18600 Praha 8, Czechoslovakia.

W.Fulton, J.Harris: Representation Theory. A First Course, Springer-Verlag, Berlin, 1992, xv+551 pp., 144 fig., DM 48.00, ISBN 3-540-97495-4

The subject of the book is well known and already classical – finite-dimensional representations of semisimple Lie groups and algebras – and many textbooks describing the topic from different angles are available. Nevertheless, the book under review has many new and nice features. The most important of them is the approach chosen. The first part describes representations of finite groups. Many basic notions, ideas and constructions of the representation theory are presented in a simple and clear form; moreover, a particular attention is paid to representations of the symmetric group which are important later for representations of Lie groups. The second part explains first in detail how representations of Lie groups are related to representations of Lie algebras and explains the classification of representations in the simplest cases of sl_2 and sl_3. The next part describes the classification of representations of four series of classical Lie algebras case by case. At this point the reader should already understand the subject and can enjoy (if he so wishes) the general abstract theory including five exceptional algebras and several character formulas. A lot of standard material are postponed to appendices. Frequent excursions to projective algebraic geometry throughout the book add a very nice and special flavour. The book contains a lot of examples, exercises, problems and pictures. It can well be used as a source for lectures, careful comments on this aspect are included and the book retains an excellent pedagogical style of original lectures. Well recommended both for lecturers and students. (vs)

M.Kishi (Ed.): Potential Theory. Proceedings of the International Conference on Potential Theory, Nagoya (Japan), August 30-September 4, 1990, Walter de Gruyter, Berlin, 1992, ix+403 pp., DM 198.00, ISBN 3-110-12812-8

The invited lectures reflect various aspects of contemporary potential theory. Nonlinear potential theory is represented by four contributions: L^p potential theory techniques and nonlinear PDE by D.R.Adams, Une version non linéaire de théorème de Hunt (C.Dellacherie), Nonlinear potential theory (thin sets and fine topologies by L.-I.Hedberg) and Potential theory and quasiconformal mappings (O.Martio). J.C.Taylor's paper deals with the Martin compactification on a symmetric space, A.G.O'Farrell's contribution is devoted to capacities in function theory. There are two other papers related to functions of a complex variable: Strict isoperimetric inequalities and asymmetry (W.K.Hayman) and Level sets and the Green function (J.-M.Wu). Potential theory on non-locally compact spaces is studied via Dirichlet forms by M.Röckner. Applications of the Choquet theory of function cones are described in J.Bliedtner's paper on the solvability of the weak Dirichlet problem and its consequences to approximation theory. The boundary behaviour of solutions of the Dirichlet problem is investigated in the framework of harmonic spaces by I.Netuka. Finally, the paper of G.Mokobodzki is devoted to the relationship between maximal inequalities in ergodic theory and classical principles of potential theory. The proceedings also include 26 contributed papers reflecting a rich variety of potential theory and its applications. (in)

J.Nešetřil, M.Fiedler (Eds.): Fourth Czechoslovakian Symposium on Combinatorics, Graphs and Complexity, Annals of Discrete Mathematics, vol.51, North-Holland, Amsterdam, 1992, x+400 pp., $ 140.00, ISBN 0-444-89543-4

The Fourth Czechoslovak Symposium on Graph Theory and Combinatorics was held in Prachatice, a small town in Southern Bohemia, in June 1990. By coincidence, it was one of the first international meetings held in Czechoslovakia after the collapse of communism in November 1989. This fact might have contributed to significant participation of foreign mathematicians – two thirds of the contributions in the Proceedings are written by foreigners. Topics covered by the contributions (many of them are in form of extended abstracts) include complexity theory, algorithms and graph theory as well as classical combinatorial themes like Ramsey theory or designs. Among others, there are survey papers about Planar graph colorings (Borodin), Self-dual polyhedra (Archdeacon), Inefficient existence proofs and complexity classes (Papadimitriou). One of the most often cited original results presented in Prachatice is '11/6-approximation for Steiner problem on graphs' by Zelikovsky. (jakr)

A.Riede: Mathematik für Biologen. Eine Grundvorlesung, Friedrich-Vieweg & Sohn, Wiesbaden, 1993, xii+321 pp., 120 fig., DM 39.80, ISBN 3-528-06468-4

This book is designed as a three semester guide to mathematics for students of biology. The text is carefully subordinated to this purpose: most notions are thoroughly biologically motivated, especially by population dynamics, genetics and ecology. All theorems are precisely stated, the majority of them without proofs, though accompanied with many examples. A good feature of the book are the many illustrative figures. The reader is introduced to the basic principles of probability, statistics, linear algebra, real functions and differential equations. The Hardy-Weinberg law, predator-prey and two species competition models are the most important biological applications. The whole exposition is rather elementary and K. Hadeler's book with the same title can be recommended for deeper insight. (jm)

F.A.Berezin, M.A.Shubin: The Schrödinger Equation, Mathematics and Its Applications 66, Kluwer Academic Publishers, Dordrecht, 1991, xvii+555 pp., $ 249.00, ISBN 0-7923-1218-X

In my opinion, the book is an example of how a good mathematical text should be written. The formalism is subordinated to the (successful) effort of expressing the ideas as distinctly as possible without any loss of mathematical exactness. The explanation of basic tools is done in well written supplements. (The first one deals with spectral theory in Hilbert spaces, the second one is an introduction to elliptic operators in Sobolev spaces). Compared with the 1983 Russian edition, the present text is enriched by Supplement 3 (written by D.A.Leites) entitled Quantization and Supermanifolds. In Chapter 1, general concepts of quantum mechanics are presented. The one-dimensional Schrödinger equation is treated in Chapter 2. The 3rd chapter deals with n-dimensional Schrödinger equation. Chapter 4 is dedicated to scattering theory and the topics of the fifth chapter are symbols of operators and Feynman path integrals. The book contains 18 pages of references and a very useful Short Guide to Bibliography. (oj)

H.Lange, Ch.Birkenhake: Complex Abelian Varieties, Grundlehren der mathematischen Wissenschaften 302. A Series of Comprehensive Studies in Mathematics, Springer-Verlag, Berlin, 1992, viii+435 pp., 9 fig., DM 148.00, ISBN 3-540-54747-9, ISBN 0-387-54747-9

In recent years the theory of Abelian varieties has become very popular due to applications in different fields of mathematics and mathematical physics. The book gives a partial survey of the theory. It covers, among others, topics in complex tori, theta functions, geometric properties of Abelian varieties and Prym varieties. Special attention is paid to the moduli spaces of Abelian varieties with an additional structure and also to the applications in the theory of algebraic curves. A lot of exercises on different levels are included, which complement the main text in a suitable way. Some topics of the theory as e.g. rationality questions, Schottky problem, are omitted in the book. The book is self-contained in most parts, it requires only basic facts from differential geometry and complex analysis; some deeper results (with references given) are used only in a few places, in particular in last chapters. It is written in an understandable and systematical way and can be recommended to all mathematicians and physicists interested in this subject. (jbu)

A.Kawauchi (Ed.): Knots 90. Proceedings of the International Conference on Knot Theory and Related Topics held in Osaka (Japan), August 15-19, 1990, Walter de Gruyter, Berlin, 1992, x+641 pp., DM 248.00, ISBN 3-110-12623-0

Knot theory and various new knot invariants form a flourishing subject, important new points of view and interconnections of various approaches are still emerging. The conference on Knot Theory held in Osaka in summer 1990 brought together 174 participants (mostly from Japan and USA). Its Proceedings contain 42 papers, majority of them based on lectures presented at the conference (not all lectures are covered). Many aspects of the theory, among others approach to links via closed braids, Witten's 3-dimensional approach to knot invariants, spin networks and 3-manifold invariants, surgeries on knots, link homotopy theory, tangle invariants and quantum groups, higher-dimensional links, state models for link invariants, skein modules on 3-manifolds, monodromy representations, are described. The book gives an overview of the field at the time of the conference. (vs)

J.Dieudonné: Mathematics - The Music of Reason, Springer-Verlag, Berlin, 1992, x+287 pp., 59 fig., DM 68.00, ISBN 3-540-53346-X

This is a readable book on the history of mathematics and on the evolution of mathematical thought. As mentioned in the introduction, it is designed for readers who for various reasons are interested in science, but are not professional mathematicians. The concept of mathematics as well as the work of mathematicians and the mathematical community are described. "Pure" and "applied" mathematics and the nature of mathematical problems are discussed. Two chapters are devoted to classical mathematics: its objects and methods, intractable problems, sterile problems and prolific problems. There is an extensive exposition on new objects and methods of mathematics (dealing essentially with mathematics of the 19th and 20th centuries). The final chapter touches problems and pseudo-problems about "Foundations". Four appendices (including about one quater of the book) recall the relevant mathematical background. Brief biographies of distinguished mathematicians are added. The book will be well accepted by students, teachers and anybody willing to listen to "the music of reason". Even professional mathematicians can find bits of new information: the history of mathematics is rich and Dieudonné's opinions and views interesting. (in)

R.Meise, D.Vogt: Einführung in die Funktionalanalysis, Vieweg-Studium, Bd.62, Aufbaukurs Mathematik, Friedrich Vieweg & Sohn, Wiesbaden, 1992, ix+416 pp., DM 54.00, ISBN 3-528-07262-8

Functional analysis, a modern part of mathematics rapidly developing since the thirties, provides other branches of mathematical analysis with its powerful tools and directions of research. This book, a well-written and up to date introduction to functional analysis, explains its fruitful and general methods and concepts. The reader is guided through Banach space theory and the theory of linear compact operators to Banach algebras theory and the spectral theory of linear operators. Special attention is also paid to the theory of locally convex vector spaces (duality, projective and inductive topologies, (DF)-spaces) and the structure of special classes of Fréchet spaces. Each paragraph ends with a collection of well-chosen exercises. Since this book serves as a modern introduction to functional analysis, it is of interest to all readers who wish to be acquainted with the above mentioned parts of mathematical analysis. (joko)

G.L.Naber: The Geometry of Minkowski Spacetime, Applied Mathematical Sciences, vol.92, Springer-Verlag, New York, 1992, xvi+257 pp., 43 fig., DM 98.00, ISBN 0-387-97848-8, ISBN 3-540-97848-8

An elementary and very detailed introduction to basic concepts of special theory of relativity is given. Attention is centered around a description of the properties of the electromagnetic field and Maxwell equations. The electromagnetic field is treated first as a skew-symmetric linear transformation and identified later with a 2-form on Minkowski space. After a comprehensive discussion of properties of spinors, the electromagnetic field is described using symmetric spinor fields and the Maxwell equations are presented in spinor form. The classification of the electromagnetic field is presented both in tensor and spinor form. The book starts from the very beginning and needs only a bit of linear algebra; it contains almost 200 exercies. It can be recommended to undergraduate students of mathematics and physics. (vs)

A.M.Meirmanov: The Stefan Problem, de Gruyter Expositions in Mathematics 3, Walter de Gruyter, Berlin, 1992, ix+244 pp., DM 148.00, ISBN 3-110-11479-8

The book provides a wide explanation of various aspects of the Stefan problem, which is a free boundary problem for the parabolic equation describing a phase transition. The author considers classical solutions to the Stefan problem as well as generalized ones, based on problem formulation of S.L. Kamenomotskaya and O. A. Oleinik. The existence and uniqueness of generalized solutions is proved, existence and behaviour of classical solutions is studied, too, for one-phase or two-phase Stefan problem (existence over a small time interval, existence on an arbitrary time interval, asymptotic behaviour). In the context of Lagrange coordinates, the filtration problem in porous layer is studied which is equivalent to the one-phase Stefan problem. In the Chapter VI, the existence of mushy region is considered. Compared to the Russian original, an appendix is added concerning binary alloy crystalisation. Because of complexity of the problems, many important aspects remain beyond the scope of the book (a large part of the book presents results of the author and his colleagues), but a list of references is included and a nice introduction describes various related problems. The book represents a very interesting text which will be useful for specialists as well as for the general reader. (pd)

A.A.Karatsuba: Basic Analytic Number Theory, Springer-Verlag, Berlin, 1993, xiii+222 pp., DM 148.00, ISBN 3-540-53345-1, ISBN 0-387-53345-1

This book is devoted to four problems in analytic number theory: the problem of lattice points in planar domains, the distribution of primes, Goldbach's problem and Waring's problem. To show the most important results (not the recent refinements), the author masterly explain the fundamental methods of analytic number theory: I.M.Vinogradov's method of trigonometric sums, the method of complex integration and the circle method. Many parts of this book including some proofs are interesting even for specialists. Further, an essential part of this book are "exercises" (better: suggestions for further study or research work). In over one hundred of these "exercises", one can find - for example - Jarník's well known example of the extremal planar curve - the last chapter from the second volume of "Vorlesungen ..." of E.Landau or Stepanov's elementary proof of Weil's theorem. Eleven chapters, a short bibliography, a subject index, a little table of primes and their smallest primitive roots and more than thirty pages of hints for the solution of the exercises (with many references). The English edition is the translation of the 1983 Russian second edition; for this purpose, the author rewrote the part of Chapter 1 (lattice points). The book can be warmly recommended to specialists as well as to students. (bn)

O.A.Oleinik, A.S.Shamaev, G.A.Yosifian: Mathematical Problems in Elasticity and Homogenization, Studies in Mathematics and its Applications, vol.26, North-Holland, Amsterdam, 1992, xiv+398 pp., $ 128.50, ISBN 0-444-88441-6

This monograph presents a well organized, clear and concise exposition of homogenization and strong G-convergence of operators and boundary value problems arising in the linear elastostatics. For the convenience of readers, the book begins with preliminaries on function spaces, Korn inequalities and existence and uniqueness theorems for Dirichlet, Neumann and mixed boundary value problems on bounded as well as on unbounded and perforated domains. The topics discussed in the second chapter are: strong G-convergence, N and N' conditions (the latter guaranteeing an estimate of rate of convergence) and asymptotic expansion of solutions. Starting with systems with rapidly oscillating coefficents, the authors also deal with almost periodic coefficients on systems describing stratified materials. The behaviour of eigenvalues and eigenvectors for G-convergent sequences of operators are treated in the last part of the book. Valuable both for specialists and for graduate students. (js)

H.-O.Peitgen, H.Jürgens, D.Saupe: Fractals for the Classroom. Part Two. Complex Systems and Mandelbrot Set, Springer-Verlag, New York, 1992, xii+500 pp., DM 54.00, ISBN 0-387-97722-8, ISBN 3-540-97722-8

A carefully written book bringing a broad view of the underlying notions behind fractals, chaos and dynamics. Mathematical aspects are accompanied with relations to natural phenomena. The visual beauty of the subject is demonstrated in an attractive way: numerous figures and coloured plates illustrate the variety of shapes appearing in the study of chaos and fractals. This volume emphasises the dynamical aspects of complexity: the signs of chaos, from order to chaos, strange attractors. Recursive structures (like L-structures) and cellular automata are studied in detail and a readable account of Julia sets and Mandelbrot sets is given. For each of 7 chapters, a computer program is designed (examples: final state diagram, the Rössler attractor) and the reader is encouraged to try small computer experiments. The book is not written in a "popular scientific" style even though it does not rely on the knowledge of sophisticated technical mathematics. Recommended to anybody who wants to be introduced to the modern development of the exciting interdisciplinary field dealing with chaos and fractals. (in)

A.Beutelspacher, U.Rosenbaum: Projektive Geometrie. Von den Grundlagen bis zu den Anwendungen, Vieweg-Studium, Bd.41, Aufbaukurs Mathematik, Friedrich Vieweg & Sohn, Wiesbaden, 1992, vi+229 pp., 52 fig., DM 38.00, ISBN 3-528-07241-5

The book offers a presentation of basic facts in projective geometry (mainly over finite fields) and applications to the theory of codes and to cryptography. The first part of the book describes synthetic projective geometry, analytic methods, the basic configuration theorem as well as collineations and quadratic sets, especially quadrics. In the second part, an introduction to the theory of codes, a description of Hamming codes and Reed-Muller codes, an introduction to the cryptography and application of the finite projective geometry to the Shared Secret schemes are given. The book can also be used for an introductory course on projective geometry. (jbu)

K.-E.Hellwig, B.Wegner: Mathematik und Theoretische Physik I., Ein integrierter Grundkurs für Physiker und Mathematiker, de Gruyter Lehrbuch, Walter de Gruyter, Berlin, 1992, xi+443 pp., DM 58.00, ISBN 3-110-13857-3

The book is the first part of a two volume textbook offering an integrated introductory course for physics and mathematics students. It covers selected parts of linear algebra and geometry (affine spaces, vector spaces, Euclidean spaces, linear mappings, systems of linear equations, eigenvaules and bilinear forms). Further, analysis in Euclidean spaces is dealt with (topological notions, continuity, compactness, connectedness, differentiability, series, Riemann integration, differential forms, curvilinear and surface integrals). Three chapters are devoted to physics (Motion, Space and Time; Galilei Relativity Theory; Electromagnetic Field). Also applications of mathematics explained in previous six chapters are presented (e.g. linear harmonic oscillator, motion in Newtonian mechanics). (in)

A.I.Kostrikin, I.R.Shafarevich (Eds.): Algebra VIII, Encyclopaedia of Mathematical Sciences, vol.73, Springer-Verlag, Berlin, 1992, 177 pp., 98 fig., DM 136.00, ISBN 3-540-53732-5, ISBN 0-387-53732-5

During the past twenty years, the representation theory of finite dimensional algebras has developed rapidly. The book presented serves as an introduction to this theory. Starting from the basic notions and their properties, the authors pass through the theory of quivers and their representations to the finitely represented algebras. With respect to the introductory character of the monograph, it is quite natural that the theory of tame and wild representations of finite dimensional algebras is not included. Each of fourteen chapters contains a lot of illustrative examples making the book much more readable. The list of 150 articles (or monographs) at the end of the book seems to be sufficiently extensive (a reference to a detailed bibliography up to 1984 is mentioned in the foreword). (lb)

E.Ossa: Topologie, Vieweg Studium, Bd.42, Aufbaukurs Mathematik, Friedrich Vieweg & Sohn, Wiesbaden, 1992, xii+307 pp., 69 fig., DM 48.00, ISBN 3-528-07242-3

The book is a nice introduction to the modern topology. It covers basic general topology, homotopy theory, homology and cohomology including their product structure. Moreover topological groups, Lie groups, homogeneous spaces and Stiefel manifolds are introduced and described there. Some interesting and well-known topological and geometrical problems on elementary level are discussed and solved, examples being the study of Jordan curves, a presentation of some properties and computations of the index of a closed curve with respect to a point, the problem of vector fields on two-dimensional sphere and the classification of closed surfaces. Only basic knowledge from analysis and linear algebra is required. The book is nicely written and organized and can be recommended to all beginners in the field as well as a main source for a basic course in topology. (jbu)

L.H.Y.Chen, K.P.Choi, K.Hu, J.Lou (Eds.): Probability Theory. Proceedings of the 1989 Singapore Probability Conference held at the National University of Singapore, June 8-16, 1989, Walter de Gruyter, Berlin, 1992, xi+208 pp., DM 168.00, ISBN 3-110-12233-2

The conference proceedings demonstrate in a striking way the growing connection and fruitful cooperation between probability theory and differential and integral geometry. The main topic of the proceedings - stochastic differential and integral calculus - is represented particularly by the consistent lecture of K. Ito on the Malliavin calculus built on a basic probability space and by the lecture of D.W. Strook on second order divergence operators and bounds for the corresponding Markov operator semigroups. The workshop lecture of M.A.Pinski (Inverse questions in stochastic differential geometry) illustrates how purely geometrical properties of Riemannian manifolds can be derived from the behaviour of stochastic differentiable processes defined on them and may be interesting also for geometers. Beside the leading theme, the interesting contributions of C. Stein on auxiliary randomization and of H. Kesten on the connectivity of random graphs should be noticed. (jr)

L.D.Andersen et al. (Eds.): The Julius Petersen Graph Theory Centennial, Topics in Discrete Mathematics, vol. 6, North-Holland, Amsterdam, 1992, 708 pp., $ 228.50, ISBN 0-444-89781-X

This is simply an excellent book which no graph theorist should miss. Euler, Petersen and Kuratowski are milestones in the history of graph theory. In 1990, a group of Danish mathematicians organized a conference in honor of Julius Petersen, to celebrate his 150th birthday (which passed in 1989) and the centennial of his famous paper on regular graphs (which appeared in 1891). Based on proceedings of this meeting, completed with several more recent papers, the book under review was first published in two volumes (Nos. 100 and 101) of Discrete Mathematics, and it undoubtedly deserved to be republished in one volume, as it happens now in Topics in DM. Though all contributions relate to Petersen and his favourite topics, the scope of the book is incredibly wide: it begins with history (introducing the personality of Petersen, his biography, annotated bibliography, correspondence between him, Sylvester, Hilbert and Klein, and a report about Petersen's theory of regular graphs), it continues with a survey on matching theory and with forty contributed papers to be concluded by a set of 27 open problems (carefully updated by the editors). Just two examples show that a book motivated by the history is touching graph theoretical topics which are very hot at present – there are two papers about Hadwiger's conjecture (which was proved for $k = 6$ very recently, after the book was published), and probably the most juicy candy, the proof of the famous 'cycle plus triangles' conjecture of Erdös is included. (jakr)

Yu.D.Burago, V.A.Zalgaller (Eds.): Geometry III, Encyclopaedia of Mathematical Sciences, vol.48, Springer-Verlag, Berlin, 1992, 256 pp., 80 fig., DM 136.00, ISBN 3-540-53377-X, ISBN 0-387-53377-X

This book is a survey of results which are presented without proofs with many comments. The content of the book is divided into three independent parts. The first part "The geometry of surfaces in Euclidean spaces " written by Yu.D.Burago and S.Z.Shefel covers the geometry of smooth as well as non-smooth surfaces in the n-dimensional Euclidean space. The main topic of this part is the problem of the connection between classes of metrics and classes of surfaces in E^n. Special attention is paid to convex surfaces, saddle surfaces and surfaces with bounded extrinsic curvature. The second part "Surfaces of negative curvature" by E.R.Rozendorn is devoted to the properties of surfaces in E^3 with negative curvature. Starting with the classical Hilbert theorem claiming that there is no complete analytic surface with constant negative Gaussian curvature in E^3, the author presents the evolution of the embedding problem for surfaces. The last part "Local theory of bendings of surfaces" by I.Kh.Sabitov gives a condition of bending of surfaces, the classification and integral characteristic of points of a surface and studies infinitesimal bendings of surfaces and of polyhedra. (jbu)

GEOMETRY OF LAWS

1. Universal Law of Gravitation: Discovery

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2. Universal Law of Politics: Corollary

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