# European Mathematical Society

## NEWSLETTER No. 13

## 1st September 1994

**An Electronic Information system for Mathematics**

**Committee of Applications of Mathematics**

**Mathematics Education - Competitions**

**Problem Corner**

**Euronews**

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EC HUMAN CAPITAL AND MOBILITY PROGRAMME

# MRI POST-DOCTORAL FELLOWSHIPS IN MATHEMATICS

*Third Round*

Applications are invited for a number of fellowships for research in mathematics at the Mathematical Research Institute (MRI) in the Netherlands.

**The Mathematical Research Institute** (MRI) in The Netherlands has been set up jointly by the mathematics faculties of the universities of Groningen, Nijmegen, Twente and Utrecht. Its aim is to promote research, organise graduate courses and seminars, and stimulate international contacts and exchange. The MRI is one of the main mathematical institutes in The Netherlands. The MRI research programme is divided into three main streams:

Algebra and Geometry
Analysis
Stochastics and Operations Research

**Conditions.** Applicants must be a citizen of one of the member states of the European Community, other than the Netherlands, or a resident of the Community; similar rules apply to applicants from several non-member states which participate in the HCM-programme (Austria, Switserland, Sweden, Norway, Finland, Iceland). The activity is intended primarily for the benefit of young researchers at post-doctoral level, defined as researchers having at least six years of higher education and who hold a doctorate or an equivalent degree, or have had two or more years of research experience following a post-graduate course.

**Applications.** These must include a c.v., list of publications, concise description of research interests and letters of recommendation and/or names of 3 referees, and should reach :

| | |
|---|---|
| Mathematical Research Institute | |
| Postdocs Committee | Tel:+31-30-531421 |
| P.O.Box 80.010 | Fax:+31-30-518394 |
| 3508 TA Utrecht | Email:mri@math.ruu.nl |
| The Netherlands | |

by **1 November 1994**. Scientific information is available from the following people:
Prof.dr. E.N. Looijenga - Algebra and Geometry- +31-30-531535 email: looijeng@math.ruu.nl

Prof.dr. F. Takens - Analysis- +31-50-633979 email: f.takens@math.rug.nl

Prof.dr.ir. J.H.A. de Smit- Stochastics and OR - +31-53-893386 email: j.h.a.desmit@math.utwente.nl

Duration: 6-12 months, exceptionally 24 months.
An MRI committee will make an initial selection of the postdocs in December 1994.

**Exeter University** **Loughborough University**

# RESEARCH FELLOW: NONLINEAR DYNAMICS

**1 YEAR POSITION**

Applications are invited for a Postdoctoral Research Fellow to work on the SERC funded project 'Renormalisation and Universal Structures in Complex Dynamical Systems'. The grant is held jointly by Dr B D Mestel (Mathematics Department, Exeter University) and Dr A H Osbaldestin (Mathematical Sciences Department, Loughborough University).

The aim of the project is to investigate the universal structures in complex dynamics using renormalisation group ideas. The project will encompass both numerical investigations and theoretical and rigorous analysis.

The ideal candidate will have postdoctoral research experience or be completing a Ph.D. in nonlinear dynamics.

Interested applicants are invited to contact the grant holders by telephone or e-mail

Mestel: (44) (0)392 - 263987, bdm@maths.exeter.ac.uk

Osbaldestin: (44) (0)509 - 223189, A.H.Osbaldestin@lut.ac.uk.

The post will commence on 1 September 1994 (or as soon as possible thereafter) and will be of 1 year duration. Salary range is on the RA1A scale in the range 15,566-17,007 pounds commensurate with age and experience.

Applications (curriculum vitae and two referees) should be sent by 5 August 1994 to Dr B D Mestel, Department of Mathematics, Exeter University, Laver Building, North Park Road, Exeter, EX4 4QE.

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**University of Southampton** **Faculty of Mathematical Studies**

# LECTURESHIPS IN PURE MATHEMATICS

Applications are invited for 2 Lectureships in Pure Mathematics in the Faculty of Mathematical Studies to commence on 1 September 1995.

Applicants should have a strong research record in Pure Mathematics. Preference may be given to candidates whose research interests would reinforce areas that are already strongly represented in the Faculty. In particular, it is hoped to make an appointment in or close to geometric group theory.

Salary will be on the University Lecturer Grade A scale: £13,601 - £18,855 per annum.

Informal enquiries are welcome and should be addressed to Professor M J Dunwoody, Faculty of Mathematical Studies, University of Southampton, Southampton, SO17 1BJ (telephone 0703-593659, fax 0703-593939, email mjd@uk.ac.soton.maths).

Further particulars and an application form may be obtained from the Personnel Department (L/34), University of Southampton, Highfield, Southampton, SO17 1BJ (telephone (44) (0)703-594047). The closing date for the return of completed application forms is Monday, 7 November 1994, quoting reference number L/34.

**Working for Equal Opportunities**

### European Congress of Mathematics 2000

The Executive Committee has set a deadline of 31 December 1994 for the receipt of bids to stage the European Congress of Mathematics 2000. Institutions or societies wishing to stage this major event should submit to the Secretary a proposal addressing such questions as

- finance (how will funds be raised, including fellowships to support visitors from Eastern Europe; will fees be reduced for EMS members?)
- facilities (how many participants will the lecture halls accommodate, are cheap student hostels and cafeteria available?)
- structure of meeting (plenary and sectional lectures, round tables, other activities?)
- local support (does the proposal have the wholehearted support of the host institution and the national mathematical community?)
- organisational structure (the EMS should have a decisive influence in the scientific committee, but the local organisation must be financially independent)
- experience (do the organisers have experience of, and resources for, undertaking such large-scale activities, or do they have access to others who do?)
- prizes (do the organisers have views on whether, and if so how, these should be awarded?)
- dates (when, how long?).

At its first meeting in 1995, the Executive Committee will begin to consider the bids. It expects to be able to present a single proposal for approval at the 1996 Council meeting.

European Mathematical Society

### Executive Committee for 1995–96

As a result of the elections held at the Council meeting in Zürich, 12–13 August 1994, the Executive Committee for 1995–96 will consist of

| | |
|---|---|
| President | **J.-P. Bourguignon** |
| Vice-Presidents | L. Màrki |
| | **D.A.R. Wallace** |
| Secretary | **P.W. Michor** |
| Treasurer | A. Lahtinen |
| Other members | E. Bayer |
| | **A. Conte** |
| | I.S. Labouriau |
| | A. Pelczar |
| | V.A. Solonnikov |

The names in bold type are not on the present Executive Committee.

A report on other decisions and discussions at the Council meeting will appear in the next issue of the Newsletter.

# New Perspectives of a Distributed Electronic Information System for Mathematics – Part I –

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Konrad-Zuse-Zentrum für Informationstechnik Berlin
Heilbronner Str. 10, D-10711 Berlin-Wilmersdorf, Germany

**Abstract**

Combining electronic specialized information, such as electronic information retrieval from central databases, with the new means of communication opens up new perspectives for mathematics in Germany. Based on the current Fachinformationsprojekt (Specialized Information Project) run by the Deutsche Mathematiker-Vereinigung (DMV) and supported by the Federal Minister for Research and Technology (BMFT), the DMV is planning a new infrastructure activity for mathematics. This activity will not only include mathematical university departments and research institutes, but also partners from mathematical research laboratories in industry as well as suppliers of mathematical information, in particular, scientific publishing houses, the Technical Information Library (TIB) Hannover, university libraries and – last but not least – the Fachinformationszentrum (FIZ) Karlsruhe with the Zentralblatt für Mathematik.

On the technical basis of the Internet and its worldwide information services (Gopher, WAIS, World Wide Web, Hyper-G, ftp and e-mail), a distributed mathematical information system is to be created, whose partners make their local resources available both to other partners and to the worldwide Internet community. These aims can be achieved by means of the consequent use of software that is structured according to the client-server model and distributed and accepted within the Internet.

Providing the technical equipment, however, is by far not enough. Without the creation of a personal, technical and organizational infrastructure, realization of such a project will not be possible. For every partner the realization of the following measures is envisaged:

* Establishing an *Information Coordinator* at every participating institution
* Creation of a *Forum for Mathematical Information*
* Installation and maintenance of *Mathematical Information Stations*
* Participation in national and international *Standardization Activities*
* Regular workshops and training courses, public relations

The following activities (carried out by all partners or within pilot projects by special groups) focusing on mathematical and mathematics-related information are planned:

* Set up of *Electronic Information Systems* by all partners
* *Distributed* electronic offer of *Preprints* and scripts (full texts) by all partners
* *Distributed* electronic offer of *Software and Data Collections* by all partners
* Access to *Global Information Systems in Mathematics*
* Organization of a *Living Museum of Mathematics*
* Access to *Electronic Library Catalogs,* esp. to libraries of university departments
* Electronic offer of *Scanned Historical Books and Documents*
* Creation and management of *Electronic Mathematical Journals*
* Creation of a framework for various kinds of *Electronic Reviewing*
* Testing of new methods for *Electronic Document Delivery*
* *Electronic Project Organization*

The project aims, at its beginning, at the creation of an information infrastructure for database retrieval, e-mail, electronic conferencing and subject-specific information networks. Its focus is on mathematics in Germany. The general scope, however, is broader. The project is open for discussion, coordination, and cooperation with partners in other areas of science, industry or in other countries. It is also hoped that this project may form an example along which other models of electronic information and communication can be developed. Moreover, the project is also meant to enhance the offer from German mathematics to the worldwide "give and take" within the Internet community.

## 1. Introduction

In 1992 the "Deutsche Mathematiker-Vereinigung" (DMV) together with the "Konrad-Zuse-Zentrum für Informationstechnik Berlin" (ZIB) started a project supported by the German Federal Minister for Research and Technology (BMFT) "Improving access to subject-specific online databases and CD-ROM for mathematical institutes in Germany" (short: DMV Project "Specialized Information"). The aim of this project is to supply mathematicians, scientists and students at mathematical departments and research institutes with the possibility to search in the major mathematical databases, especially the databases MATH, MATHDI, PHYS and CompuScience offered by the "Fachinformationszentrum Karlsruhe" (FIZ Karlsruhe) [Grötschel 93a].

In the course of this project, in which 51 mathematical departments and research institutes are participating, it has become clear to us that, today, specialized electronic information must be seen in a much wider context than that of online search possibilities in databases that mainly contain bibliographic information, abstracts and reviews on scientific publications; see also [Grötschel 93b].

For mathematical research, for applications in mathematics, but also for teaching purposes, electronic access to full texts, to mathematical software and data collections and to other information systems is gaining more and more importance. In Germany, similar to the United States, there is an increasing need for electronic access to local information with an organizational character, such as contact addresses, institute and project descriptions and information about scientific conferences.

Another, probably even more important perspective is the fact that questions arise that are relevant not only for the sciences, but will be of great importance for German industrial companies in the future. Electronic call for tenders and the free flow of information about the support of research are but one example in this context.

We will mention some highlights of the technological change that originates from the United States and has taken shape in the installation and dissemination of fast and efficient networks. First of all, there is the Internet, the network of networks [Internet 94], which today provides access to more than 35,000 networks and well over 3 million hosts [Press 92], [Time 93]. Thousands of subject-specific information networks and electronic conferences have become established in the Internet. The Usenet News (a collection of several thousand single conferences), which is the most important of these information networks, has more than 6 million readers a day.

In the Internet, numerous (over 500) electronic journals can be found: three examples from mathematics are the "Electronic Journal of Differential Equations", which can be read free of charge via the E-math server of the "American Mathematical Society" (AMS) from any (Internet) workstation [AMS], the "Electronic Transactions on Numerical Analysis" of the University of Kent, which can also be read at no cost at least for a trial period of three years [Kent 93] and the "Electronic Journal of Combinatorics" [EJC]. In the past six months, six further electronic journals with similar characteristics have been founded in the field of mathematics alone. Some of them have high-ranking editorial boards, their contributions are peer-reviewed, they have an ISSN number and they are archived by the Library of Congress.

The Springer-Verlag in Heidelberg, too, now has its own electronic server [Springer].

Prepublications of books can also be found in the Internet. An example in the area of computer science is the book "An Introduction to Tcl and Tk" by J. K. Ousterhout [Ousterhout 93]. Addison-Wesley was obviously not afraid of sales losses from making this book (which has meanwhile appeared in print) available in the Internet – on the contrary. Publishing houses offer their own products on information servers working with high-quality graphic environments [O'Reilly].

For quite some time now, the *netlib*, a very comprehensive collection of research software, has been offered free of charge [AT&T] (organized by J. J. Dongarra of the Oak Ridge National Laboratory and E. Grosse of AT&T Bell Laboratories). This software is classified according to the GAMS Index, which is defined by the National Institute of Standards and Technology (NIST) in the USA. The NIST has its own server [NIST] that allows a problem-oriented retrieval in the *netlib* and other mathematical software libraries.

In addition, O'Reilly's "Network Information Center" also offers a great number of links to other important information servers and catalogues (also from libraries) [O'Reilly], for instance, it provides access to the Library of Congress USA [LOC], which is presently conducting an electronic exhibition of coloured (scanned) historical manuscripts, books and maps of the Vatican Library in the Internet, which can be "visited" free of charge and from which copies of the exhibits can be retrieved. In Germany, too, many libraries have their on-line catalogues connected to the Internet [Braun 93]. Last but not least, an increasing number of renowned research institutes, such as the Argonne National Laboratory, offer their preprints and technical reports in the Internet [ANL].

Electronic mail (e-mail) plays an important role in this context. In the field of high energy physics, e.g., today all publications are offered early on a preprint server in the USA (that is mirrored in Italy) [LANL], [Taubes 93]. Electronic mail not only makes it possible to transmit letters quickly and organize electronic conferences efficiently. In the United States it has become a commonly-used tool, not only in the field of science, but also in industry: submissions of offers and order placements can often be settled within one day, whereas the same process may well take weeks in Germany (or in Europe). Even the President of the United States today can be reached by e-mail. On the average, he receives 1,000 to 6,000 electronic messages a day [Internet 93].

The main problem, however, is that these developments have not been sufficiently noticed in Germany (nor in Europe) and that their importance has not been realized, which may result in a real location disadvantage for the German (or European) economy. We will mark this important topic with the key word

"Electronic Information and Communication",

which is to be understood as the creation of an adequate infrastructure for scientific institutes in the field of mathematics and their partners in industry and – of course – the traditional suppliers of specialized information, i.e., publishing houses, libraries and the Fachinformationszentrum Karlsruhe. In concrete terms, our proposal is to create a "Distributed Information System for Mathematics" in Germany.

Our aims are the following:

* Enhancement of the traditionally central supply of information by a decentralized, wide-spread and interactive information and communication system for science and industry.

* Full accessibility of all forms of specialized electronic information (full texts, software, data collections, contact offers), partly by means of international cooperation.
* Active participation of mathematicians from science and industry in the electronic supply of specialized information.
* Increased efficiency of current research by intensifying the electronic exchange of information.
* Improved studying conditions, increased transparency for students, reduced duration of university studies.
* Speeding-up and cost reduction in the general supply of information.
* Testing of new models of electronic information distribution.

We consider this project, which is only a small step in this direction, as an examplary contribution to overcome the current backwardness as well as the lack of acceptance towards electronic tools, also in industry. In additon, we consider it as an example for other fields of science. Scientific societies, such as the

* "Deutsche Physikalische Gesellschaft" (DPG)
* "Gesellschaft für Informatik" (GI)

are also preparing similar [DPG 94] or even more comprehensive [GI 94] programs on the subject "information and communication". Although our project aims may be slightly different from those of these two societies, we are in close cooperation with DPG and GI.

## 2. Pilot Project: "Distributed Electronic Information System for Mathematics in Germany"

We propose the creation of an organizational and technical infrastructure for a distributed information system. Besides extending the use of electronic specialized information at the partner institutes (as a further development of the aims of the DMV Project "Specialized Information"), local, but also worldwide resources for subject-specific mathematical information are to be opened up. The electronic specialized information available shall be further established and, in addition, the methods and techniques for setting up one's own offer of subject-specific information shall become part of the scientist's work.

In this context, central concepts for the supply of information shall be supplemented by decentral ones. Partners in this process of distributing the supply of information could be

* Mathematical university departments and research institutes
* Mathematical laboratories in industry
* Fachinformationszentrum Karlsruhe and Zentralblatt für Mathematik
* TIB Hannover and scientific libraries
* Museums with scientific-technical departments
* Scientific publishing houses and possibly software companies.

The objective of this project is an integrated and coordinated realization of the following infrastructural measures at the partner institutions:

* Creation of the function of an *Information Coordinator*, who is in charge of all responsibilities attributed to the "Specialized Information Coordinator" in the current DMV Project "Specialized Information" plus the organization of the offer of information in his/her institute.

* Creation of a *Forum for Mathematical Information* with representatives from all partner institutes.
* Initiation, approval and control of single activities and special projects – platform for funding activities of the BMFT and other institutions.
* Implementation of *Information Stations* (servers) and *Clients* with the aim of access from all workstations at the partner institutions (and worldwide) to information offered by other partners.
* National and international cooperation in order to coordinate and standardize the distributed offer of information.
* Joint and local workshops and special training courses.

The project will be realized under the auspices of the Deutsche Mathematiker-Vereinigung. The Konrad-Zuse-Zentrum für Informationstechnik is willing to participate in the "Forum" with a scientific-technical working group.

## 3. Distributed Offer of Information

In the following we will give a short illustration of the term "distributed information system", which has different connotations in different fields of computer science.

We do not see this term with the eyes of a database specialist, who might have in mind a distributed database offered centrally. We do not take up the role of a communication specialist either, who might think of a "distributed service" (or a "communication protocol"). A computer scientist will possibly take it as the development of a new information system integrating several workstations with a common windows environment. A librarian will probably understand it as the access to several catalogues in his/her library with a central lending system. Each of these perspectives has its own legitimacy, however, none of them reflects our aim properly.

### 3.1 Distributed Information System

As a matter of fact, mathematicians want to use the latest communication tools without having to develop them. Our special purpose is to create a platform in the Forum for Mathematical Information where the latest tools available at no cost and distributed in the Internet and in the open domain can be used as components for the distributed information system. By using servers and clients that are widely accepted in the Internet (presently Gopher, WAIS, WWW, Hyper-G and Mosaic [Krol 92], [Berners 92], [Kappe 93], [Andreessen 94]), an opening of the distributed information system and, as a consequence, worldwide, easy and mutual access to locally available subject-specific information is aimed at. Today, the use of local information servers makes it possible, for instance, to make full texts available in a suitable and inexpensive form.

We see a distributed information system from the perspective of the scientific field mathematics. Relevant information that is locally available shall be opened up for the community of mathematicians;

* Preprints, also prepublications of books (full texts, LaTeX, postscript)
* Lecture notes and other teaching materials (LaTeX, postscript)
* Mathematical software and documentation (ASCII, online manuals)
* Data collections, e. g. concrete data of important application cases (ASCII)

* Connections (Electronic Links) to other information systems (Gopher, WAIS, WWW, Hyper-G).

In addition, subject-specific information with organizational contents shall also be made available:

* Contact addresses (WhitePages, whois, find) with fields of interest
* Latest project news and new project tenders (conferencing, mailing lists)
* Information on research funding (national & international).

In this context, a model for an organizational framework for the offer and distribution of electronic journals is to be developed, which is suitable for the electronic publishing of mathematical contents. This "tool", however, shall also be used for general messages in the "Forum".

The partners of the project and, possibly, the special interest groups of the DMV offer their local resources of information via their own mathematical information stations (servers) in the Internet. They make use of the resources made available by other partners with corresponding clients, which, in principle, can be installed at any of their workstations (not only at their actual information servers). The utilization offer can be made in the Internet – worldwide – as it is made up according to the client-server model and, for the time being, only Gopher, WAIS and WWW and Hyper-G server and clients will be used. As a universal browser that integrates the services of several clients at present Mosaic is to be considered.

Technically speaking, one of the main tasks will be the coordination of data exchange formats and, in this context, the participation in national and international standardization committees.

### 3.2 Advantages of a Distributed Information System; Example: Preprints

A research result has a long way to go from being written down by the author, accepted, e.g., by a university department, submitted to the editor of a journal to publication by a publishing house in a journal and, finally, entry and review in a database. First, the author compiles the results in the form of a preprint of his/her university department or institute. The preprint is then submitted to a publishing house for publication. The publishing house, i.e., the editor of the journal, carries out a complex refereeing procedure before the article is printed in order to guarantee high-level quality standards. The reviewing publication can only prepare a review when the article has been published in a professional journal. Normally, 1 to 3 years pass between preparation and publication of an article, and another 6 to 12 months until entry in a database.

In research, preprints have, to a large extent, taken the role of publications in journals, in particular due to the above mentioned delays in the publishing process. From the author's point of view, preprints secure the right of discovery. From the reader's point of view, preprints are available much earlier than the final publications.

If an author makes his/her preprint available on the information server of his/her institute, "readers" with a workstation will not only have access to

* the full text of a preprint, but also
* immediate access

provided they are informed of the availability. Indeed, all partners in the project can be informed of each new preprint via e-mail. A central information service, such as the (Internet) Archie service or a WAIS server could also inform external partners of new offers.

Within a few days, the Fachinformationszentrum Karlsruhe and the Zentralblatt can now integrate either the abstract of the mathematical preprint that is available on-line (with reference to the local server) or a related review that could also be obtained electronically from the reviewer.

Thus, searchers in the MATH database, which is the online version of the "Zentralblatt", not only find references to an article or a review within very short time, but also have immediate access to the full text.

### 3.3 The Importance of a Distributed Information System for Research, Teaching and Application

The distributed information system can become a new and powerful tool for mathematicians. The retrieval of information is extremely complex today. Mathematicians have to use a broad repertoire of sources for this purpose: publications and reviews, personal messages, preprints, conferences etc. In this context, the distributed information system can extend and improve the electronic offer of information. With a distributed information system mathematicians can make their own contribution to an efficient supply of information to their colleagues.

As results of the project we expect

* access to mathematical information that has usually been of limited availability
* relocation of information to electronic media at the expense of print media
* synergy effects due to immediate access
* a simple and intelligent user environment.

The distributed information system will not only provide mathematicians with more information, but also with new means to extract those bits of information that are relevant for them.

While the significance of such a system for research work is evident, we would like to add a word on its significance for teaching and application. In teaching, for instance, the offer of electronic lecture notes is an interesting supplement and alternative to the usual offer of lectures. In particular students may obtain additional information about special branches and centers of their discipline etc. If several departments offer lecture notes on the same topic, they are in competition with each other. Thus, students not only have a wider choice (transparency of offer), but we also expect the better lecture notes to become more generally accepted. Information on job advertisements spread nationwide can increase motivation to reduce the duration of studies.

The distributed information system is a qualitatively new kind of link between mathematicians at universities on the one hand and in industry on the other hand. The information servers make it possible to obtain straightforward information on every institution and its profile. In this way, fears of contact are mitigated and contacts between partners intensified.

## 4. The Information Station

The partner institutes shall realize both access to the other partners' offer of electronic information and implementation of their own offer of information. In this context, the partners will create the technical and organizational preconditions by carrying out the following measures:

* Provision for an information server plus suitable responder software for the Internet ftp and telnet services as well as the installation of suitable server software for the Internet Gopher, WAIS, WWW or Hyper-G.
* Connection of the server to the Internet to make access of external partners possible.
* Implementation of information clients on all workstations of the local net with suitable access to the Internet services ftp, telnet and e-mail as well as installation of suitable client software for Gopher, WAIS, WWW or Hyper-G and the use of the integrated browser Mosaic.
* Furnishing of all workstations for access to servers of external partners in the Internet.

Due to the different conditions at the partner institutions, the decision on technical equipment will be left to themselves. The use of Unix is not a necessary precondition. Today, the relevant Internet server and client software are available for all major machine platforms: PC, Mac, and, of course, Unix-based machines.

We are proceeding on the assumption that access to the host of the Fachinformationszentrum Karlsruhe (FIZ) via telnet will soon be possible. The FIZ is presently working on the realization of a connection to the Internet. The required access coordination (password splitting etc.) can be carried out analogously to the DMV Project "Specialized Information".

## 5. The Information Coordinator

Making suitable techniques and tools available for the retrieval and offer of electronic information, however, is not enough. Experiences made in the course of the DMV Project "Specialized Information" have shown that imparting knowledge about how to use the new facilities to other colleagues seems to be even more important. This role shall be taken up by the "Information Coordinator", who will be appointed by every partner and who will pass on his/her technical know-how to his/her institute, possibly with the inclusion of further colleagues ("multipliers").

The central task of the information coordinator is – in addition to the tasks of the Specialized Information Coordinator in the DMV Project – to structure the offer of information and to participate in the Forum for Mathematical Information. He/she is the – internal and external – contact person and creates, coordinates and accompanies the realization of all measures carried out at his/her institute. In detail, these tasks include:

* Organization of the supply of information in his/her institute (retrieval and offer)
* Installation and update of the technical and organizational infrastructure for searches and on-line retrieval of information
* Technical accessibility of the offer of information (via Gopher, WAIS, WWW, Hyper-G, ...)

* Participation in the coordination of standards for the exchange of information
* Cooperation with the central project management.

This continuation of the function of the Specialized Information Coordinator will ensure the continuity of electronic specialized information in the field of mathematics. Each partner, i.e., the Fachinformationszentrum Karlsruhe as well as libraries, museums and publishing houses, too, will appoint a scientist for an adequate proportion of his working hours.

## 6. The Forum for Mathematical Information

Under the auspices of the DMV a *Forum for Mathematical Information* will be created consisting of the *Assembly of Information Coordinators* of all partners. The partners will pursue their common aims in the Forum on the basis of written cooperation agreements.

Scientific societies, organizations and institutions working in the field of research funding may participate in the Forum as associated members.

The Information Coordinators will meet at regular intervals (twice a year) to carry out joint workshops and will constitute working groups for special tasks. To this aim, cooperation will also take place electronically (installation of special mailing lists or electronic conferencing systems).

The Forum is the platform for the realization of the partners' activities (special tasks) and major special projects with a pilot character, which may be carried out by a group of partners. In particular, the Forum is the appropriate body to realize related BMFT support activities.

For the evaluation of new special tasks and pilot projects a *Scientific Technical Committee* will be created within the Forum, which will also analyse project results. To support the Scientific Technical Committee in fulfilling its tasks, the partners may also delegate specialists that do not belong to the group of information coordinators.

In order to fulfill the administrative tasks a *Central Project Management* will be set up within the Forum, which will also be responsible for the control of special tasks and pilot projects. The *Central Project Management* organizes joint workshops and is responsible for cooperation on national (DMV, DPG, GAMM, GI, KMathF, DFG, BMFT, ...) and international (Euromath, Internet Committees, standardization committees, ...) level. Its tasks will include central project reporting and public relations.

The Konrad-Zuse-Zentrum is willing to provide a scientific-technical working group to support the Forum in its technical responsibilities. This group's tasks will include the installation and testing of reference servers, the use of central mailing lists and a central information server as well as the organization and realization of corresponding training courses.

End of Part I

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Part II of this article will be published in the next EMS Newsletter, containing

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**Contact:** Wiss. Dir. Joachim Lügger
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The overall responsibility for the project planning and organization lies with the current President of the Deutsche Mathematiker-Vereinigung (DMV),

Prof. Dr. M. Grötschel
**groetschel@zib-berlin.de**

For an electronic discussion, a mailing list has been installed, which is open to everybody interested in the subject of the distributed information system for mathematics

**dmv-ug-pvefm@zib-berlin.de**

and which is moderated by Dr. Sperber(**sperber@zib-berlin.de**).

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The complete paper is also available electronically in the ftp archive of the Konrad-Zuse-Zentrum and can be obtained as follows:

```
ftp elib.zib-berlin.de
Name: anonymous
Password: <specify your e-mail address>
cd /pub/zib-bibliothek/reports/TR-94-08
get TR-94-08.ps.Z
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# Committee on APPLICATIONS OF MATHEMATICS

This recently formed Committee of the Society will undertake a variety of work, under the chairmanship of Adrien JAMI, Head of Mechanics and Numerical Models, EDF-Research Division, 1 Avenue du Général De Gaulle 92141 CLAMART Cédex, FRANCE.

Tel: (33) 1 47 65 37 56 Fax: (33) 1 47 65 41 18 e-mail: Adrien.Jami@der.edf.fr

An article describing the aims of the Committee in detail will appear in a future issue. One of these aims is to increase awareness in the mathematical community at large of the nature and range of problems in Industry, Science and Society in general, where mathematical methods could be successful. The article which follows is the first of a series directed toward this end.

Comments, suggestions and requests for further information may be sent to

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## MATHEMATICAL METHODS IN DATA ASSIMILATION PROBLEMS

**V.I. Agoshkov**

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In this report we would like to draw attention to one of the important contemporary problems of Applied and Industrial Mathematics - the Data Assimilation problem. We shall describe some mathematical methods which can be used to investigate this problem and present some references and addresses of groups studying these questions.

### 1. DATA ASSIMILATION PROBLEM

The problem of rational use of data from sea-stations, satellite observation data and others in the study of agriculture, meteorology, environment protection, etc. is becoming more and more important nowadays. A Mathematical model of this problem can be formulated as the Data Assimilation Problem (abbreviated, DAP). This is an optimal control problem.

Let there be a physical system, governed by some state equation and (possibly) additional relations, i.e., by a DAP-model. The problem associated with an analysis of observations for improving the parameters of the DAP-model (initial state, forcing, coefficients, etc.) is one of modern important problems. DAP can frequently be treated as a variational problem: a cost function measuring the model-to-observations distance is minimized with respect to the unknown system's inputs. This technique is in practical use, but little attention is paid yet to a rigorous mathematical justification. Now there are a lot of numerical experiments with various DAP-models [1], but solvability of the DAP-models of physical interest still remains to be studied in suitable functional spaces. The solvability result is not only of theoretical interest but is also needed for development and justification of efficient numerical algorithms to solve the problem.

One needs to understand that the DAP may have some specific properties. So, the authors of [2] investigated the solvability of some class of optimal control problems and formulated proposals on the reasons for the difficulties encountered in solving the problems. In particular, they showed that these problems are equivalent in a certain sense to ill-posed problems. This causes difficulties when solving these problems and simultaneously it requires here the use of regularization methods.

### 2. MATHEMATICAL AND NUMERICAL METHODS

To investigate the DAP-models one needs to apply the tools of some branches of Mathematics. To prove the existence of solutions of these problems the investigator should introduce suitable functional spaces and (usually !) use regularization techniques (both for theoretical investigations and numerical solution of problems). It is important to choose an effective algorithm for the minimization of the cost function and the problem of optimal values of the regularisation parameter will be very important here. The investigators can use the fractional steps schemes or other effective algorithms for the temporal discretization of the DAP-models [4].

One of the main steps of the discretization of DAP-models consists of applying finite element methods, finite difference schemas [4] and modern computational methods - Domain Decomposition Methods [3] which will give the possibility to parallelize calculations for modern computers and to accelerate the

solution of the problem. Of course, one needs to complete the justification of the algorithm for solving the data assimilation problem (prove stability and convergence). Since we are interested in the solution of the differential problem, one needs to verify that the numerical procedure actually provides an approximation to this solution. First, the discrete schema should be analysed in order to estimate the truncation error and to deduce the stability.

So, we can point out the following steps of mathematical and numerical investigations in the process of solving data assimilation problems.

1. Formulation of the mathematical model (state equation, boundary conditions, cost functions, restrictions, etc.) as an optimal control problem, or an inverse problem.
2. Derivation of variational Euler equations and studies of solvability of the problem in appropriate functional spaces.
3. Construction of approximations in temporal variable, stability and convergence studies.
4. Development and study of methods for solving nonlinear problems arising at each time step.
5. Approximation of problems in complex domains by the finite element method, domain decomposition algorithms and others.
6. Coding the program and numerical experiments.

So, while investigating data assimilation problems we need the methods and techniques of linear and nonlinear functional analysis, functional spaces, optimal control problems, ill-posed problems, numerical mathematics and informatics.

It is clear also, that these problems can be solved only through the cooperation of mathematicians, physicists and engineers using modern computers.

## 3. SOME SCIENTIFIC GROUPS AND CONTACT ADDRESSES

Below we present some contact addresses of scientific groups studying the application of mathematical methods to Data Assimilation Problems.

1. F.-X. Le Dimet
   Laboratoire de Modilisation et Calcul,
   51, Rue des Mathematiques,
   Domaine Universitaire
   B.P. 53X, 38041 Grenoble Cedex, France
   Fax : (33) - 76631263
2. C. Le Provost
   Institut de Mecanique de Grenoble,
   Universite Joseph Fourier,
   B.P. 53X, 38041 Grenoble Cedex, France
   Fax : (33) - 76825001
3. Agoshkov V.I., Ipatova V.M,
   Trufanov C.D., Shutyaev V.P.
   Institute of Numerical Mathematics,
   Russian Academy of Sciences,
   Leninski Prosp., 32-A,
   117334, Moscow, Russia
   Tel : (095) - 938-18-19
   fax : (095) - 938-18-21
4. Zalesny V.B.
   Institute of Numerical Mathematics,
   Russian Academy of Sciences,
   Leninsky Prosp., 32-A,
   Tel : (095) - 938-63-13
   Fax : (095) - 938-18-21
5. Penanko V.V.
   Computer Center of Siberian
   Branch of Russian Academy of Sciences
   Prosp. Ac. Laurentiev, 6,
   630090, Novosibirsk, Russia
   Tel : (383) - (2)-35-11-52
6. Naven I.M.
   Super Computer Research Institute
   Florida State University,
   FI. 32306 4032, Tallahassee, USA
7. Wunsch C.
   Massachusetts Institute of Technology,
   Block 54, Room 1324,
   Cambridge, MA 071 39, USA
8. Talagrand O.
   Laboratoire de Meteorologie Dynamique,
   Ecole Normale Superieure,
   24, rue Lhomond,
   75231 Paris Cedex 05, France
9. Olbers D., Schroster S., Sailer U1.
   Institute for Polar and Marine Research
   Columbusstrasse 120161-27515
   Bremerhaven, Germany
   Tel : 0 471 48 31 410

Other contact addresses and research groups in field of DAP-models can be found in [1].

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## Editorial and Call for Contributions

*It is now about two years since I have been in charge of the Education section of the EMS Newsletter. Thus, it is appropriate to thank all who have contributed to it and also all the members of the Committee for Mathematics Education who have supported my work. Diverse topics have been presented and discussed and this should continue in the future as well. But the purpose of this Editorial note is to announce a kind of focus which should be set for about the next two years:*

*Mathematics Competitions. Those are a widespread and successful means for arousing interest in mathematics on the part of students, to select and train gifted ones and to establish a mathematics culture. Therefore, exchange of experiences, of information about organisation, courses, contents and tasks, development of participants and the like appears to be highly appropriate. Some contributions already have been solicited.*

*All readers are sincerely invited to report on any kind of maths competition they have experience with, even as participants in their younger years. This refers to local, regional, national or international competitions as well. Please send such contributions of a length of up to 4 pages to the editor.*

*Of course, any other contributions on different topics are welcome so that the section can serve well in its purpose as a discussion forum.*

*I am looking forward to your reactions and contributions.*

*W. Dörfler*

## 29th Conference on Didactics of Mathematics

### Kassel (Germany) 1995

The 29th Conference on Didactics of Mathematics (29. Tugung für Didaktik der Mathematik) will take place from March 6 to 10, 1995 at the University of Kassel *(Germany)*. The first announcement will be available in October 1994 and may be obtained by writing to:

Professor Dr. Werner Blum, Kassel University
Department of Mathematics, D-34109 Kassel, GERMANY

## U.M.I. - C.I.I.M. Annual Meeting

From the 27th to the 29th October 1994 will be held in Latina (near Rome) the annual meeting on mathematics teaching organized by U.M.I.-C.I.I.M. (Unione Matematica Italiana . Commissione Italiana per l'Insegnamento della Matematica).

The theme is "The teaching of geometry from primary to secondary high school" and the meeting foresees plenary sessions and workshops on different schooling level.

For information write to: Lucia Grugnetti, Università Degli Studi di Parma,
Dipartimento di Matematica, Via M. D'Azeglio, I - 43100 PARMA
Tel: (0521) 205 300 FAX: (0521) 205 350

# A day (almost) of mathematics

**Michael Meyer**
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D-64625 BENSHEIM

In March 1991, pupils of the 12th grade from Southern Hesse and Northern Baden-Württemberg were first invited to spend a Saturday free of school together, in a friendly atmosphere, to do mathematics and exchange ideas. This initiative was well received from the start. Participants grew in number year after year until they reached record level this year, when three hundred enlisted. The initiative follows the example of the Society for the Advancement of Mathematically Gifted Young People which holds its own Days of Mathematics at the university towns of Karlsruhe, Constance, Ulm and Tübingen.

## A day to learn from

The "Bensheim Day of Mathematics" is more than just a day of competion and lectures, but has grown to be an institution constantly at work in initiating and organizing advancement programmes. All programmes, including those for teachers, are recommended and even supported by the Ministries of Culture in Hesse and Baden-Württemberg. In the region of Bensheim the Day of Mathematics has become well-known as a reliable institution whose additional, intellectually challenging contribution to school mathematics is widely appreciated. Even the general public has increasingly taken notice of the Bensheim Day of Mathematics as is proved by its extensive coverage in the local press.

## A day well organized

In the course of the past four years the organization has consolidated. There is a supra-regional committee for mathematical problems which sets the assignments for all similar competitions held at various locations, as well as a local committee responsible for the evaluation of the test papers handed in.

In Bensheim four curators are responsible for the curriculum of advancement programmes, while an industry-sponsored fund guarantees financial security.

The endeavours of the Day of Mathematics are accompanied and reinforced by intensive courses held annually at the universities of Constance or Ulm. In addition to that, there was a modelling week last year at the Centre for Practical Mathematics at the Pfalzakademie Lambrecht.

## A day of challenge

Once a year, the Bensheim Day of Mathematics invites pupils to participate in a competition which is designed to arouse interest in mathematics. All competitions aim at this goal. Our competition, more so than others of its kind, aims at motivating the broad spectrum of mathematically gifted pupils, rather than concentrating on the highly-gifted few. Moreover, the challenge is mainly team-oriented, and limited to one day.

Pupils who attend a secondary school of the college-preparatory kind, currently in the 12th grade, are eligible. Schools within a distance of approximately 80 kilometers from Bensheim are notified. There, pupils form groups of three to five members whose names may be sent in by their mathematics teachers. The programme of the Bensheim Day of Mathematics 19934 may serve as an example:

9:00 checking in
9.30 welcoming address and opening session
9:45 group competition
11:00 individual competition
12:00 lunch and recreation
13:30 high-speed competition
14:30 coffee and cake
15:15 "Exploring the Infinite", lecture by Professor Dr. Harro Heuser, Karlsruhe
16:30 victory ceremony performed by a representative of the Hesse Ministry of Culture

While the pupils were occupied with the assignments of the competition their teachers joined in a didactic colloquy with a lecture about "Solving problems - but how?" by Dr. Regina Bruder.

All pupils receive diplomas while the best are also awarded book prizes. Moreover, twenty pupils are selected for further advancement programmes. As a rule, they get a grant for the modelling week at the Centre for Practical Mathematics which comprises a seven days' stay at the Pfalzakademie Lambrecht, free of charge including expert counselling and guidance.

## A day's challenges - what are they?

As an example of the kind of problems the pupils are confronted with, here are those presented at the Bensheim Day of Mathematics 1994. The following are problems set for the group competition:

**G1.** (15 points)

From a cube with the edge $a$, eight pyramids are cut off by means of planes that intersect the edges in their midpoints. Determine the volume and the total area of the remaining solid.

**G2.** (15 points)

The equation

$$\big|\,|x|+\big|\,|y|-3\,\big|-3\,\big| = 1$$

determines a set of points in the xy-plane.

2.1 Why are the horizontal and vertical axis lines of symmetry for the set of points?
2.2 Draw the set of points (unit 1 cm).

**G3.** (15 points)

For a certain $f > 0$ the graphs $F$ and $G$ of the two functions $f_t$ and $g_t$ with

$$f_t(x) = \frac{1}{t}\cdot(t^2 - x^2), x \in R \text{ and } g_t(x) = x^3 - t\cdot x^2, x \in R$$

enclose a finite region $A$. Compute the area of $A$.

The following are problems set for the individual competition:

**E1.** (15 points)

Let $f$ be a function with

$$f(x) = \frac{r}{x^2 + 1}, \; x \in R.$$

and let $K$ be the graph of f.

1.1 By reflection of $K$ through the line $y = 4$ one gets the graph $C$ of a function $g$. Determine the equation of $g$.

1.2 Let $u > 0$. The lines $x = u$ and $x = -u$ intersect $K$ and $C$ in points $P, Q, R$ and $S$. Determine $u$ in such a way that the points $P, Q, R$ and $S$ form a square.

**E2.** (10 points)

On three different days the extra-curricular work groups in chess, mathematics and informatics meet. There are 35 participants altogether. They are divided in the following way:

(a) Exactly 16 persons take part in only one group.
(b) The chess group consists of 17 participants.
(c) Exactly eight persons take part in both the mathematics group and the informatics group.
(d) Exactly 3 persons take part in all three work groups.

How many persons are active solely in the chess group?

**E3.** (15 points)

Let $ABCD$ be a quadrilateral with the sides $|CD| = c$ and the angles $\sphericalangle BAD = \alpha$, $\sphericalangle CBA = ß$, $\sphericalangle ADB = 90°$ and $\sphericalangle ACB = 90°$. Determine the length of the side $AB$ in terms of $c$, $\alpha$ and ß.

**E4.** (7 points)

What is the last digit of the number $7^{77}$?

The following are problems from the high-speed competition which is done in groups and whose main purpose is simply fun:

**S1.** (4 points)

Given two concentric circles with radii $r < R$. The chord $AB$ of the larger circle is tangent to the smaller circle. Let $|AB| = 8$. How large is the area $F$ of the circular ring?

**S2.** (4 points)

The product

STETS·99999

ends in 705. Decode the number STETS.

**S3.** (3 points)

A champagne glass has the shape of a perpendicular circular cone with the base of radius $r$ and the height $h$. Where must the glass be marked to ensure that the champagne, filling the glass to this mark, fills half its volume?

**S4.** (3 points)

One digit is to be added to the number 10, on both left and right, in such a way that the resulting number is divisible by 72.

# Problem Corner

**Paul Jainta, Werkvolkstr. 10, D091126 Schwabach, Germany**

Like most things, the United States has a large number of mathematics contests, many good ones, but also a great many bad ones. An important characteristic of American education, which sets it apart from most other educational systems, is the high degree of local control over education. No American 'Ministry of Education' mandates the curriculum. Teachers are not centrally licensed. Indeed, free public education is not directly required by any federal governmental agency.

Under examination, the American educational system rapidly breaks down into thousands of tiny fragments. This is a natural consequence of the wider traditions of a country whose foundations are rooted in a search for personal freedom and individual opportunity. So it is not surprising that American mathematical competitions reflect the same decentralizing trends as other aspects of American education. There are for example a lot of competitions, which unfortunately reach more students, which are not very good. For students in the seventh and eighth grades there is no equal to MATHCOUNTS. For high school students, the only good national contests I know of are the *American High School Mathematics Examination (AIME),* the *American Invitational Mathematics Examination (AHSME)* and the *United States of America Mathematics Olympiad (USAMO),* which determine the American IMO-Team. Intentions quite different from the previous ones are pursued by the *American Regions Mathematics League (ARML),* the *U.S.A. Mathematics Talent Search (USAMTS)* and *The Mandelbrot Competition,* which I advertised in my first *Corner* in the summer. These all have their own little drawbacks (except perhaps the USAMTS, which is free to competitors and encourages mathematical writing and problem-solving). The AIME, the USAMO, and ARML are generally favoured by experienced students, as there are qualifying rounds to be passed in order to take them (most ARML teams represent an area and therefore there are trials and such to make the team).

The aforementioned contests are not the only ones existing, as hinted before. There are numerous other local, state and national contests in the U.S., and several private companies which market uniform competitions nationwide. Most of these events are very formula-intensive. This means that they encourage students to memorize formulas rather than learn problem-solving methods — there's a huge difference. Some of the rest are largely money-making schemes. It was in answer to these last two that three outstanding young Americans started *The Mandelbrot Competition.* The threesome, **Sam Vandervelde, Richard Rusczyk** and **Sandor Lehoczky** are still undergraduates. Sam is in his first year of graduate studies in mathematics at the University of Chicago. He was a member of the U.S. IMO-Team in 1989 (at Braunschweig, Germany). Sandor is currently a senior at Princeton and is studying physics, and Richard is on leave of absence from graduate studies at Stanford University in chemical engineering. All three are still avid problem-solvers.

*The Mandelbrot Competition* (named after *Benoit Mandelbrot,* whose work in the theory of fractals is well-known) is one of the few high-school mathematics competitions designed to educate participating students as well as challenge them. Competition topics include all non-calculus subjects usually found in the high-school curriculum, such as geometry, trigonometry, functions, complex numbers plus a few subjects, such as number theory and classical inequalities, in which most high school students have little experience. As evidence of the educational value of the contest, over 50 of last year's participants were among the 130 students who qualified for the U.S.A. Mathematical Olympiad.

The *Mandelbrot competition* is broken down into 5 rounds spread throughout the year: each round consists of an individual test and a team test, a peculiarity of the organizers' own creation. As sketched last time the individual portion is made up of seven short-answer questions. This test lasts 40 minutes. For the team section, four students chosen by the coordinator work together on a series of proofs. The Californian creators of this contest wanted to include mathematical writing through proofs and teamwork in some way. They justified their claims of being educational by providing the subjects of the team tests, and by writing articles on various mathematical topics such as modular arithmetic, Sylvester's Theorem, the Pancake Theorem, etc. at the beginning of the school year.

Thereby students can research the subjects and prepare beforehand. This (and the challenging nature of the questions) is perhaps what distinguishes *The Mandelbrot Competition* from other American mail-order contests!

By the way, *The Mandelbrot Competition* will run concurrently in both the United States and Germany this year. The organizers hope to foster a friendly mathematical correspondence between American and German students. Their aspirations are to spread the contest to as many schools in the U.S. and abroad as possible. They are very excited about the prospect of introducing the contest to European schools, and they hope that some will be able to help them meet that goal.

The 'pre-olympiad' set of problems for this time is the Team Test Round Five, April, 1991. Usually each round is subdivided into three sections: Facts, Definitions, Problems. The team test, which is 50 minutes long, is a series of proofs which are designed to enhance the student's understanding of a particular subject. The selected example below is just typical of the art of problem-solving as imparted to those undergoing the team test. Here, the questions range from easy to difficult. As a dessert I will serve an old-fashioned problem drafted in the ponderous rhymes of earlier days, submitted by **Malcolm MacCallum**, Inverness. He tracked it down from the 1718 edition of the *Ladies Diary* following on from my reference in the first *Problem Corner.*

**Q 9** ***Facts:*** A proper divisor of a positive integer n is a positive integer smaller than n which exactly divides n . One is a proper divisor of every positive integer. A perfect number is a positive integer whose proper divisors sum to the original number. For example, 6 is the smallest perfect number since its proper divisors are 1,2,3, and $1+2+3 = 6$. The next smallest perfect number is 28.

**Definitions:** A magical set is a set of three or more positive integers, not necessarily distinct, such that each number in the set exactly divides the sum of the remaining numbers. We also require that these numbers have no common divisor except 1. Hence the set {1,2,6,9} is magical since $1+2+6 = 9$ is a multiple of 9, $1+2+9 = 12$ is a multiple of 6, $1+6+9 = 16$ is a multiple of 2, and $2+6+9 = 17$ is a multiple of 1. The set {2,4,12,18} is not magical since all the numbers are divisible by 2.

***Problems*:**

i. Show that the set $\{1,1,2,4,\ldots,2^n\}$ is magical for all $n \geq 1$.
ii. Show that all the proper divisors of a perfect number form a magical set.
iii. Find all magical sets with exactly three numbers.
iv. Find all magical sets with four numbers, whose smallest elements are 1 and 3, i.e. of the form {1,3,m,n} with $m,n \geq 3$.
v. Prove that given any magical set, one can include an additional number in the set so that this new set is also magical.

**Q 10** (Question 60 by Mr Tho.Cary, of Lynn, from the 1718 edition of 'The Ladies Diary')

Within my garden I've a pond that's round
Whose surface equal to 5028 4/7 square feet is found:
In th' midst of which, a pole stands just upright
About the plain, one hundred feet in height:
This pole being broke into two parts,
Come, tell this query now, ye men of arts.
The broken piece fell just at the ponds brink:
How long is then the piece left, do you think?

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 to the editor. They can be anything from elementary to advanced, from easy to difficult. Original problems are particular sought. So, please submit any interesting problem you came across, especially those from (problem) books and contests that are not easily accessible. I hereby invite my readers to share them with their colleagues and students.

## SOLUTIONS

**Q 1.** In the figure, ABCD is a square of side length 1, and M and N are the midpoints of AB and CD respectively. Find the area of the shaded region.

**Solution** by *Malcolm MacCallum, Inverness, Scotland.*
Observe that the shaded area is half the area of the parallelogram MBND (by symmetry). Since the area of MBND is

$$A = (BM)\cdot(BC) = \frac{1}{2} ,$$

the shaded area is $\frac{1}{4}$ .

*Also solved by François Sigrist, Institut de Mathématiques, Université de Neuchâtel, Switzerland.*

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**Q 2.** Jayne writes the integers from 1 to 2000, inclusive, on a piece of paper. She erases all the multiples of 3, then all the multiples of 5, and so on, erasing all the multiples of each odd prime integer. How many numbers are left when she finishes?

**Solution** by *Malcolm MacCallum, Inverness.*
All numbers with odd factors other than 1 are erased. The only integers not erased are the powers $2^0, 2^1, \ldots, 2^{k-1}, \ldots$ . Thus the only numbers remaining are $1,2,4,\ldots, 2^{10}=1024$. Hence, there are 11 numbers left.

*Also solved by François Sigrist*, Université de Neuchâtel, Switzerland.

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**Q 3.** A certain type of lottery ticket pays \$100 two percent of the time, pays \$50 five percent of the time, allows you to get two more tickets for free five percent of the time, and is worthless the rest of the time. If the company marketing the tickets wants to break even on average, how much should it charge per ticket?

**Solution** due to *François Sigrist*, Institut de Mathématiques, Université de Neuchâtel,Switzerland.
Let the break-even price of a ticket be x . Then by the given conditions,

$$x = \$100\cdot 0.02 + \$50\cdot 0.05 + 2x\cdot 0.05$$

where the $2x$ is because the two free tickets can be assumed to be 'worth' the same amount as the original one. Solving the equation, we find $x = 5$ dollars.

**********

**Q 4.** In right triangle $\Delta$ ABC , with right angle at C and angle $\measuredangle$ A = 36° , a circle is inscribed touching $\overline{BC}$ at R, $\overline{AC}$ at $S$ , and $\overline{AB}$ at T .

Find the angle $\measuredangle$ RTS .

**Solution** by *Malcolm MacCallum, Inverness.*
$\overline{AS} = \overline{AT}$ (equal tangents) which implies $\Delta$ AST is isosceles. Therefore $\measuredangle$ STA $= \frac{1}{2}(180-36)^0 = 72^0$ . Similarly we have $\overline{BR} = \overline{BT}$ which yields $\measuredangle$ BTR $= \frac{1}{2}(180-54)^0 = 63^0$ . Finally this gives $\measuredangle$ RTS $= 180^0-(72+63)^0 = 45^0$

*Also solved by François Sigrist*, Université de Neuchâtel, Switzerland.

**Q 5.** The set A contains 12 points in space, and a subset B of A contains 7 points which lie in a single plane. If all groups of four coplanar points in A are subsets of B, then how many distinct planes may be drawn which pass through 3 or more points of A?

**Solution** *François Sigrist* gives a very short solution. He finds

$$1+5\cdot\binom{7}{2}+7\cdot\binom{5}{2}+\binom{5}{3}=\mathbf{186}$$

distinct planes as demanded.

***Editor's note.*** A perhaps more obvious solution, appropriate for students, is the following. Three noncollinear points determine a plane. Thus, given 12 points with no three collinear, there are $\binom{12}{3}=220$ planes which pass through at least 3 of the 12 points. However, we have counted the plane in which the 7 coplanar points lie once for each set of 3 points among the 7 points. We have thus counted this single plane $\binom{7}{3}=35$ times. Since we should only count it once, we must subtract 35-1 = 34 from our total counted number of planes, 220. Thus the 12 points define **186** planes.

***************

**Q 6.** What is the largest prime divisor of $3^{15}+1$ ?

**Solution.** Both solvers gave the correct largest prime divisor **271.**

Factoring $3^{15}+1$ as a sum of cubes, we have $3^{15}+1=(3^5+1)\cdot(3^{10}-3^5+1)$. We note that $(3^5+1)^2=3^{10}+2\cdot3^5+1$ and $(3^5-1)^2=3^{10}-2\cdot3^5+1$ . Thus we can write for example $3^{10}-3^5+1=(3^5+1)^2-3\cdot3^5=(3^5+1)^2-3^6$ as a difference of squares. Thus

$$3^{15}+1=(3^5+1)\cdot(3^{10}-3^5+1)=(3^5+1)\cdot((3^5+1)^2-3^6)=(3^5+1)\cdot(3^5+3^3+1)(3^5-3^3+1)\ .$$

The largest of the three factors is $3^5+3^3+1=\mathbf{271}$ , which is prime.

***************

**Q 7.** Evaluate $\dfrac{19}{93}+\dfrac{19\cdot18}{93\cdot92}+\dfrac{19\cdot18\cdot17}{93\cdot92\cdot91}+\cdots+\dfrac{19!}{93\cdot92\cdots75}$ as a fraction in lowest terms.

**Solution.** *François Sigrist* used summation notation and expressed each fraction as a product of fractions with factorials. Thus, we have

$$\sum_{j=1}^{m}\frac{m!}{(m-j)!}\cdot\frac{(m+k-j)!}{(m+k!)}=\frac{m!k!}{(m+k)!}\sum_{s=0}^{m-1}\binom{k+s}{s}=\frac{m!k!}{(m+k)!}\cdot\binom{m+k}{k+1}=\frac{m}{k+1}$$

and the entire sum is equal to $\dfrac{\mathbf{19}}{\mathbf{75}}$ for $m=19$, $k=74=93-19$.

Also solved by *Malcolm MacCallum, Inverness.*

***************

This makes a good place to end this number of the *Problem Corner.* Please send me your Olympiads, pre-Olympiads, and especially your nice solutions !

# EUROPEAN NEWS: Country by Country

## BYELORUSSIA

### Mathematical Investigations in Byelorussia

The Byelorussian Mathematical Society and VOMA Scientific Innovation Company are preparing for publication in 1994 an English version of the reference book "MATHEMATICAL INVESTIGATIONS IN BELARUS" a book of 400 pages in English.

Belarus is one of the leading mathematical centres of the former Soviet Union. Scientific schools founded by D.A.Suprunenko, V.P.Platonov and S.A.Chounikhin in the field of algebra, V.G.Sprindzhuk in the field of number theory, N.P.Erugin and Yu.S.Bogdanov in the field of ordinary differential equations, F.A. Ghaov in the field of boundary value problems in theory of analytical functions, E.A.Barbashin in the field of optimal control, V.I.Krilov in the field of computational methods have attracted attention in the world of science.

for the first time independent experts will publish in the reference the results of systematic analysis of the main branches of mathematical development in Belarus.

The contents of the review is the following:

1. ***The main branches of mathematical development in Belarus.***
   - *1.1 Algebra (Theory of algebraic, linear, finite groups, rings and bodies).*
   - *1.2 Number theory (diophantine approximation, diophatine equations, metric theory of numbers, theory of transcendental numbers, classification of real, complex and p-adic numbers.*
   - *1.3 Geometry and Topology (theory of symmetric spaces, Lie groups, geometry of probability theory).*
   - *1.4 Theory of functions (boundary value problems of theory of analytical functions and singular equations, theory of special functions and integral transform, theory of approximation).*
   - *1.5 Ordinary differential equations (theory of dynamic systems, qualitative, asymptotic and analytic theory of differential equations).*
   - *1.6 Functional analysis and equations with partial differentials (theory of groups representation, differential-operators equations, problems of mathematical physics).*
   - *1.7 Mathematical control theory (controllability, observability, optimal control systems, constructive methods of control systems synthesis).*
   - *1.8 Probability theory, mathematical statistics and stochastic processes (limit theorems for dependent random variables, numerical methods of queueing systems theory, stochastic differential equations, robust statistical conclusions, time series, adaptative statistical parameter estimation).*
   - *1.9 Discrete mathematics (discrete optimization, graph theory, scheduling theory, polyhedral combinatorics, computational geometry).*
   - *1.10 Computational methods (mathematical modelling; the theory, approximate computation and application of continual integrals; numerical solution of differential equations; computational methods of linear algebra).*
2. *Information concerning mathematical enterprises, departments and laboratories.*
3. *The list of mathematicians with scientific degree. Presentation of mathematicians - the members of the Byelorussian Academy of Science.*

A guiding price of the review is US 72.00 $

We ask to address your orders for the publications to: 220072, Belarus, Minsk, Surganov Str., 11, the Byelorussian Mathematical Society.

The Byelorussian Mathematical Society and VOMA Scientific Innovation Company are ready to carry out joint research, educational projects, getting experience of Byelorussian mathematicians in foreign countries and vice versa in any form you like. We are also ready to accept your orders for fundamental and applied research.

**The Council of the Byelorussian Mathematical Society**

**VOMA Scientific Innovation Company**

## CATALONIA

### The Ferran Sunyer i Balaguer Prize 1994

This international mathematical research prize is awarded every year by the Institut d'Estudis Catalans, in memoriam of the Catalan mathematician Ferran Sunyer i Balaguer (1912-1967). 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. Monographs, preferably typeset in TeX, should be sent to the following address, and must arrive before January 15, 1995, in order to be considered:

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

5. The name of the prize-winner will be announced in April 1995.

* * * * *

## WINNER OF THE FERRAN SUNYER I BALAGUER PRIZE 1993

The Institut d'Estudis Catalans has awarded the Ferran Sunyer i Balaguer prize 1993 to **KLAUS SCHMIDT**, of the University of Warwick, for his monograph entitled "Dynamical Systems of Algebraic Origin". The awards ceremony took place in Barcelona on April 22, 1994.

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## CENTRE DE RECERCA MATEMÀTICA (BARCELONA)

### LIST OF VISITORS DURING 1994-95

The CRM organizes two specialized semesters in the academic year 1994-95. The lists of invited participants in each of these two semesters are the following.

#### SEMESTER ON DYNAMICAL SYSTEMS

From September 1 until December 22, 1994.

Invited participants: S. López de Medrano (Mexico), L. Chierchia (Roma), D. V. Treshchev (Moscow), V. Kalantarov (Baku), J. Smítal (Opava), A. I. Neishtadt (Moscow), E. Belbruno (Minneapolis), G. Fusco (Roma), S. Verduyn (Amsterdam), T. Hall (Cambridge), Q. Jiang (Jiangsu), P. Robutel (Paris), M. Vishik (Moscow), P. Veerman (Recife), R. Roussarie (Dijon), F. Dumortier (Diepenbeek), J. Los (Nice), J. Guaschi (Toulouse), H. Cabral (Brasil).

#### SEMESTER ON DIFFERENTIAL GEOMETRY

From April 18 until July 18, 1995.

**Invited participants:** D. Boutat (Lyon), A. Verjovski (Villeneuve d'Ascq), A. El Kacimi (Lille), G. Hector (Villeurbanne), H. Hauser (Innsbruck), J. Álvarez López (Santiago), G. Meigniez (Paris), G. Oshikiri (Sendai), J. J. Loeb (Angers), S. Matsumoto (Tokyo), X. Masa (Santiago), A. E. Fischer (Santa Cruz), P. A. Schweitzer (Rio de Janeiro), V. Sergiescu (Grenoble).

**Continued.....**

In addition, the following people from other areas of mathematics will be guests of the CRM in the period 1994-95. Please consult the secretary of the CRM (Mrs. Consol Roca, Tel: (34-3) 581 1081, e-mail: icrm0@cc.uab.es) in order to inquire about the dates of the stay of each visitor.

**Other visitors:** I. Leary (Barcelona), N. V. Hung (Hanoi), A. Mathias (Oberwolfach), B. Schuster (Illinois), V. Camillo (Iowa), D. A. Stegenga (Hawaii), E. Dror Farjoun (Jerusalem), P. Paramonov (Moscow), P. Ribenboim (Kingston), S. Friedman (Boston), L. Vaserstein (Pennsylvania), E. Chirka (Moscow), S. Chirita (Iasi), Y. Netrusov (St. Petersburg), Ch. Cassidy (Québec), J. B. Conway (Knoxville), D. Scevenels (Leuven), M. Mimura (Okayama), B. Jiang (Beijing), S. Grellier (Paris), R. L. Griess (Michigan), J. Coates (Cambridge), R. H. Torres (Ann Arbor), E. A. Gavosto (Ann Arbor).

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## CZECH REPUBLIC

### Winter School "Volterra Integral Equations and their Applications"

**Date:** **4-10 December 1994**

**Location** **Paseky (Giant Mountains - Krkonose, North Bohemia)**

**Program:** Series of lectures delivered by:
M.Gyllenberg *(Turku, Finland):* Abstract integral equations and population dynamics;
S.O.Londen *(Helsinki, Finland):* Fractional conservation laws;
J.Pruess *(Weimar, Germany):* Operator methods in viscoelasticity;
W.Schappacher *(Graz, Austria):* The title will be announced. Short communications

**Contact:** Dr Jaroslav Milota, Dept.Math.Analysis, Charles University, Sokolovska 83, 186000 Praha 8, Czech Republic.

Fax: 42-2-2317662 e-mail: milota@karlin.mff.cuni.cz

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## FRANCE

### Congrès International sur la Modelisation Mathématique des Ecoulements en Millieux Poreux

**Date:** **22 - 26 May 1995**

**Location** **Université Jean Monnet à SAINT-ETIENNE (FRANCE)**

**Organizers:** A.Bourgeat, C.Carasso, A.Mikelic *(France)*, R.Ewing *(USA)*, S.Luckhaus *(Allemagne)*, M.Primicerio *(Italie)*

**Principle Speakers:** G.Allaire *(France)*, S.Antontsev *(Espagne)*, M.Avellaneda *(USA)*, G.I.Barenblatt *(Russie)*, J.Bear *Isreal)*, A.Bourgeat, G.Chavent *(France)*, J.H.Cushman *(USA)*, G.Dagan *Israel)*, J.Douglas Jr *(USA)*, H.Ene *(Roumanie)*, R. Ewing, L.W. Gelhar, R.Gilbert, J.Glimm, R.A.Greenkorn, A.Gutjahr, G.H.Homsy *(USA)*, U.Hornung *(Allemagne)*, S.Kozlov, R.Lenormand *(France)*, S.Luckhaus *(Allemagne)*, A.Mikelic *(France)*, V.N.Monakhov *(Russie)*, G.Panasenko *(France)*, P.Panfilov *(Russie)*, M.Primicerio *(Italie)*, G.Papanicolaou *(USA)*, M.Quintard *(France)*, T.F.Russel *(USA)*, C.J.Van Duijn *(Hollande)*, S.Whitaker, Y.C.Yortsos *(USA)*, V. Zhikov *(Russie)*.

Un resumé de deux pages recto doit être envoyé avant le 20 mars 1995 aux organisateurs.

**Contact:** Congrès Milieux Poreux, Equipe d'Analyse Numerique Lyon
Saint Etienne (URA 740 du CNRS), 23 rue du Dr. Paul Michelon
42023 St.Etienne cedex 02

Tel: (33) 77 42 15 35 Fax: (33) 77 25 60 71

email: CMP@ANUMSUN1.UNIV-ST-ETIENNE.FR

## GERMANY

# DEUTSCHE MATHEMATIKER-VEREINIGUNG E.V.

Geschäftsstelle: Albertstraße 24, D-79104 Freiburg - Telefon: 0761/278020, Telefax: 0761/272698

Die Geschäftsstelle der Deutschen Mathematiker-Vereinigung e.V. zieht um.
Bitte verwenden Sie ab **15. Juli 1994** nur noch die neue Anschrift:

Deutsche Mathematiker-Vereinigung e.V.
Geschäftsstelle
Institut für Angewandte Analysis und Stochastik
Mohrenstraße 39

D - 10117 Berlin

Telefon: 030 / 20377-306

**Wir ziehen um:**

Die Geschäftsstelle des Mathematischen Forschungsinstituts Oberwolfach wird zum 1. August 1994 von Freiburg nach Oberwolfach verlegt.

Unsere neue Adresse ab **August 1994** lautet

Mathematisches Forschungsinstitut Oberwolfach – Geschäftsstelle
Lorenzenhof, D – 77709 Oberwolfach-Walke

Tel.: 07834 / 979 – 50 **Fax: 07834 / 979 – 55**

# DEUTSCHE MATHEMATIKER-VEREINIGUNG E.V.

Geschäftsstelle: Albertstraße 24, D-79104 Freiburg - Telefon: 0761/278020, Telefax: 0761/272698

The office of the "Deutsche Mathematiker-Vereinigung e.V." moves.
Please use from **July 15th 1994** on only the new address:

Deutsche Mathematiker-Vereinigung e.V.
Geschäftsstelle
Institut für Angewandte Analysis und Stochastik
Mohrenstraße 39

D - 10117 Berlin

Telephone: 030 / 20377-306

**We will move:**

The office of the Mathematisches Forschungsinstitut Oberwolfach will move on August 1st, 1994 from Freiburg to Oberwolfach.

Our new address from **August 1994** on will be

Mathematisches Forschungsinstitut Oberwolfach – Geschäftsstelle
Lorenzenhof, D – 77709 Oberwolfach-Walke

Tel.: 07834 / 979 – 50 Fax: 07834 / 979 – 55

## ITALY

### II International Conference on Homotopy Theory

**Date:** **19 - 25 June 1995**

**Location** **Palazzo Feltrinelli *(University of Milano)* at Gargnano, Garda Lake.**

**Committee:** Albrecht Dold *(Heidelberg)*, Ioan M.James *(Oxford)*, Renzo A.Piccinini *(Milano)* and Douglas Ravenel *(Rochester)*.

**Contact:** Renzo A.Piccinini
Dipartimento di Matematica, Università di Milano
Via C. Saldini, 50-20133 Milano ITALY

Fax 39 2 7063 0346 e-mail "renzo@vmimat.mat.unimi.it"

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## SPAIN

WOGDA'94 III Workshop de oto No: Geometria Diferencial y sus Applicaciones

III Autumn Workshop: Differential Geometry and its Applications.

**Topics:** The Workshop consists of three parts:

- Mechanics and Fields Theory
- Lorentz Geometry
- Sympletic Geometry

**Date:** **26-27 September 199**

**Location** **Granada, Andalucia, Spain.**

**Organizers:** C.Ruiz, A. Romero, M.Sanchez, M.A. Cañadas-Pinedo
(University Granada)

**Contact:** C.Ruiz, Dpt. Geometria y Topologia, Univ. Granada,
18071 Granada, SPAIN.
E-mail: ruiz@ugr.es Phone: +34 58 24 3278 Fax:+34 58 24 3281

## SWITZERLAND

At the ICM in Zürich, the Fields medals were awarded to

| | |
|---|---|
| **J. Bourgain** | University of Illinois, Urbana-Champaign/IHES,Paris/IAS,Princeton |
| **P.-L.Lions** | CEREMADE, Université Paris-Dauphine |
| **J.-C. Yoccoz** | Université Paris-Sud, Orsay |
| **E. Zelmanov** | University of Madison, Wisconsin |

The Nevanlinna prize was awarded to **A. Widgerson**, Hebrew University, Jerusalem

Our President, Professor F.E.P. Hirzebruch, has been elected a Foreign Member of the Royal Society of London

## 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, Czech Republic.*

**G.A.Anastassiou: Moments in Probability and Approximation Theory,** Pitman Research Notes in Mathematics Series, vol.287, Longman Scientific & Technical, Harlow, 1993, 411 pp., GBP 39.00, ISBN 0-582-22770-4

This book is a research monograph that summarizes in a selfcontained manner the author's contributions in the field of applications of J.H.B.Kemperman's geometric moment theory, neatly presented in Chapter 2, to probability and approximation theory. In particular, the method of the optimal distance and ratio are used to solve a variety of important moment problems. Among those the reader will find in Chapters 3-6 problems arising from Kantorowich mass transportation theory, problems related to Jefferson rounding proportions and both to Levy and Prochorov radii. Geometric moment theory surprisingly provides also a very efficient tool that enables one to establish the optimal rate of weak convergence of probability measures to point measures and, more generally, the optimal rate of pointwise convergence of positive stochastic linear operators to the unit operator. Chapters 5-10 give an account of the above results while Chapters 11-15 extend those in other related ways motivated mostly by the famous Korovkin convergence theorems. A preview chapter presenting simplified formulations and solutions to the problems treated in the book makes all its parts easily accessible even for those readers who do not intend to study the text systematically. In the reviewers opinion, G.Anastassiou has written an excellent and useful book that will surely not only encourage further research by drawing deserved attention to Kemperman's geometric moment theory, but also provide a well written survey of moment theory methods (15 p. of references) applicable in probability, statistics, approximation theory and numerical analysis. (jos)

**K.Walker: Surveys in Combinatorics, 1993,** London Mathematical Society. Lecture Notes Series 187, Cambridge University Press, Cambridge, 1993, 287 pp., GBP 22.95, ISBN 0-521-44857-3

The book under review comprises the invited lectures of the Fourteenth British Combinatorial Conference which was held in Cambridge in 1993, in honour of C. Nash-Williams, one of Britain's and the world's leading graph theorists (to celebrate his sixtieth birthday). Two of the invited lectures were particularly devoted to areas which were founded or strongly influenced by the work of Nash-Williams. These are a survey on submodular functions by A. Frank and a survey on weighted quasigroups by A. Hilton and J. Wojciechowski. The other invited lectures were also very well chosen, and the entire book presents a very useful and comprehensive overview of the most recent development in graph theory and combinatorics. The topics covered by the articles include designs and cryptography, circuit decompositions and Euler tours, probabilistic approach to partial orders, and applications of algebraic methods in graph theory and combinatorics, including an excellent survey on choosability and colourability by N. Alon. (jakr)

**G.James, M.Liebeck: Representations and Characters of Groups,** Cambridge Mathematical Textbooks, Cambridge University Press, Cambridge, 1993, x+419 pp., GBP 45.00, ISBN 0-521-44024-6, ISBN 0-521-44950-6

The first 330 pages of the textbook cover the basic theory of group representations. Every detail is carefully explained; examples and exercises take up about half of the text. The authors provide character tables for groups of order less than 32, and for $A_5$, $A_6$, PSL (2,7) and PSL (2,11). Applications to group theory are restricted to Burnside's theorem. The final chapter describes how the equations of motion of a molecule are connected with characters of the corresponding symmetry group. 53 pages of solutions to exercises, the index and a short bibliography complete the book which should be easily understandable for everyone familiar with basic notions from complex linear algebra. The book can well serve undergraduate students of mathematics, chemistry and physics. (tk)

**E.B.Vinberg (Ed.): Geometry II. Spaces of Constant Curvature,** Encyclopaedia of Mathematical Sciences, vol.29, Springer-Verlag, Berlin, 1993, 254 pp., 87 fig., DM 141.00, ISBN 3-540-52000-7, ISBN 0-387-52000-7

This volume of the Encyclopeadia consists of two papers on spaces of constant curvature. The first paper "Geometry of spaces of constant curvature" by D.V.Alexandrov, E.B.Vinberg and A.S.Solodovnikov contains the

following topics: general theory of homogeneous spaces, spaces of constant curvature in arbitrary dimensions, a detailed description of spherical, Euclidean and Lobachewskij plane geometry, including trigonometry, a study of several problems in $n$-dimensional spherical Euclidean and Lobachewskij geometry such as properties of planes, spheres, horospheres, equidistant surfaces, acute-angled polyhedra, volumes of sector, wedges and polyhedra. Special attention is paid to the classification and properties of motions in these spaces. The second part "Discrete group of motions of spaces of constant curvature" by E.B.Vinberg and O.V.Schvartsman covers the following topics: discrete groups of motions, fundamental domains, crystalographic groups, Fuchsian groups, reflection groups, arithmetic groups and sociology of discrete groups in the Lobachewskij spaces.

Both papers are very well written. The subject is described from different viewpoints: elementary geometry, Riemannian geometry and group theory. The book can be recommended as a nice introduction to hyperbolic and spherical geometry. At the same time, the book also includes very recent results from the theory of spaces of constant curvature which will be of interest to researchers in this field. (jbu)

**H.Eves: Fundamentals of Modern Elementary Geometry,** Jones and Bartlett Publishers, Boston, 1992, x+198 pp., $ 37.50, ISBN 0-86720-247-5

An excellent book directed at high school mathematics teachers to widen, as well as deepen their knowledge of elementary geometry. Using the advantage of the notion of sensed magnitude, the author derives some powerful theorems (like those of Ceva's and Menelaus') to study many important properties of ranges of points and pencils of lines in an extended Euclidean plane and pencils of orthogonal lines and circles in an inversive plane. The concept of geometrical transformations (including isometries, similarities, inversions, reciprocation and perspectivity transformations) is introduced to be used in the "transform-solve-invert" and "transform-discover-invert" procedures of problem solving, which forms the second part of the book. In the third part of the book the possibility of solving a problem using a predetermined set of tools (like straightedge and compass, straightedge alone, compass alone, straightedge and rusty compass) is questioned. The text is rich in historical comments introducing every new concept and in supplementary problems ending each topic. The lucidity of explanation is one of the main characteristics of the book. (jtro)

**R.Kanigel: Der das Unendliche kannte. Das Leben des genialen Mathematikers Srinivasa Ramanujan,** Friedrich Vieweg & Sohn, Wiesbaden, 1993, viii + 331 pp., 41 fig., DM 58.00, ISBN 3-528-06509-5

The original version of the book, "The Man Who Knew Infinity. A Life of the Genius Ramanujan", was published in USA in 1991. The main goal of the book is to describe the destiny of the exceptional Indian mathematician S. Ramanujan (1887-1920). The book is an interesting and valuable contribution to the "life of mathematics" in the 20th century. Eight chapters, photos, bibliography (7 pp.), notes, index. Strongly recommended to specialists as well as to amateurs. (jbe)

**M.Feistauer: Mathematical Methods in Fluid Dynamics,** Pitman Monographs and Surveys in Pure and Applied Mathematics, vol. 67, Longman Scientific & Technical, Harlow, 1993, xiii+657 pp., GBP 72.00, ISBN 0-582-20988-9

The book covers a wide spectrum of mathematical models, problems, methods and techniques applied in contemporary fluid dynamics. It contains the derivation of fundamental equations and presents the formulation of mathematical models and boundary value problems describing a number of fluid flows. Attention is paid to the investigation of qualitative properties of models as well as of their numerical solution. Special attention is paid to the existence and uniqueness of the solution to incompressible or compressible inviscid and viscous flow. The book explains the application of the theory of complex functions, integral equations and partial differential equations including the recent concepts of weak and measure-valued solutions. Furthemore, theoretical analysis and practical implementation of computational fluid dynamics, i.e., finite difference, finite element and finite volume methods, are presented. The book represents a rigorous introduction to the mathematical modelling of flow problems and provides knowledge of modern mathematical and numerical methods used in this field. It can be warmly recommended to students of mathematics and professional mathematicians working in applied mathematics, partial differential equations, numerical analysis and fluid dynamics. In addition, it will be of interest to people from theoreticaly oriented aerodynamics, physicists, engineers, natural scientists and students from these areas. (fel)

**Y.Kitaoka: Arithmetic of Quadratic Forms,** Cambridge Tracts in Mathematics 106, Cambridge University Press, Cambridge, 1993, x+268 pp., GBP 35.00, ISBN 0-521-40475-4

This is a book on arithmetic of quadratic forms over $\mathbf{Z}$. Its main goal is to give a self-contained proof (more precisely, only the algebraic part of the proof) of Siegel's formula for positive-definite quadratic forms over $\mathbf{Q}$. Along the road it explains all the necessary techniques. Chapter 1 treats the general theory of quadratic forms. Chapter 2 covers classical reduction theory for positive-definite quadratic forms over $\mathbf{R}$. Quadratic forms over $\mathbf{Q}_p$, $\mathbf{Q}$ and $\mathbf{Z}_p$ are studied in Chapters 3,4, and 5, respectively. The culmination of the book is Chapter 6, devoted to quadratic forms over $\mathbf{Z}$. It includes a discussion of genera, spinor genera, representation theorems and Siegel's formula. The final Chapter 7 studies the behaviour of positive-definite quadratic forms under tensor products. The book requires only a modest knowledge of algebra and algebraic number theory. It could be useful to students of algebra and/or number theory as well as to professional mathematicians. (jnek)

**F.Jones: Lebesgue Integration on Euclidean Space,** Jones and Bartlett Books in Mathematics, Jones and Bartlett Publishers, Boston, 1993, xiv+588 pp., $ 46.25, ISBN 0-86720-203-3

This is a very detailed and (as the author says) slow introduction to Lebesgue integration on Euclidean spaces. All the standard material is covered in a pleasant and readable way, concreteness is emphasized throughout. Abstract measures are only introduced after the reader becomes familiar with classical Lebesgue measure. One chapter is devoted to the gamma function, there is also a short chapter on convolutions. The strength of Lebesgue integration theory is well illustrated by a thorough treatment of Fourier analysis. The Fourier transform on $L^1$ as well as the Fourier-Plancherel transform are studied and a short introduction to Hilbert spaces is included. Formal applications to differential equations are nicely documented and a lot of concrete calculations done (e.g., Bessel functions, Hermite polynomials etc.). Trigonometric series and Fourier series in one variable are also discussed in detail. The two last chapters are devoted to differentiation of measures and of functions of one variable. The role of the Vitali covering theorem, the Hardy-Littlewood maximal function, and the Besicovitch covering theorem is explained. Well chosen problems are spread throughout the book (there are 600 of them) and present an integral part of the study of the book. In summary this book is a very good textbook of important parts of classical analysis. The choice of material, the style and a lot of problems will surely attract the attention of both students and teachers. (in)

**K.E.Hellwig, B.Wegner: Mathematik und Theoretische Physik II. Ein integrierter Grundkurs für Physiker und Mathematiker,** de Gruyter Lehrbuch, Walter de Gruyter, Berlin, 1993, xii+390 pp., 41 fig., DM 98.00, ISBN 3-11-014005-5, ISBN 3-11-013786-0

This second volume of an integrated course for physicists and mathematicians concentrates mainly on theoretical physics. The chapter on special relativity theory includes the Michelson-Morley experiment, Poincaré transformations, Minkowski space, relativistic mechanics and electrodynamics in special relativity. Basic facts on functions of a complex variable are summarized and fundamental notions from functional analysis are presented. The next chapter deals with existence and uniqueness theorems for ordinary differential equations. Methods of solution of usual types of equations are explained. First order partial differential equations are also studied and basic information on the wave equation and the Laplace equation is included. The final part (more than one third of the book) covers important topics of theoretical physics (Wellenbewegungen, Anfangsgründe der Quantenmechanik, Bindung eines Teilchens im Potential). Mathematicians interested in physics as well as students of theoretical physics will find the book interesting and useful. (in)

**W.Bruns, J.Herzog: Cohen-Macaulay rings,** Cambridge Studies in Advanced Mathematics, vol.39, Cambridge University Press, Cambridge, 1993, xi+403 pp., GBP 45.00, ISBN 0-521-41068-1

This monograph is devoted to homological and combinatorial aspects of commutative algebra. Its central topic is a study of Cohen-Macaulay and Gorenstein rings. The book is divided into three parts. The first part (Chapters 1-4) covers basic concepts of the classical homological theory of local rings (regular sequences, Koszul complexes, Cohen-Maculay rings and modules, complete intersections Gorenstein rings, injective hulls, canonical modules, local duality, Hilbert functions and multiplicities). In the second part (Chapters 5-7), the authors examine several contexts in which Cohen-Macaulay rings arise: combinatorics of simplicial complexes, theory of semigroup rings, invariant theory, Hodge algebras and determinantal rings. The final two chapters treat big Cohen-Macaulay modules and their applications. A summary of dimension theory is included in an appendix. The book will be extremely useful to both students of and specialists in commutative algebra and algebraic geometry and will undoubtedly become a standard reference on the subject. (jnek)

**S.Breuer, G.Zwas: Numerical Mathematics - a Laboratory Approach,** Cambridge University Press, Cambridge, 1993, 267 pp., ISBN 0-521-44040-8

The book presents numerical mathematics in conjuction with computational laboratory assignments. No knowledge of calculus or linear algebra is assumed, and thus the book is tailor-made for college freshmen and prospective mathematics teachers. The material in the book emphasizes the algorithmic aspects of mathematics, making them viable through numerical assignements in which the traditional chalk-and-talk lecturer turns, in part, into a laboratory instructor. This book is not a numerical-methods book, containing ready-made computational recipes, but a guide for students to create algorithms for any assignement - in whichever programming language they use - on the basis of the underlying mathematics. The computational assignements cover iterative processes for root extraction, area approximations, solutions of linear systems by Gaussian elimination, algorithmic computations of $\pi$ and $e$, acceleration of series summation by Kummer's method, interpolative approximations and construction of computer library functions. Throughout, emphasis is placed on vital concepts such as error bounds, precision control, numerical efficiency and computational complexity, as well as round-off errors and numerical stability. (fel)

**M.Gardner: Mathematical Circus,** The Mathematical Association of America, Washington, D.C., 1992, xv+280, ISBN 0-88385-506-2

The Mathematical Circus is a spectacular show of a vast number of puzzles, illusions, games and various entertainments of a mathematical nature, to which the reader is not only a passive spectator, but drawn in, taking part in the performance. By offering a huge collection of opportunities for testing ones capacity for logical thinking, geometrical visualization and rigorous reasoning, the book stimulates a reader-spectator to appreciate the subtle charm of mathematics, while raising their interest to learn more about the particular topic. The reader will find it surprising, how challenging some mathematical problems appear and how thrilling it is to look for their solution. No special mathematical knowledge is necessary for admission to the show; the spectator will enjoy the language of the Chief Magician ranging from strict logical explanation to poetry. An exhaustive list of literature on each of the topics discussed can be found at the end of the book. (jatr)

**S. von Bechtolsheim: TEX in Practice. Volume I: Basics,** Monographs in Visual Communication, Springer-Verlag, New York, 1993, xl+386 pp., DM 98.00, ISBN 0-387-97595-0, ISBN 3-540-97595-0

The first volume (Basics) of the "ultimate monograph" on the use of TEX is written by a specialist well-known in the TEX-world. (Other volumes: Paragraphs, Maths, and Fonts (II), Tokens, Macros (III) and Output Routines, Tables (IV).) The book contains nine chapters. The first two chapters provide general information about terminology, formats, books, TEX Users Group (TUG), public domain TEXware, etc. The rest of the book (seven chapters) is devoted to a careful treatment of notions like registers, counters, dimensions, glue, leaders, rules, horizontal and vertical boxes. The whole monograph is oriented to TEX programmers and typesetters and contains much more material than is needed by a user writing (even regularly) articles on mathematics. On the other hand it is a valuable text for those who want to know more about typesetting with TEX; it is also recommendable for TEXperts helping others to prepare more complicated documents. Each volume contains a very comprehensive index and a list of useful authors macros which are available on nets or through TUG. (jive)

**M.A.Akivis, V.V.Goldberg: Projective Differential Geometry of Submanifolds,** North-Holland Mathematical Library, vol.49, North-Holland, Amsterdam, 1993, xi+362 pp., GBP 128.50, ISBN 0-444-89771-2

A systematic study of submanifolds in multidimensional projective spaces is presented in the book. The method of moving frames and exterior differential forms are systematically used and their applications to a description of special types of submanifolds as submanifolds carrying a net of conjugate lines, tangentially degenerate submanifolds etc, are given. Several chapters of the book are based on results presented in the seminar on classical differential geometry at the Moscow State University which was supervised by S.P.Finikov, G.F.Laptev and A.M.Vasiljev. The book can be reccomended to anybody interested in the topic. (jbu)

**S.Lang: Real and Functional Analysis. Third Edition,** Graduate Texts in Mathematics, vol.142, Springer-Verlag, New York, 1993, xiv+580 pp., 37 fig., DM 88.00, ISBN 0-387-94001-4, ISBN 3-540-94001-4

This book is essentially the third edition of "Real Analysis" by the author. It contains 23 chapters grouped into 6 parts (General Topology, Banach and Hilbert Spaces, Integration, Calculus, Functional Analysis, Global Analysis). The well-known and prolific author presents material intended for a two-semester graduate course; since chapters are not too interdependent, some parts can be omitted without encountering difficulty when covering the chapters

which follow. Some topics are more or less standard, such as the basics of spectral theory, others can be used for complementary reading (e.g. the law of large numbers). A lot of exercises and examples have been included making the edition more useful for independent work by students. (jl)

**R.M.Smullyan: Gödel's Incompleteness Theorems**, Oxford Logic Guides, vol.19, Oxford University Press, Oxford, 1992, xiii+139 pp., GBP 20.00, ISBN 0-195-04672-2

This book is intended for non-specialistsand only a minimal acquaintance with the symbolism of first-order logic is assumed. Still, the exposition of the subject is given with high mathematical accuracy. The text can be viewed as consisting of four parts. The first one (Chapters I - II) presents the essentials of Gödel's ideas of the method of the arithmetization of the syntax of formal systems and covers the first steps of this method. The second one (Chapters III - VI) deals with the original Gödel's undecidable sentence and Rosser's undecidable sentence. Furthemore, some separation theorems are studied. The unprovability of consistency is treated in the third part, consisting of Chapters VIII and IX; the topics as truth predicate, provability predicates, Henkin sentences and Löb's theorem are included. The fourth part contains "Some General Remarks on Provability and Truth" (Chapter X) and the last chapter "Self-Referential Systems" with discussions about the interpretations of the results presented. The book is interesting and the presentation with many exercises and useful commentaries will lead the reader to a good understanding of the topics. (jm)

**G.Schmidt, T.Ströhlein: Relations and Graphs. Discrete Mathematics for Computer Scientists**, EATCS Monographs on Theoretical Computer Science, Springer-Verlag, Berlin, 1993, viii+301 pp., 203 fig., DM 88.00, ISBN 3-540-56254-0, ISBN 0-387-56254-0

The sub-title "Discrete Mathematics for Computer Scientists" faithfully describes the aim of the book. The authors present a basis of relational calculus and some related areas inspired by Computer Science, including graphs, combinatorics (e.g. the matching problem), games such as chess and nim, basics of the concept of the relational data base, and an extensive discussion of program verification and correctness. The book is divided into ten chapters and an Appendix. Relational calculus and basic elements of graph theory are presented in Chapters 1–5. The notions are often visualized (the book contains 203 pictures) but the calculus of Boolean 0–1-matrices is used quite systematically. This description, though less intuitive, is suitable for formal manipulation. Chapters 6–10 are devoted to further topics, namely reachability, terminality and the Church-Rosser Theorems in Chapter 6, homomorphisms and products of graphs and relations in Chapter 7 (though the title of this chapter is "The Category of Graphs", the notion of a "category" is neither introduced in this chapter nor the word "category" used in the text of this chapter; on the other hand, the category of graphs is really examined and categorical notions are introduced and investigated here); in Chapter 8, absorptiveness and stability of sets of vertices of graphs is introduced and used in a subsegment investigation of kernels of games. Chapter 9 deals with matchings and coverings, Chapter 10 is devoted to the structure of abstract programs, their partial correctness and verification, total correctness and termination, weakest preconditions of program constructs and other related questions. In the Appendix, Boolean and abstract relational algebras are mentioned and, last but not least, some previously introduced notions or problems are described as fixed points of pairs of antitone mappings. The material summarized in the book forms an important part of education in discrete mathematics both for students of mathematics and computer science. Also, the text is very thorough. Since the readers are supposed to be oriented more to concrete problems than abstract notions, the authors introduce abstract notions very carefully and persuade the reader about their usefulness. Abstractly oriented readers would possibly prefer another style and different composition of material (e.g. inclusion of the topic of the Appendix much earlier in the book), the book, however, can be recommended for them also. (vt)

**T.J.Willmore: Riemannian Geometry**, Oxford Science Publications, Oxford University Press, Oxford, 1993, 318 pp., GBP 45.00, ISBN 0-198-53253-9

This book surely contains a standard minimum about Riemannian geometry (in a nice exposition). Therefore, I will just mention some parts which may be specific to this work. Special attention is paid to what is known about normal coordinates, including explicit power-series expansions (of higher order) for various tensor fields and also for the volumes of geodesic balls. In the chapter devoted to the almost complex and complex structures, many relations with twistor spaces are given. Chapter 6 named "Special Riemannian manifolds" contains a satisfactory exposition of harmonic spaces and the Lichnerowicz conjecture; in this context, the spherical mean-value operators are studied in more detail. I have one remark to section 6.14 devoted to D'Atri spaces. (These are Riemannian manifolds on which all local geodesic symmetries are volume-preserving). It seems that the results presented in

this section (10 pages) are not always the most important ones. Missing here is even the main result by Joseph D'Atri himself, saying that all naturally reductive spaces belong to this class. The last chapter is devoted to the study of the surfaces in $E^3$ and $S^3$ which give critical points for the functional $\int H^2\, dA$ and which are generally known as "Willmore surfaces". This is an intersting and still developing part of integral geometry. The references to the "German School" should be completed by the paper of P.Wintgen, C.R.Acad.Sci.Paris, 288(1979), 939-995. (ok)

**H.Cramér: Collected Works. Volume I,II,** Springer-Verlag, Berlin, 1994, xxvii+1437 pp., 1 fig., DM 128.00, ISBN 3-540-56671-6, ISBN 0-387-56671-6

A few words about Harald Cramér. He was born in Stockholm in 1893 and died in 1985. During a period of 70 years he wrote 114 publications in foreign languages and 38 publications in Swedish. His last scientific paper was published when he was 89. Some examples where his name belongs to a subject index are: Cramér - Rao inequality (estimating theory), Cramér - von Mises statistic (nonparametric statistics), Cramér - Wold device (proof of normality), Cramér - Lévy theorem (probability theory), Cramér - Slutsky theorem (a limit theorem) etc. His scientific work concerns chemistry, pure mathematics, actuarial mathematics, probability and mathematical statistics. The Collected Works contain 73 papers by H. Cramér. The articles are reprinted in the original languages. Some of the papers are not easily obtainable. For readers who know H. Cramér as a probabilist and statistician it may be surprising how many articles concern number theory. It is nice to have all the substantial papers by H. Cramér available. His results are very important and his way of presentation is extraordinarily good. (ja)

**M.Aigner: Diskrete Mathematik,** Vieweg Studium. Aufbaukurs Mathematik, bd. 68, Friedrich Vieweg & Sohn, Braunschweig, 1993, ix+316 pp., DM 39.50, ISBN 3-528-07268-7

This book is designed as a textbook for a basic course in Discrete Mathematics for undergraduate students of Mathematics or Computer Science. All the material can be covered by a two-semester course, or selected parts can be used in a one-semester course. The book consists of three parts entitled Enumeration, Graphs and Algorithms, and Algebraic Systems. The parts are mutually independent and can be read in arbitrary order. While the selection of the material in the first two parts is more or less standard and can be found in other textbooks as well, the third part contains some topics which are usually covered by more specialized courses. Let me briefly mention the contents of the individual parts. The part "Enumeration" includes basic combinatorial identities, the inclusion-exclusion principle, and elements of the asymptotic analysis. The part "Graphs and Algorithms" introduces basic notions of graph theory such as paths, cycles, and trees (but not the chromatic number and planarity), and algorithms as breadth-first-search, depth-first-search, dynamical programming, sorting, matching and network flows. The last part, "Algebraic Systems", contains various material ranging from linear programming to finite fields, including a chapter on codes and cryptography. The author has made a good choice of topics which are both useful for computer science and mathematically interesting. Each chapter is completed by approximately 40 exercises which make 500 in total for the whole book. (sp)

**V.I.Arnold' (Ed.): Dynamical Systems VI. Singularity Theory I,** Encyclopaedia of Mathematical Sciences, vol.6, Springer-Verlag, Berlin, 1993, 245 pp., 55 fig., DM 141.00, ISBN 3-540-50583-0, ISBN 0-387-50583-0

**V.I.Arnol'd (Ed.): Dynamical Systems VIII. Singularity Theory II. Applications,** Encyclopaedia of Mathematical Sciences, vol.39, Springer-Verlag, Berlin, 1993, v+235 pp., 134 fig., DM 141.00, ISBN 0-387-53376-1, ISBN 3-540-53376-1

These two volumes of the Encyclopaedia of Mathematical Sciences are devoted to the theory of singularities of smooths maps and its applications. The authors offer here an up to date guide to the topic and its main applications, including a number of new results. There are no proofs in the books; the authors concentrate just on a description and explanation of results. It is very convenient for the reader, a carefully prepared and extensive bibliography (both volumes together contain more than 600 references) makes it easy to find the necessary details when needed. The books describe a lot of interesting topics. The classification of the simplest critical points of functions is given and its relation to simple Lie groups and to symmetry groups of regular polyhedra is described. The Picard-Lefschetz theory can be considered as a complex analogue of the Morse theory for real functions. The main objects of study here are the monodromy corresponding to the critical value of the singularity, the vanishing cohomology bundle and its mixed Hodge structure. The first volume contains also a study of various equivalence relations on a space of maps and a number of results on the topology of singular sets.

The second book starts with a study of functions on a manifold with boundary, singularities of complete intersections and projections. Applications in geometry, optics, ordinary and partial differential equations (including a discussion of Thom's catastrophe theory) follow. Various mathematical objects with special properties (e.g. stable families of linear autonomous equations, elliptic and hyperbolic PDEs, linear differential equations) are described by domains in the corresponding parameter space. A study of singularities of the boundaries of these domains is another application described. Ramified integrals, the corresponding monodromies and generalized Picard-Lefschetz formulas are discussed in various situations. The book ends with a study of deformations of real singularities. At various places, conjectures and open problems are given. Both volumes are a very valuable addition to the library of any mathematician or physicist interested in modern mathematical analysis. (vs)

**S.G.Krantz, H.R.Parks: A Primer of Real Analytic Functions,** Basler Lehrbücher. A Series of Advanced Textbooks in Mathematics, vol.4, Birkhäuser, Basel, 1992, x+184 pp., DM 78.00, ISBN 3-764-32768-5, ISBN 0-817-62768-5

The study of real analytic functions attracted the attention of famous mathematicians a long time ago and led to research in many parts of modern analysis. It is very difficult to trace results in this field through the literature. The authors have collected important results of real analytic function theory to their own taste and presented them in this publication. The material in the book can be divided into three parts. In the introductory Chapter 1, elementary theory and basic properties of real analytic theory are covered (topics such as analytic continuation, the Cauchy-Kowalewski theorem, the inverse function theorem) while topics of a moderate difficulty are introduced in Chapters 2–4 (separate real analyticity, Puiseux series, the Fourier-Bros-Iagnolitzer transform, the theorems of Pringsheim and Boas, Besicovitch, Bernstein, Paley-Wiener). The final chapter is devoted to deeper results (embedding of real analytic manifolds, subanalytic and semianalytic sets, the resolution of singularities, or Lojaciewicz's structure theorem for real analytic varieties). The authors have really done a very nice and useful job. The primer can be recommended to everybody interested in the field. (jl)

**J.P.Serre: Lie Algebras and Lie Groups. 1964 Lectures given at Harvard University. 2nd edition,** Lecture Notes in Mathematics, vol.1500, Springer-Verlag, Berlin, 1992, vii+168 pp., DM 44.00, ISBN 0-387-55008-9, ISBN 3-540-55008-9

This jubillee volume of the famous Springer Lecture Notes in Mathematics is the second unchanged edition of Serre's well known book. The first edition was published by W. A. Benjamin, Inc., New York, in 1965. In 1969, the Russian translation (Moscow, Mir) appeared. (jiva)

**H.M.Edwards: Advanced Calculus. A Differential Forms Approach,** Birkhäuser, Boston, 1993, xv+508 pp., DM 112.00, ISBN 3-764-33707-9, ISBN 0-817-63707-9

This is a bold, nonstandard and successful attempt to present calculus. The book is already in its third edition. The first one was published in 1969. As the subtitle says the exposition is based on differential forms. This approach makes the text very modern from the point of view of mathematics, and simultaneously very attractive and useful from the point of view of physics. It is obvious that modern and global analysis, modern differential geometry as well as theoretical physics can not do without differential forms. Therefore it is very good if a student is taught in these directions from the very beginning. Moreover, such a student acquires a deeper understanding in several areas. I admit when opening the book for the first time I had many doubts. In the beginning I had the feeling that it is not sufficiently accurate. (When I was a student there was only one level of presentation of notions and theorems. Namely, up to the last detail.) But when you continue reading you can see that it is accurate. Even more, it is very often deeper than one would expect. I was also afraid that it was too one-tracked and did not contain enough material. I found more than I expected. Here are some examples: ordinary and partial differential equations, functions of complex variable, introduction to homology theory, applications to mathematical physics, Lebesgue integration and Banach spaces. The book is based on differential forms and you will find there the proof that $e$ is not rational! There are many very nice exercises (with hints and answers), and a student will learn well how to make computations when studying the book. Only one doubt remains, and here I agree completely with the author. The book requires teachers who will accustom themselves to a new point of view, and students, who have no prejudices to overcome. I will try to be such a teacher. (jiva)

**J.-L.Loday: Cyclic Homology,** Grundlehren der mathematischen Wissenschaften 301, Springer-Verlag, Berlin, 1992, xvi+454 pp., 24 fig., ISBN 3-540-53339-7, ISBN 0-387-53339-7

This is a very interesting book containing material for a comprehensive study of the cyclic homology theory and of non-commutative geometry in general. The book contains a description of the cyclic homology of algebras, cyclic sets and $S^1$-spaces, Lie algebras and algebraic K-theory and (in the last chapter) an introduction to Connes' work and recent results on the Novikov conjecture. The book requires a knowledge of homological algebra and Lie algebra theory as well as basic technics coming from algebraic topology. The bibliographic comments at the end of each chapter offer good suggestions for further reading and research. The book can be strongly recommended to anybody interested in noncommutative geometry, contemporary algebraic topology and related topics. (jbu)

**M.E.Taylor: Pseudodifferential Operators and Nonlinear PDE,** Progress in Mathematics, vol.100, Birkhäuser, Boston, 1991, 224 pp., sFr 88.00, ISBN 0-8176-3595-5, ISBN 3-7643-3595-5

The theory of pseudodifferential operators has played an important role in many profound investigations in linear PDEs and over the past decade in nonlinear PDEs. The book begins with a preliminary chapter reviewing some fundamental results on pseudodifferential operators and then turns to an exposition of the further development both in the theory of paradifferential operators and in the study of pseudodifferential operators whose symbols have limited regularity. After establishing the basic tools, the authors treat in subsequent chapters various topics from nonlinear PDEs: regularity results for solutions of nonlinear elliptic equations, sharp results on regular solutions to symmetric and symmetrizable hyperbolic systems, a variant of Bony's theorem on propagation of singularities, nonlinear parabolic equation, etc. The book is accompanied by four appendices: two of them collect some facts about function spaces and norm estimates. In the third appendix, a proof of the de Giorgi-Nash regularity theorem is given in the framework of Moser's and Morrey's ideas. Some paraproduct estimates are proved in the last appendix. The book represents an overview valuable for mathematicians working in the field as well as for those interested in partial differential equations. (js)

**B.D.Sleeman, R.J.Jarvis (Eds.): Ordinary and Partial Differential Equations. Volume IV,** Pitman Research Notes in Mathematics Series, vol.289, Longman Scientific & Technical, Harlow, 1993, 292 pp., GBP 22.00, ISBN 0-582-09137-3

This contains invited lectures presented at the Twelfth Conference on Ordinary and Partial Differential Equations held at the University of Dundee, Scotland, from 22-26 June 1992. The Conference was dedicated to honouring the mathematical contributions of Prof. Douglas Jones and the lectures presented cover a broad area including asymptotic expansions with uniformly valid estimates of remainders, Fourier asymptotics, asymptotics for the solutions to ODEs and PDEs, direct and inverse scattering problems both from theoretical and numerical point of view, waves in fractal media and the Weyl-Berry conjecture, pattern generation in neural systems or problems of reactive transport, dispersal and flow arising in disposal of radioactive waste. The papers are well written and will be valuable for graduate students and research mathematicians interested in ODEs and PDEs, nonlinear analysis and applied mathematics. (js)

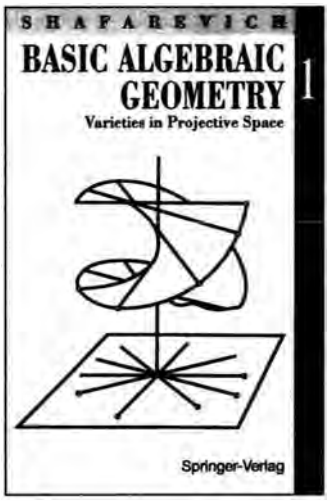
**P.Giblin: Primes and Programming. An Introduction to Number Theory with Computing,** Cambridge University Press, Cambridge, 1993, xi+235 pp., GBP 30.00, ISBN 0-521-40182-8,

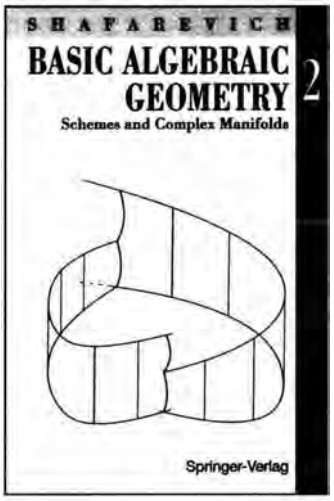
The book is a good introduction to computational number theory (elementary part). Every part begins with a theoretical introduction. The more interesting part consists of many exercises, as well as computing exercises and projects. The book contains further nearly thirty complete interesting programs (written in Pascal). From the contents: Euclid's algorithm, factorization, sieve of Eratosthenes, Legendre's sieve, power algorithm, Miller's test for primality, cryptography, continues fractions etc. Valuable both for mathematicians and amateurs. (bn)

**O.L.R.Jacobs: Introduction to Control Theory,** Oxford Science Publications, Oxford University Press, Oxford, 1993, xii+390 pp., GBP 22.50, ISBN 0-198-56249-7

This is a rewritten edition of a book published twenty and ten years ago. It presents basic mathematical models and tools of control theory in a way which makes it readable for undergraduate students of both mathematics and engineering. The book is a good text for the users of control theory software. The various topics are explained for continuous as well as discrete time models. The pre-1950 control theory (feedback control, stability, design of controllers, non-linear systems) is followed by a presentation of optimal linear-quadratic control and of the elements of optimal non-linear control. Part III on stochastic control covers state estimation and stochastic linear-quadratic control with a brief outline of relevant facts from the theory of random processes. In the book there are 175 problems for solution at the ends of the chapters. (pm)

# THE popular introduction to basic algebraic geometry




**I.R. Shafarevich**

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