NEWSLETTER

OF THE EUROPEAN MATHEMATICAL SOCIETY

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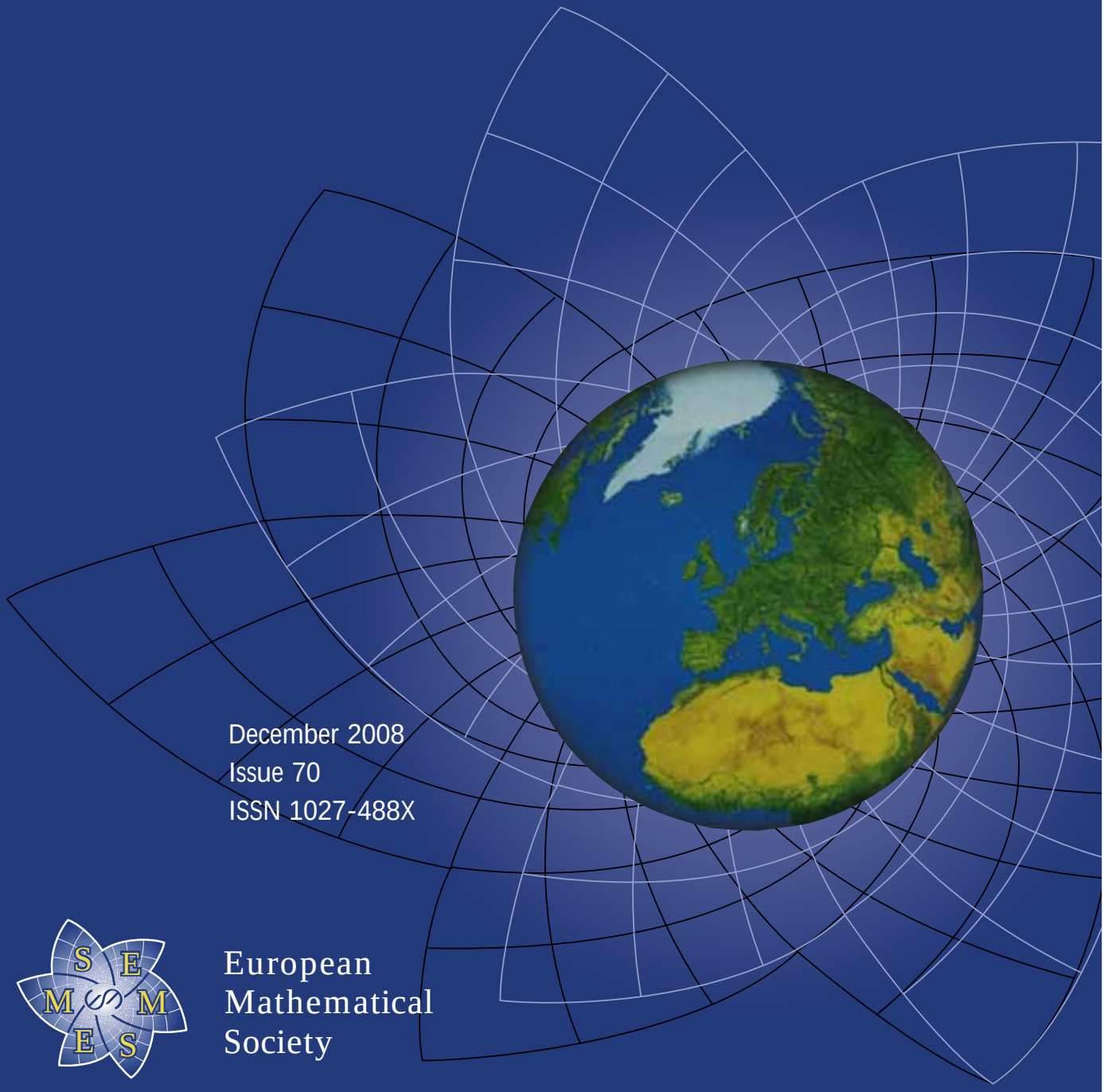

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EMS Executive Committee

EMS Agenda

2009

1 February
Deadline for submission of material for the March issue of the EMS Newsletter
Vicente Muñoz: vicente.munoz@imaff.cfmac.csic.es

5–8 February
European Student Conference in Mathematics EUROMATH 2009, Cyprus; www.euromath.org

4–8 March
4th World Conference on 21st Century Mathematics, Lahore (Pakistan), wc2009.sms.edu.pk

20–22 March
EMS Executive Committee Meeting
Stephen Huggett: s.huggett@plymouth.ac.uk

21 May
International Council for Industrial and Applied Mathematics (ICIAM) Board meeting, Oslo (Norway)

2010

19–27 August
International Congress of Mathematicians, ICM2010, Hyderabad (India), www.icm2010.org.in

2012

2–7 July
6th European Mathematical Congress, Kraków (Poland)
www.euro-math-soc.eu

EMS Publicity Campaign

In order to disseminate information on the European Mathematical Society amongst as many mathematicians in European countries as possible, a publicity package was posted to more than 2300 departments of mathematics in Europe in June–July 2008. This package consisted of:

- A letter from the EMS President Ari Laptev.
- A leaflet summarising the main aims and activities of the EMS.
- A poster advertising the EMS to be posted in mathematical departments.

As the publicity materials have been returned from some of the addressees, it appears that some addresses in our list are wrong or incomplete. We would therefore very much appreciate feedback from all mathematical departments that did not get the above mentioned publicity package. This should be sent to Vasile BERINDE, EMS Publicity Officer, at vberinde@ubm.ro. Please also include in your message the complete mail address of your department.

Editorial

Olga Gil-Medrano (University of Valencia, Spain)
EC Member from January 2004 to December 2008
President of the Royal Spanish Mathematical Society

I have been working for the EMS as an Executive Committee (EC) member since January 2004 and now that my term is almost over, I want to share with the readers some of my reflections based on what I have learnt from this exceptional four year experience.

Some of my duties during this time have been related to Raising Public Awareness of Mathematics activities. In particular, I was very involved in the ICM2006 Special Activity organised by the EMS and consisting of a panel discussion on the subject: *Should mathematicians care about communicating to broad audiences? Theory and practice*. The conclusions, which appeared in the first volume of the ICM proceedings, led to a positive answer. One of the purposes of outreach efforts is to provide good arguments to convince the society in general, and the decision makers in particular, that to provide the proper level of funding for mathematical research is always a good investment, especially during this critical period. It is not an easy task to deal with mass media; for instance two years ago it could be quite effective to explain how mathematics was influential in markets and economics and now, only some months later, our biggest effort would be perhaps to convince the public that the financial system crisis is not the fault of mathematicians.

The transfer of knowledge to society in general and the spreading of mathematical literacy, with special incidence in scholars and students, can be seen as part of a survival strategy, since the interest in following degree studies in mathematics, and scientific studies in general, is decreasing in many European countries. Analogously, the proportion of graduate students choosing research as their profession is not satisfactory. It can be a paradox that, at the same time that we are very concerned and worried about losing young European researchers because of a lack of adequate funding, we could be neglecting the good teaching practices that allowed us to export some bright mathematical talent.

I have noticed that the decline of mathematical education practices, especially at a pre-university level, have become more and more a subject of deep concern, appearing spontaneously in any forum where European mathematicians come together. The EMS could help by exhibiting some success models that could serve as a reference for countries with less mathematical tradition. Probably it would be useful to promote something like *Maths for Europe*, similar to the initiative *Math for America* (see http://www.mathforamerica.org) that aims to recruit, train and retain outstanding mathematics teachers.

So, in several ways, the future of mathematical research relies very much on the capacity of the mathematical community to show the best aspects of our science to the general public.

I'm also the president of one of the member societies. From this alternative point of view, to serve in the EC has helped me to realise the number of actions we can undertake to implant the EMS in our countries. To recruit individual members is of course an obvious goal but I'm conscious that the situation very much differs from place to place and that in some countries it is very difficult to increase the number of individual members. At least it is always possible to highlight EMS activities and its new web page in our journals, newsletters and web pages.

The complicity of national societies is in fact necessary to organise the scientific activities of the EMS. In that context, it was impressive for me, as a member of the Site Committee for the 6ECM to see the enormous effort made by the groups supporting the three excellent bids and see how generously many mathematicians are prepared to work for the visibility of mathematics in their countries, the promotion of mathematics in Europe and the increase of the scientific presence of the EMS.

The biannual council meeting is really a forum where the representatives of the various societies can share their common concerns. This is one of the important roles of the EMS and has been reinforced by the recent celebration of a more informal meeting of the presidents of the member societies in Luminy (France).

It is noteworthy that, although in the period 2000-2004 four of the EC members were women, during the period 2004–2008 there were only two and from the beginning of 2009 only one will still remain. Therefore, the EC composition does not represent the gender distribution existing in European mathematics departments. There is no discrimination in the voting process of the council and, as a matter of fact, in the last July elections there was not even one female candidate. It is difficult to understand the reasons behind this lack of candidates, since women are very active working within the different committees.

To be part of the Executive Committee has been an unforgettable and very rewarding experience. I encourage any EMS individual member to consider the possibility of dedicating a part of their time to serve the EMS, either in the EC or as a member of the other committees.

Letters to the Editor

Starting with the current issue, the EMS Newsletter will have a section "Letters to the Editor" open to the opinions and complaints of readers of the Newsletter. To send a letter for publication in this section, please contact any member of the editorial committee.

Invitation or extortion?

Bernard Prum
Université d'Evry, France, prum@genopole.cnrs.fr
Professor of the Université d'Evry
Former President of the
Commission de Mathématique and the Commission
"Modélisation des Systèmes Biologiques" of the CNRS

A new practice seems to have reached Europe, as well as other continents, and sadly I experienced it at the "Fifth International Conference of Applied Mathematics and Computing" held in Plovdiv, Bulgaria, last August. It is the purpose of this short contribution to warn colleagues and advise them on how to react.

You receive an email "invitation" to deliver a plenary lecture. The email explains that the organisers cannot cover your transport expenses but that you will be accommodated in the best hotel in the town. Moreover, your address to the conference will be published in the *International Journal of Pure and Applied Mathematics* (IJPAM). All your queries – concerning the length of your lecture, the day you will deliver it and the possibility of bringing your wife (at your own expense) – remain unanswered.

When you arrive at the conference, after flying for two and a half hours and travelling as many again in a coach, you are told that you have to pay $420 for registration fees and accommodation costs and only cash payment will be accepted. And if you want to have your writings (no more than six pages) published in IJPAM, you have to add $60 per page, again in cash. The conference website boasts some 400 people attending the event. Even with Bulgarians and students not having to pay, the fees collected by the organisers totals nearly $100,000 (plus the odd subsidies). When you learn that the coach trip between Sofia and Plovdiv (about 100 miles) cost me 13 leva ($8) and that the price of the meals that were served in the cafeteria (water not included!) could be assessed to be less than 3 leva (in a restaurant for tourists I could have a proper lunch for 14 leva, beer and dessert included), you have to renounce your sympathy for the poor East European country trying to raise its scientific standard, which induced you to travel so far afield.

One last word about publication: you are warned that your work will be accepted by the IJPAM journal "if and only if" you duly pay your share. Such practice severely damages the legitimacy of this journal!

I had the opportunity of briefly speaking to some other outraged "guest speakers" from the United States, Japan and Africa, including some young African colleagues sent over by their universities who needed to prove their participation of the conference. Some paid the money assuming that it was normal practice in Europe. Personally I told the organiser how I really felt about it. In Bulgarian, the word is…

Sad news on Ibni Oumar Mahamat Saleh

The conclusions of the commission of inquiry in Chad were made public on Wednesday 3 September 08. We are now convinced that Ibni Oumar Mahamat Saleh died in detention at the beginning of February. He was kidnapped from his home in N'Djamena on 3 February 2008 by the armed forces of Chad, following the withdrawal of rebel forces.

Ibni Oumar Mahamat Saleh, Professor of Mathematics at the University of N'Djamena and former government minister, was one of the leading figures in the democratic opposition to the government of Chad.

Ibni Oumar Mahamat received his doctorate in mathematics from the University of Orleans. He was instrumental in the establishment of higher-education exchanges between France and Chad and between African countries.

We express our condolences to Ibni's family and friends, to the people of Chad and to all democrats in Africa and in the World. We send our warmest thanks to all signatories of the list for their support.

Since March 2008, the French Mathematical Societies have been co-sponsoring a petition demanding that the government of Chad publicly disclose correct information on the whereabouts and condition of Dr. Ibni Oumar Mahamat Saleh. The website of the petition http://smf.emath.fr/PetitionSaleh has provision for electronic signing of the petition, a list of those who have signed to date and extensive information on the case. In particular, for information given by the media since September, one can consult the file http://smf.emath.fr/en/PetitionSaleh/Documents/ibni_depeches_3–15_sept_2008.pdf available on the website of the petition. One can find at http://www.fidh.org/spip.php?article5846 the full report of the Commission of Inquiry on the events that took place in the Republic of Chad between 28 January and 8 February 2008. A summing up written by the commission itself is also available at the same website. The report describes

the investigation that was carried out on the abduction of three opponents and the disappearance of Ibni, who was one of them, as well as many other events in this period in Chad (including dead civilians, rape, damage to property and persons due to rebel forces or regular forces or due to clashes between them and the existence of illegal prisons in Chad). The report also gives the conclusions of the commission of enquiry. Unfortunately all these documents are only available in French.

A poster (in French) is available at http://smf.emath.fr/PetitionSaleh/affricheIbni.pdf to be displayed in mathematics departments. Other versions, in English and French (due to the AMS and the Canadian Mathematical Society) are available on the website of the petition.

We ask Mathematical Learned Societies to honour the memory of Ibni, continue to seek the truth about the circumstances of his death as long as it is necessary and extend his work to promote mathematics in Africa, especially through inter-university exchanges. We intend to create a scholarship named after Ibni, which will support travelling expenses for graduate students who are studying in Sub-Saharan Africa under the joint supervision of a local African colleague and a colleague from a more developed country. The project is still under study.

Let us remain united in asking for the whole truth and keeping alive the memory of Ibni.

Aline Bonami & Marie-Françoise Roy

In memory of Henri Cartan

J.-P. Bourguignon, R. Remmert & F. Hirzebruch

Henri Cartan

Remembering Henri Cartan, a Highly Influential Mathematician, a Passionate Advocate for Europe and Human Rights

Henri Cartan died on August 13, 2008 at the age of 104. His professional life had been extremely full, with many commitments, some strictly mathematical, and others addressing more general societal issues.

His scientific achievements, and in particular his involvement in the birth and development of the Nicolas Bourbaki group, will be presented and discussed elsewhere.

His role as a teacher at the Université de Strasbourg, both in Strasbourg and in Clermont-Ferrand where the university moved to during the war, then at the Université de Paris, and most notably at the École Normale Supérieure (ENS), left a long lasting impression on the many mathematicians who attended his lectures. The seminar that he organised and forcefully led at ENS in the 1950s has become legendary. His role in shaping a new generation of mathematicians cannot be underestimated, as he both attracted exceptional people and offered them the most advanced teaching, while orienting them towards worthwhile and challenging problems.

I personally followed his famous "Introduction à la topologie algébrique" course in 1967–1968, but had to do it at a distance, as I was at the time a student at École polytechnique with a busy schedule there.

Henri Cartan spent the last years of his career in the early 1970s as professor in Orsay at the mathematics department of the newly founded Université Paris-sud.

He kept informed about what was happening in the mathematical community at large up to the very end of his life. Getting a few words from Henri Cartan on one of his personal cards was always moving and a delight because of the care taken in the wording.

A first manifestation of Henri Cartan's public concern for the free circulation of scientists occurred in connection with the International Congress of Mathematicians held in Boston in 1950. The visa application Laurent Schwartz had made to attend the ICM, where he was to receive the Fields Medal, had been set aside by the US Embassy in Paris. In order to exert maximum pressure, Henri Cartan collected the passports of all the French ICM participants, and threatened that there would be no French participation if Schwartz was not allowed to enter

the US. Schwartz received his passport at the very last minute, but still in time for the French delegation led by Henri Cartan to take the boat in Le Havre to cross the Atlantic.

Later, in 1974, he, Schwartz and a few concerned mathematicians engaged in the defense of a number of mathematicians prosecuted by their governments such as Leonid Pliouchtch, Andrei Chikhanovitch and Anatoli Chtcharanski in the Soviet Union, José Luis Massera in Uruguay and Sion Assidon in Marocco. All kinds of pressures were exerted, and in the end the action of the Comité des Mathématiciens proved remarkably successful.

Later in this issue, two eminent German mathematicians discuss Henri Cartan's remarkable contributions to German-French cooperation in difficult times, and in particular his (communicative) determination to restore the flow of exchanges right after the second world war. His scope was broader than German-French relations and embraced Europe as a whole. He in particular tried to set the practical foundations of an academic Europe, by ensuring that students would be able to move from one institution to another while progressing in their studies.

He made a very public political stand for Europe through his engagement in the "Mouvement fédéraliste européen". This led him to become a candidate for the European Parliament.

Jean-Pierre Bourguignon
(CNRS-Institut des Hautes Études Scientifiques)

Henri Cartan 1904–2008

In December 1949 Henri Cartan came to Münster for the first time after World War II. I was a freshman. Heinrich Behnke encouraged me to attend Cartan's lecture. I went out of curiosity. The speaker discussed his forthcoming paper on ideals and modules of holomorphic functions, Œuvres II, p. 618. I understood nothing. However, I felt as if I were in good company. After the talk there was a reception. Cartan concluded his short address (in German) with the toast "À l'Europe!" I must have looked like a doubting Thomas.

In 1952 Cartan became Doctor honoris causa of the University of Münster. This was his first honorary degree. In his words of thanks he pleaded strongly for the reconciliation of scientists on both sides of the Rhine.

In 1953 Karl Stein attended a conference on several complex variables in Brussels. Cartan and Serre presented their Theorem A and Theorem B for Stein manifolds to a dumbfounded audience. Back in Münster, Stein said to me: "The French have tanks. We only have bows and arrows." ("Die Franzosen haben Panzer, wir nur Pfeil und Bogen.")

Complex manifolds with many holomorphic functions were baptised "variétés de Stein" by Cartan. In the late fifties Cartan teased Stein at a conference in Oberwolfach: "Cher ami, avez-vous aujourd'hui une variété de vous dans votre poche?" Stein looked embarrassed and said: "I never use that expression." Cartan advised him to circumvent the notation by using a variation of a well-known phrase of Montel: "…les variétés dont j'ai l'honneur de porter le nom."

Henri Cartan was on very friendly terms with Heinz Götze, the wizard of Springer Verlag, Heidelberg. Both men were extremely pleased when, in 1979, the Œuvres of the French mathematician Cartan were published by the German publishing house. During the ceremony at "La Tour d'Argent", where the leather-bound volumes were presented, numerous jubilant toasts à l'Europe were given.

In 1981 Götze suggested having the famous ten papers by Kiyoshi Oka edited. I asked Cartan for advice. He immediately agreed to write commentaries. Later he told me that he enjoyed doing this, however completely underestimated the work involved.

The last time I met Cartan was in 1997 in Paris at the "Journée en l'honneur d'Henri Cartan". We talked about bygone years and his friendship with Behnke and Stein.

Reinhold Remmert

Henri Cartan 1904–2008

I met Henri Cartan for the first time in Oberwolfach in 1951. We met for the last time during the celebration of his 100th birthday in Paris 2004. I gave a lecture with the title "Henri Cartan: a great friend, mathematician, and European". I shall use parts of this talk that do not overlap Remmert's report.

On the occasion of Behnke's 80th birthday on October 8, 1978, celebrated in Münster, Henri Cartan gave a beautiful dinner speech. We were all sad that Heinrich Behnke unexpectedly could not attend the dinner because of illness. He died one year later. Cartan's dinner speech was printed by Springer-Verlag under the title "Quelques souvenirs par Henri Cartan". In his speech Cartan recalled his first visit to Münster in 1931. Behnke, a young Professor, 32 years old, had decided to make Münster an active and interesting center for the young people around him. For this purpose he had invited a young French mathematician of 26 years having related interests who gave four lectures in German and one in French during his one week visit. Cartan met Peter Thullen, this was the beginning of a scientific cooperation and long lasting friendship. Cartan reported also about his second visit to Münster in 1938. In the meantime the famous "Ergebnisse-Bericht" (Springer-Verlag) by Behnke and Thullen had appeared in 1934. Thullen had left Germany. The political atmosphere was depressing. There were not many students. But still mathematics went on. Behnke's assistant was Karl Stein who had received his Ph.D. degree in 1936.

During the war, the friendship between Cartan and Behnke was not interrupted; Behnke, for example, received a mathematical letter from Oka in December 1940 and informed Cartan about it.

In 1943 Cartan's brother Louis was deported to Germany. About this tragedy, Cartan says in "Quelques souvenirs" addressed to Behnke:

> *"Je ne puis pas non plus oublier toutes les démarches que vous avez faites durant les années 1943 et 1944 (en vain, hélas) pour tenter de retrouver la trace de mon frère Louis, déporté en Allemagne au mois de février 1943, et qui ne devait jamais revenir."*

Already in 1946 Cartan came to Oberwolfach where he met Behnke again after eight years. The Oberwolfach guest book records that Cartan participated in a concert (Haydn, Bach, Beethoven) on November 1, 1946 and lectured on Galois theory for non-commutative fields on November 4, 1946. In this way Cartan began his efforts to reconciliate the mathematicians on both sides of the Rhine (cf. Remmert's contribution).

Cartan was always interested in the work of Behnke and his students, in particular Stein, Grauert, Remmert, and myself.

For Stein's 60th birthday (1973) Cartan lectured at a conference in Munich and wrote an article "Sur les travaux de Karl Stein". He reported in particular about Stein's Habilitationsschrift (1940) which concerns Cousin's second problem. The title (translated into English) is: "Topological conditions for the existence of holomorphic functions with a given zero divisor". This is related to the famous Theorem B of Cartan and Jean-Pierre Serre.

Cartan reported about my thesis (written under Behnke and Hopf) in the Bourbaki seminar of December 1953. In the thesis I had introduced complex spaces of dimension 2 and described the resolution of their singularities.

In his *Habilitationsschrift*, Hans Grauert proved that for a Stein manifold X and a complex Lie group L the classification of topological principal fibre bundles over X with structural group L coincides with the classification of analytic principal fibre bundles over X with structural group L. This includes the solution of Cousin I and II ($L = \boldsymbol{C}$ or $\boldsymbol{C}^*$ respectively). Grauert published his work in three parts in "Mathematische Annalen" in 1957 and 1958 and thanked Cartan for advice. Cartan lectured on Grauert's results in the "Symposium Internacional de Topologia Algebraica, Mexico 1956".

In his contribution Remmert shows that Henri Cartan was a real European. I want to emphasize this by the following remarks:

The first European Congress of Mathematics took place in Paris from July 6 to July 10, 1992. In his opening speech, Cartan calls the congress an event of great importance showing that the mathematicians know the solidarity of the countries of Europe, that are different in so many ways, but have a rich common heritage and a common future. Cartan was especially glad that this first European Congress reunited the mathematicians from the two parts of Europe that were separated for such a long time. Cartan's 88th birthday was celebrated during the first European Congress at the residence of the German Ambassador in Palais Beauharnais.

The "Association Européenne des Enseignants" ("European Association of Teachers") was founded in Paris in 1956. Cartan was president of the French section. As such he took the initiative to invite participants from eight European countries to a meeting in Paris in October 1960. Emil Artin, Heinrich Behnke and I were the German members. The second meeting of this committee was in Düsseldorf in March 1962. As a result, the "Livret Européen de l'Etudiant" ("European Student's Record") was published and distributed by the "European Association of Teachers". The booklet contained a description of minimal requirements for basic courses. It was supposed to increase the mobility of students from one country to another. The professor of one university would mark in the booklet the contents of courses attended by the student. The professor at the next university would then be able to advise the student in which courses to enroll. The booklet was not used very much. For me it was often useful when reforms of the contents of courses were discussed.

The efforts of Cartan for harmonising mathematical studies in Europe date back to more than 45 years ago. Now we are implementing the Bologna process. In all European countries bachelor and master degrees are to be introduced. Is this is the harmonisation we wanted?

Cartan, the European, was also active at the international level. He was president of the International Mathematical Union for the four years 1967 to 1970. He addressed the International Congress of Mathematicians in Nice 1970 during its opening ceremony and announced the names of the Fields Medal winners. Sergei Novikov, one of the four winners, was unable to attend, indicating the political difficulties of the time.

The mathematicians of my generation, from Germany and everywhere else, learned from Henri Cartan. His papers, books, and seminars were a source of inspiration. He showed us the right way of developing international cooperation. He and his wife were charming hosts for many visitors to Paris. He has left us, but we will always remember him with gratitude.

Friedrich Hirzebruch

EMS Council meeting in Utrecht, 12–13 July 2008

Ulf Persson

Academiegebouw, Utrecht University, the venue of the EMS Council Meeting

Group photograph

Venue

The Council of the EMS convened in Utrecht, the Netherlands, in July 08 on the weekend preceding the European Congress, the meeting taking place in the Academiegebouw of Utrecht University, an old venerable location next to the cathedral. The meeting was presided over by Ari Laptev, the President of the EMS, assisted by members of the executive committee (EC). The actual meeting was held in the aula, reminiscent of a larger chapel, with tapestries covering the walls and chandeliers suspended from the ceiling. Yet the council of the EMS is much less formal (and formidable) than the council of the International Mathematical Union (IMU): the delegates are representatives of mathematical societies (not countries as in the case of IMU), there are fewer delegates in total, there is no set seating, there is no simultaneous video coverage and there is a less crowded agenda generating less heated discussions.

Finance and activities

A presentation of the finances of the society was given by its treasurer, Väänänen. The financial resources (about a 100,000 euro annual budget) of the society are limited, in many ways restricting its activities (in the words of one of the delegates, the society is more involved in looking than doing). One obvious source of additional revenue would be to enlist more individual members out of a largely untapped potential.[1] To that effect the procedure of becoming a member has been simplified (in addition to a lowering of the fees for research students and postdocs): it no longer has to go through the member societies but can be effected directly through the homepage of the EMS. Furthermore, new advantages of membership are being planned, the most notable being free access to the archives of Zentralblatt. In fact a large part of the budget comes from membership dues, and the largest single item in the budget (around 40%) is devoted to the newsletter, testifying to its importance. The outgoing chief editor Martin Raussen gave a report on recent newsletter activities and was warmly thanked for his devotion and contributions. A hope was expressed that the new chief editor Vicente Muñoz will continue to develop the newsletter, which is so important for the identity of the society and for most members the most tangible return for membership dues.

In his report on the activities of the EMS the president stressed the general importance of cultivating good relations with Brussels and the European Science Foundations and actively working to improve the visibility of mathematics in society at large. Furthermore there were references to the EMS Publishing House, in particular the Journal of the EMS, and various conferences and summer schools that have been organised. One important issue is the ongoing efforts to save Zentralblatt. Its chief editor Wegner made a presentation aimed at persuading the delegates that Zentralblatt actually covers much more ground than Mathematical

1 It was pointed out that more European mathematicians are members of the AMS than the EMS.

Reviews. It was further announced during the meeting that Zentralblatt will be free online for individual EMS members and for mathematicians from many developing countries. There were also parallel sessions for each of the standing EMS committees (Applied Mathematics, Developing Countries, Eastern Europe, Education, Electronic Publishing, ERCOM, Group of Relations with European Institutions, Raising Public Awareness, Women and Mathematics, Meetings Committee), where short presentations were given and discussions of relevant issues were held.

Elections

When it comes to actual decisions, apart from formal approvals of budget and minor statute changes, the council only had to face two issues to be decided by ballot. There were new members to join the executive committee and the location of the next ECM Congress had to be decided, points that will be returned to below. Among the formalities were the welcoming of some new member societies,[2] the only case provoking some amused debate of a principal nature being the application of a Russian Society, which turned out to be a society with societies as members.[3] This caused some protest and some worries that some countries could get disproportionate influence through the unchecked creation of formal societies. The president replied that the Russian proposal was only a convenient way of strengthening the budget of the society by increasing the number of institutional members. Eventually the application was tabled. As to the general question of votes, a new category of membership was suggested, giving four votes at the price of paying eight times the unit institutional membership; this suggestion was approved.

Members of the executive committee are elected for a mandate of four years and are only eligible for one re-election, giving a maximum term of eight years. By some clerical oversight the Czech member Exner, having served for six years (the last four as vice-president), was not re-elected as a member during the previous council meeting, and if rules were to be literally interpreted he would no longer be eligible for re-election. In view of the situation an appeal was made to re-elect him for another two years as a vice-president, an appeal made during his voluntary absence; this appeal was approved. Four new slots were available at the EC with six candidates. Four of those were present and could make their campaign speeches in situ, while the two others were presented respectively by a video and a written statement read by the secretary of the EC. The four candidates that were present (Artstein, Brezzi, Krichever and Raussen) were elected.

Choosing the next congress

The most exciting issue to be decided by the council was the location of the next ECM Congress. This time three alternatives were presented: Krakow, Prague and Vienna. All three options had been very carefully prepared and all looked very attractive, as well as being rather similar.[4] Krakow won out in the ballot, maybe because most of the delegates had been to Prague and Vienna but not to Krakow! From a political point of view, Krakow seemed also the most natural choice. This prompts the question as to the wisdom of allowing such a duplicating process to be carried on so far. The preparations for making a bid are very time-consuming and require a lot of effort and dedication and maybe such parallelism should be avoided, especially as the work done cannot be stored for the future and hence is wasted if that location is not chosen. It is to be noted that there was only one bid for the ICM in 2008.

In connection with the presentation of the various alternatives the only really heated debate that arose concerned the issue of registration fees. It was noted that registration fees are becoming too high and that the organisers should try harder to get sponsors and to opt for non-commercial venues. This was later tacitly confirmed by the president, who assured that the EMS is always trying to keep the fees as low as possible in order to ensure increased accessibility. To this the Dutch delegates reacted strongly, pointing out that one had to be realistic and that conference fees nevertheless only constitute a minor part of the expenses a participant has to face.[5]

For obvious reasons there was no discussion on the general value of organising such congresses[6] but it was pointed out that a far more important issue than the actual level of the registration fee is the scientific program of a congress. This was clearly not an issue to be addressed at this particular meeting but I would urge the readers of the newsletter to discuss such issues in its pages. Not only the existential question of why to have congresses but more interestingly how those general congresses can be rejuvenated in certain ways. Nowadays, there are so many competing special meetings that there has to be special reasons for organising general meetings, especially in the view of the existence of the big international congresses. A congress of this kind should not just be a chore to be performed every four years.

Further matters

Finally we should note that the EMS now has a new website: http://www.euro-math-soc.eu/.

2 The French Statistical Society and the national societies of Montenegro, Serbia and Turkey.

3 Could EMS apply to EMS as a member society?

4 All being Central European cities from the former Austro-Hungarian empire but obviously with national histories penetrating far deeper into the past.

5 For a more extended comment the reader is referred to the official report on the congress supplied by the organisers in this issue.

6 The question is moot as long as there are people willing to organise such ventures.

EMS launches its new website

Helge Holden

For a long time the European Mathematical Society has worked to establish a new website. It has been repeatedly requested from both our individual and society members. Our structure, with more than 50 member societies and more than 2000 individual members, displays a diversity that contrasts that of our sister society in the US, the American Mathematical Society. The European situation makes it more necessary to have an active website but also complicates its creation. To make a long story short, thanks to our colleague Professor Dmitry Feichter-Kozlov and his staff at Universität Bremen, Germany, we now have a working website in the newly established eu-domain with URL:

http://www.euro-math-soc.eu

The website is still in its infancy and the advantage of that is that we are very receptive to proposals about improvements and changes.

What you can find at the website:

1. *News*. On the website you can submit news items that will be posted. There is a screening process involved and if it is considered relevant for European mathematicians, it will be posted.
2. *Conferences*. Again you can submit information online about upcoming conferences and information about all relevant conferences will be posted without delay. For both the News and the Conferences, we offer RSS feed.
3. *Jobs*. We offer the possibility for you to announce job openings for mathematicians. Both fellowships (pre-docs and post-docs in EU lingo) and permanent jobs in industry and academia are welcome. While the News and Conferences announcements receive a steady number of new items, the possibility of advertising new jobs still needs to be better known.
4. *European funding*. The idea here is to provide easy links to the European agencies that offer funding for mathematics in Europe. This page clearly has room for improvements but the task is made more involved by the intricate systems for each of the agencies.
5. *Membership*. Renewing your membership with the EMS has always been a rather decentralized process; most members renew their membership through their national societies, and the practicality and efficiency of this method varies considerably across Europe. This may be one of the reasons why individual membership of the EMS is lower than expected. With the new website it is possible to become a member, and to renew membership, online with your credit card. If you claim membership in a national society (which is a member of the EMS), an email will go to that society when you pay.
6. *General information*. Here you can find internal information about statutes and by-laws and also links to our many active committees.
7. *Further links*. We provide links to our flourishing EMS Publishing House and online versions of present and old issues of our newsletter, as well as Zentralblatt and Jahrbuch.

What we are still working on:

1. *Membership database*. We want to provide a membership database where members can update their address and other relevant information. Steps will be made to avoid access for search engines and clearly the information from the database will not be offered to third parties.
2. *Discussion forums*. The present content of the website is, like most websites, rather passive; one goes there to find relevant information. Modern technology offers many more active approaches that include blogs and wikis. Here we have to rely on input from our members across Europe regarding what you want and what we have the resources to offer.

Our website is its infancy and it is up our membership to contribute information to the website to make it the premier mathematical website in Europe. The first thing to do is to make sure that each of our more than 50 national societies introduce a link to the new EMS web page on their own website. If you have ideas about how to improve the website, please do not hesitate to contact me at my email address: holden@math.ntnu.no (please use "EMS website" in the subject field).

Helge Holden
Vice President of the EMS
Norwegian University of Science and Technology
Trondheim, Norway

On the development of mathematics in Africa

Levis Eneya

Could centres of excellence, mathematicians joining active politics, 'twinning' of departments and online access to digital information lead to the development of mathematics in Africa and similar developing regions? After all, is mathematics an issue for developing countries?

These and many more questions stimulated a heated debate among panellists and the audience to the round table session '*Mathematics and the Developing Countries: Mathematics in Africa*' at the 5th European Congress of Mathematics in Amsterdam recently, moderated by Andreas Griewank (Berlin) and Tsou Sheung Tsun (Oxford), member and chairperson, respectively, of the Committee for Developing Countries of the European Mathematical Society (EMS-CDC). The panel, comprising individuals actively involved in several development activities and organisations, presented and discussed with the audience a wide range of issues vis-à-vis the development of mathematics in developing countries.

After introducing the panel, Griewank explained that the round table discussion was organized as a follow-up to one on '*Developing Mathematics in the Developing World*' held at ICIAM07, at which a number of issues affecting the development of mathematics in the less developed countries were discussed. He observed that developing mathematics in the developing world requires concerted efforts of mathematicians and governments in both worlds, and expressed the hope that the present round table would come up with more solutions focusing on Africa.

Causes and effects of brain drain have long been discussed and documented; remedies have been suggested including giving 'brain circulation' a chance through, for example, establishment of national or regional centres of excellence and support for existing ones. This, it has been argued, represents a 'softer' and a more realistic and achievable option compared to 'brain gain'. Being involved in such centres, hosting relatively expensive research equipment may give the diasporas a possibility to impact on the development of their home nations, and may provide access to appropriate research opportunities for the students and local researchers. Drawing from the success story of South Africa, Gareth Witten observed that centres of excellence have increased the number of graduates from mathematics departments due to new postgraduate courses in "modern" applied mathematics programmes such as mathematics of finance and mathematical biology. This, he said, has further been strengthened by the establishment of over 20 Research Chairs of mathematics and science; the number is expected to reach 210 by 2010. Since centres of excellence will ordinarily concentrate (infrastructure) development in just a few countries, thereby potentially condemning the rest of the continent to the status quo, it is important that they should not be *national* but *regional* centres. Thus, their management must be multi-national.

But setting up centres of excellence is not without challenges. Laura Pauline Fotso observed that the development of these centres faces political, economical and cultural challenges. Some members of the audience suggested that in most developing countries there is little, if any, policy of investment in (mathematical) research by governments, who view mathematical research as too abstract and inappropriate for national development. Poor working conditions, lack of sufficient funds for research and insufficient equipment are some of the economical challenges, they added. Fotso agreed with this assertion and added that it is for this reason that most mathematicians continue to work (exclusively) on research topics dealt with in their doctoral studies in developed countries (yet their countries have local problems requiring solutions from the

Some of the panel members, from right to left: Mohamed Jaoua (Nice University/UNESCO), Leif Abrahamsson (Uppsala University/ISP/EMS-CDC), Laura Pauline Fotso (Cameroon), Andreas Griewank (HU Berlin/EMS-CDC), Tsou Sheung Tsun (Oxford/EMS-CDC), and Wandera Ogana (Kenya/AMMSI)

Gareth Witten (South Africa): … centres of excellence have the potential of increasing the number of graduates from mathematics departments …

mathematicians). "Governance is a crucial issue for the future; relevant decisions regarding science need scientists", agreed Mohamed Jaoua. Perhaps the time has come when more mathematicians need to develop interest in and join active politics to sit at the decision making tables to ensure prioritisation of science and mathematical research in the national budgets. Another strategy is the creation of lobby groups. Here Fotso bemoaned lack of functioning national mathematics societies in most African countries and called for their revival to take a leading role in the lobbying. She further advised mathematicians to remember how to negotiate and compromise in a world where mathematicians are (generally wrongly) believed to be too square to adjust.

According to Jaoua, there is no question of whether mathematical research is an issue for developing countries. He reiterated its importance and emphasized that the field of applied mathematics is vital for any developing country as it is needed to produce engineers – a crucial sector for any industrial development. Further, with regard to development, he observed that new paradigms have grown from the digital revolution in which mathematical and numerical modelling are the heart of every industrial process, and he predicted real opportunities for those who master mathematics and information technology. Unfortunately for a developing country, bottlenecks such as a small industrial sector and weak, if any, industry-academic links means that there are no industrial-related problems to solve. Nevertheless, there are important issues such as epidemic control, sustainable utilisation of natural resources and economics, to mention just a few, which should be a worthy source of problems to work on. In any case, deliberate efforts need to be made to bridge the gap between the worlds of industry and academia. To this end, the Laboratory for Mathematical and Numerical Modelling in the Engineering Sciences (LAMSIN) in Tunisia and the Mathematics in Industry Study Group (MISGSA) in South Africa, among other initiatives, are steps in the right direction.

With regard to institutional and capacity development, Wandera Ogana recounted the current initiatives promoting mathematics through the African Mathematics Millennium Science Initiative (AMMSI) – a program under the Millennium Science Initiative of the World Bank – saying AMMSI has moved a step towards developing mathematics in Africa by providing research/visiting scientist fellowships, scholarships for PhD, MSc and postgraduate diploma studies in universities in sub-Saharan Africa, support for scientific meetings and the Mentoring African Research in Mathematics (MARM) program – thanks to the financial support from the Mellon Foundation, the Nuffield Foundation, the Leverhulme Trust, the International Mathematical Union, the London Mathematical Society and the US National Committee on Mathematics. It was learnt that from when the initiative was established in 2005 to 2007 a total of 170 partial scholarships had been awarded and three conferences in Benin, Kenya and Namibia had been supported within the slim budgets due to limited funds. For the same reason, postgraduate scholarships are constrained to the range of USD 300–1000 and there is no funding for research activities and no support for conference attendance despite the wide interest expressed by students. Ogana then appealed for more partners and support to continue and extend the activities.

Drawing from the experiences of INRIA (the French National Institute for Research in Computer Science and Control) with African research teams, Bernard Philippe observed that some African Masters programmes only exist because of the participation of European lecturers and he wondered weather it was acceptable to continue the support of these programmes. Here the panel and audience had something to learn from the International Science Programme (ISP) of the Uppsala University through Leif Abrahamsson. He advised that similar programs ought to be a base for collegial cooperation, fostering as direct cooperation as possible, and that they should be based on scientific criteria. He added that besides being flexible, the programs should be headed by senior scientists (who should be able to continue with the programmes when the Europeans withdraw their participation). But one real challenge, observed Abrahamsson, comes from the fact that the content of a bilateral programme is decided by the receiving university and mathematics is (usually) not prioritised by the authorities.

Tsou Sheung Tsun informed the audience about the initiatives of the European Mathematical Soci-

ety through its Committee for Developing Countries (EMS-CDC), whose aim is to assist developing countries wherever and whenever possible. These include but are not limited to: book donations, access to digital libraries, funding participation to conferences, and the "Twinning" project – a scheme initiated by one member of EMS-CDC from Uppsala University, Sweden, whereby a department in the developed world "twins" with a department in the developing world to help the latter in various ways. What has been done so far by Swedish colleagues can be found on the site "e-Math for Africa" (http://math.golonka.se/). See also the French Mathematical Society SMF (http://smf.emath.fr/en/Adhesions/ParrainagePED/) and the London Mathematical Society schemes (http://www.lms.ac.uk/grants/nuffield_scheme.html) for other similar development efforts. Tsou added that the EMS-CDC plans to launch and encourage this project by providing seed grants to mathematics departments in the developed countries to twin with departments in the developing countries. To this end, she presented a list of departments that had already been twinned so far. This, as well as more information on this initiative, can be found in the September 2008 issue of the EMS Newsletter (http://www.ems-ph.org/journals/newsletter/pdf/2008-09-69.pdf). In addition to these initiatives, she called for individual action of mathematicians in developed countries including book donations, short course offers and collaboration at institutional level.

In concluding remarks from members from the floor who had experience of working with African institutions, Jean-Pierre Bourguignon, director of the Institut des Hautes Études Scientifiques (France), outlined some of the recurring problems met by colleagues in Africa: work overload; poor working conditions; problems with travel – costs as well as proper authorisation; flexibility for arranging their professional life; how to give professional perspectives to advanced students; and visa problems – the increasingly strict attitude of countries of the European Union, which he said should be noted and fought against. He then suggested some remedies including strong collaboration between countries at the research level as well as at the higher education level. He noted that some African countries, South Africa being the most obvious example, are already well advanced and that there is a risk that these countries absorb the intellectual resources of the other less dynamic ones. Here the writer believes that for this reason, it would be better if any new centres of excellence were built in the less dynamic countries, while drawing expertise and experience from the advanced ones. Firstly governments need to improve working conditions and provide incentives to attract back and retain the trained young blood. Secondly, individuals need to be patriotic and invigorating in research and that patriotism and hard work should be rewarded appropriately. On this issue, Bourguignon suggested that there is need to give weight to competent colleagues vis-à-vis the local political structure. Thus, it is vital that an appropriate scheme for the evaluation of the work done be used. Further, he reiterated the need for proper access to digital information. In this respect, he applauded the initiative taken by the *Zentralblatt-MATH* at the suggestion of EMS-CDC to have Zentralblatt available to developing countries for free. As a last but not least remedy, he advised that the potential of centres of excellence needs to be exploited, where common education can be given to a group of selected students to improve the level of further collaboration. In this respect, the African Institute for Mathematical Sciences (AIMS) in South Africa and potentially the African Mathematical Institutes Network (AMI-Net), which aims to develop a network of about 15 'nodes' operating in partnership to build excellent teaching programmes and research collaborations across Africa, are steps in the right direction.

Levis Eneya (eneya@mathematik.hu-berlin.de / keneya@chanco.unima.mw) is a PhD student in mathematics in the applied field of optimisation at Humboldt University of Berlin (Germany). One of his goals is to contribute to the development, promotion and application of mathematics to solve some of the many problems and challenges facing developing regions, especially in Africa. He is on study leave from the University of Malawi in Malawi.

Cultivating passion – the 8th Junior Mathematical Congress

Mikael Vejdemo-Johansson

Junior Mathematical Congress 8
Jena, Germany 3–9 August 2008

Do you remember when you became a mathematician? Was it a gradual process or a moment that you still are able to pinpoint in space and time? Were you always destined for this life or was there a transition somewhere in your life?

For some of the 87 participants of this year's Junior Mathematical Congress (JMC), the transition might very well have happened in Jena, Germany during the first week of August. The participating students were from secondary schools all over Europe (11 countries, including the host country Germany, Albania, Macedonia, Norway and Luxembourg) and they had prepared 42 different projects, spanning hyperbolic 3-manifolds, cryptography, number theory, classic geometry, game theory, virtual reality and linguistics.

The JMC this year was organized by the student-run organization Die Wurzel, which in addition to this congress, publishes a bimonthly mathematics magazine and organizes mathematics camps for high school students in the region.

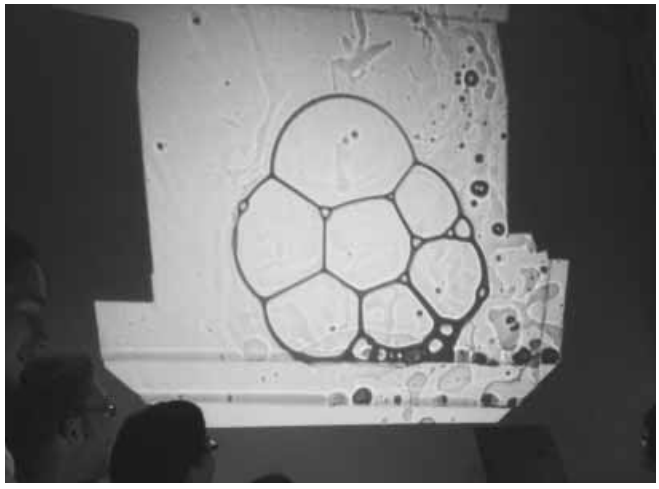
The format of the JMC, modelled on a standard large mathematical congress with talks, poster sessions and moderators (as well as a biennial frequency) was settled by the second congress in Budapest 1996. Since then, the programme of the JMC has consisted primarily of project presentations from the secondary school students themselves, which makes the JMC different from all other events available for young students with an interest in mathematics: mathematical camps have content provided by universities and mathematical competitions are fundamentally different. The closest analogue would be science fairs, such as the German competition Jugend Forscht or the Swedish Utställningen Unga Forskare where the students present projects of their own from all corners of science.

In this format, the participants experience interesting mathematics presented and worked out by their peers, interesting mathematics they could do themselves. It also gives an early taste of the elation of discovery, the fascination of research and with luck, a glimpse of what Erdős described as the Book of God.

But showing the participants the beauty and fascination of mathematics is just one component of a good congress. We also want the participants to enjoy themselves, to get to know each other and to see the area they are visiting. In Jena, we offered museum visits, free entrance to the 133 metre high JenTower, forest walks around the city and a visit to the old Carl Zeiss planetarium. Organising the JMC in Germany during the Year of Mathematics was highly beneficial; we had both the Imaginary Exhibition on display and a movie night showing "N is a number", "Flatland" and "Mesh" from the MathFilm-Festival. On Wednesday there was a half-day mini-competition combining mathematical problems with physical exercise out in the sun. And Friday evening saw a barbecue party with the prize ceremony and karaoke.

The students themselves were very pleased with the programme. One clique, formed of participants from Luxembourg, Germany and Austria, ended up celebrating the 19th birthday of one of their members up on the karaoke stage. As everyone was departing on Saturday,

Participants of the Junior Mathematical Congress 2008



Soap bubbles – the best lecture at the conference

Péter Körtesi, organizer of most past Junior Mathematical Congresses

Social programme – mathematical puzzles in the green

promises to keep in touch and meet again abounded. "At first, I didn't dare come here. After all, the best students from all of Europe will meet. Now, however, I'm glad to be here"[1], Nadja Fröhle from a school in Baden-Württemberg told one of the reporters covering the congress.

Speaking of the press, the JMC was covered in some detail by the local press. There were journalists present from Monday to Wednesday; on Monday, a full TV team tracked participants and produced two TV spots, one for the regional TV station MDR and one for the German national channel ARD. In addition, the event was covered in a radio spot on MDR-Figaro and in the regional newspapers Ostthüringer Zeitung, Thüringer Allgemeine and Thüringer Landeszeitung.

1 "Erst habe ich mich nicht getraut herzukommen, schliesslich treffen sich hier die besten Matheschuler aus ganz Europa. Jetzt bin ich aber sehr froh, hier zu sein."

The upcoming Junior Mathematical Congresses will be in 2010 in Russe, Bulgaria, and in 2012 in Edinburgh, Scotland. Over the years, the largest challenge that ever faces an organiser is to reach the students. We would therefore like to call on all members of the EMS to help reach out to secondary schools all over Europe and encourage their students to do research projects and to come to Russe in 2010. A student wanting to go to the JMC faces several hurdles along the way; the most fundamental is knowing that it happens in the first place.

The European Mathematical Society can help a lot here: with coordination, with continuity and with communication. The organisers of past Junior Mathematical Congresses sincerely hope that the EMS will engage more actively in future instances. We can help cultivate the next generation of mathematicians. How can this possibly be anything less than our duty?

4th World Conference on 21st Century Mathematics

March 4–8, 2009, Lahore, Pakistan

The Conference provides a platform to mathematicians from all over the world to exchange ideas about research and mathematics education. Conference is being staged in the historical city of Lahore, a cultural hub of Indian subcontinent and heart of old civilizations. For information on the Conference, visit the website:

http://wc2009.sms.edu.pk

The Conference is supported by European Mathematical Society (EMS), International Mathematical Union (IMU) and The Abdus Salam International Center for Theoretical Physics (ICTP).

The Scottish Mathematical Sciences Training Centre

Penny Davies

Background and aims

The Mathematical Sciences Programme of the UK Engineering and Physical Sciences Research Council (EPSRC) has funded six postgraduate Taught Course Centres to address the issue raised in the 2004 International Review of UK Research in Mathematics that: *New Ph.D.s from the UK usually have less breadth and experience than their peers from other countries*. This article is a description of the first year of operation of one of these, the ***Scottish Mathematical Sciences Training Centre (SMSTC)*** – a list of all six is available at www.epsrc.ac.uk/ResearchFunding/Programmes/Maths/Training/Courses.htm. The Scottish mathematical sciences departments have a history of collaborative graduate training going back to the first Edinburgh Mathematical Society postgraduate conference in 1995 (these popular events at The Burn, a historic house near Edzell, are now held annually). Since then we have also initiated a comprehensive joint programme of mathematically relevant generic skills. But we still did not realise exactly how much work we had let ourselves in for when we were awarded the EPSRC grant to set up the SMSTC!

Teaching and topics

The SMSTC's portfolio consists of eight six-month streams (in algebra, geometry and topology, pure analysis, applied analysis and PDEs, applied mathematics methods, mathematical modelling, probability, and statistics), each equivalent to a workload of about 25% of a student's time. The aim is to provide a broad training to complement the more specialised courses that are already available. A typical student registers for three streams, leaving about 25% of their time to work with a research supervisor during their first six months. Each stream is self-contained, and consists of a team of people who are responsible for producing comprehensive printed course notes, and delivering the lectures. Lectures are two hours long and are held weekly by video conference. Individual departments are also expected to provide students with local tutorial sessions to help promote understanding and reinforce the lecture material. Each stream sets its own assessment: the aim is to ensure that the students actually learn something, and it typically involves a small number of assignments for the students to work on. Most students performed very well in their assignments.

Student meetings

The SMSTC was launched with a two-day student symposium in October 2007. The meeting featured a short "taster" lecture from each of the eight streams, to provide information on the topics covered and allow the students to ask questions about prerequisites, content and assessment etc. (although, as was stressed at the time, some details were yet to be finalised). Interspersed with these were sessions covering introductory generic skills. The social highlight was an excellent dinner at a local restaurant, which both staff and students enjoyed. A second half-day symposium was held in February 2008 in Edinburgh, and consisted of generic skills talks and an SMSTC discussion forum, at which the students provided useful feedback on their experience so far. This was followed by a wonderful lecture by Simon Singh on Fermat's last Theorem – Maths in the Media, and a wine reception. As well as being enjoyable and useful events in their own right, we hope that the symposia will help students to become (and feel) part of the mathematical sciences community.

Technical equipment

Delivery of lectures by video-conferencing (VC) was the only feasible option, since otherwise either staff or students would have needed to travel (possibly large distances) to give or attend lectures. The SMSTC depart-

Adrian Bowman (University of Glasgow and leader of the SMSTC Statistics stream) gives a VC lecture, with students from a remote site shown in the background.

ments have a large number of leading experts across the mathematical sciences, and teaching by VC allows this collective expertise to be available to all registered students. We chose to use standard (H.323-compliant) VC equipment because it is already in widespread use as a platform for multi-site connections.

Management and administration

An Academic Steering and Management Group is responsible for the overall management of the SMSTC and ensuring academic quality. It is convened by the SMSTC Director, Tony Carbery (University of Edinburgh), and has representation from each contributing university and broad subject area, and external advisors. Non-scientific organisation and administration for the SMSTC is undertaken by staff at the International Centre for Mathematical Sciences (ICMS), one of the two EPSRC-funded mathematical research institutes in the UK.

Website

The SMSTC's website www.smstc.ac.uk is an important communication channel. It is wiki-based and extremely easy to use, and has been popular with both staff and students. Students are given read-only logins, and use the site to obtain general information (on symposia, assignments etc.) and to download PDFs of the comprehensive lecture notes before each lecture. Staff in "stream teams" all have edit permission for their pages, which enables them to upload lecture notes and any other material themselves, without needing to go through a web administrator.

Future

Plans are already well underway for the next session. The SMSTC's academic year will again open with a symposium (October 8–9, 2008), with lectures running for 9 weeks from 13 October, and resuming after a Christmas break on January 12. We welcome enquiries (to Johanna Kytöharju, johanna.kytoharju@icms.org.uk) from anyone outwith the partner departments who would be interested in finding out more about the SMSTC, or registering for the next or future academic years. Because our lectures are given by VC, we can potentially broadcast anywhere up to restrictions imposed by the UK time zone (indeed, one of last year's lectures was given by a member of staff on sabbatical in New York). We charge a registration fee to partially cover the staff costs of lectures and administration associated with the SMSTC, but would be happy to arrange a free sample lecture for anyone interested.

Penny Davies, Department of Mathematics, University of Strathclyde (penny@maths.strath.ac.uk)

European Society of Mathematical Chemistry

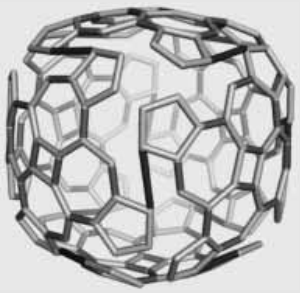
The European Society of Mathematical Chemistry (ESMC) is a scientific, professional, non-governmental, non-profit and non-politic association. It joins specialists in the field of Mathematics and Chemistry, and works as an independent organism.
The society was founded in 2007 by the actual president, Prof. Mircea V. Diudea.
Any person who recognizes the Statute and fulfills the assumed obligations can become a member of the European Society of Mathematical Chemistry. The personal contribution is 50 Euro per year.
The quality of associate / member is obtained by an application, as a hard copy or an electronic file, addressed to the General Meeting of ESMC.

Actual number of members: around 100, from Romania, Europe, Asia and America.

For more information please contact us at:

"Babes-Bolyai" University
Faculty of Chemistry and Chemical Engineering
Arany Janos Str. no. 11
RO-400028, Cluj Napoca

Homepage: http://www.esmc.ro
Email: eurosocmathchem@gmail.com



(k)not cables, braids

sarah-marie belcastro, Amy F. Szczepański and Carolyn Yackel

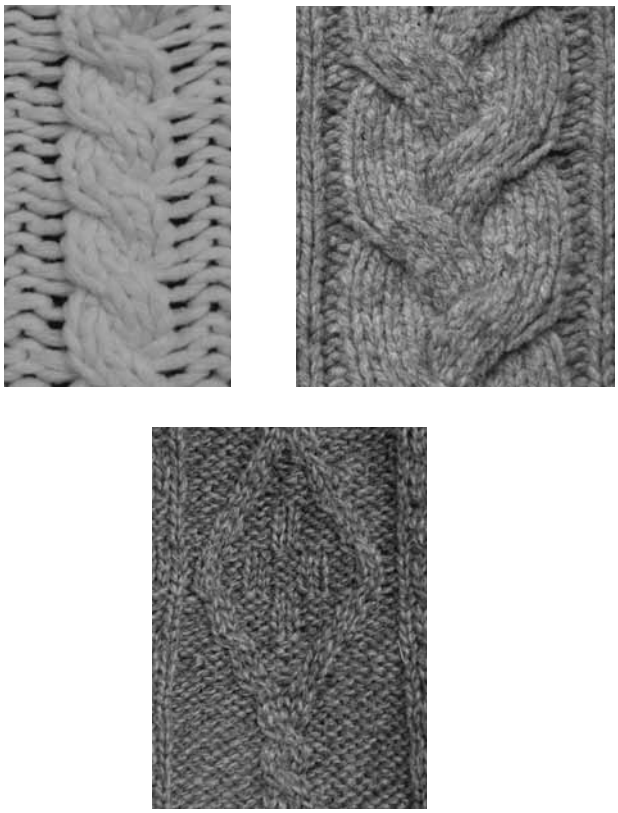


Figure 1. A few cable patterns

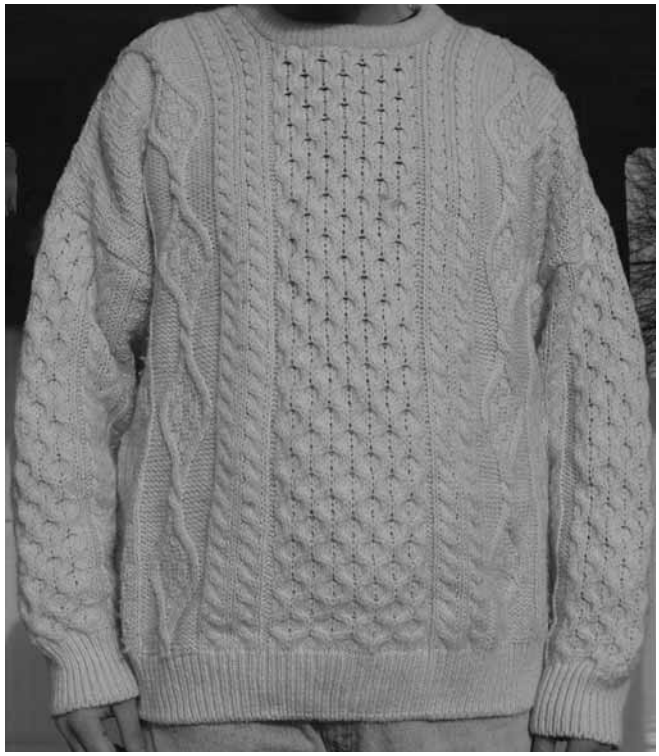


Figure 2. A fisherman's sweater from Ireland

1 Overview

Knitted sweaters are frequently embellished with beautiful textures worked into the design. Cabling is a popular technique for creating such texture; knitted cables are patterns of raised stitches that cross over and under each other as in Figure 1.

Cable patterns are the hallmark of Irish fisherman knits, and stitches that cross and weave are also found in some traditional Estonian knitting [3] as well as in designs from Bavaria, Tyrol, Alsace, Norway, and Denmark. It makes sense that these patterns would be popular in cold climates, because cabling uses more yarn than flat (e.g., stockinette) knitting, so the resulting garments are thicker and warmer.

To knit a cable pattern, one physically moves sets of (usually two to four) contiguous stitches in front of or behind other stitches. The exchanging of strand groups, weaving sets in and out, will be familiar to anyone who has attempted to braid hair. Indeed, mathematicians use the term *braids* to describe cables. The two notions are quite similar. Both mathematical braids and typical cable patterns follow the progress of several vertically oriented strands as they weave back and forth and over and under each other. For most knitted cablework, the directions are given in terms of a chart that diagrams how the stitches should be worked in a vertically repeated pattern block or motif. Similarly, mathematicians use small geometric elements that are stacked vertically when describing a specific braid. This gives us a very natural way to use the language of mathematics to describe and analyze cables, as we will do in the next section.

In the Section "Braids versus Cables" we create a dictionary to translate between the language of cables and the language of braids; then we describe the mathematical structure of braids in the section "The Braid Group". One of the big mathematical ideas represented here is that of braid *equivalence*, or how to tell when two different-looking knitted cables represent the same mathematical braid.

While most crafters loathe knots in their yarn and floss, mathematicians have a much more pleasant take on *knots*, which may be constructed from braids. The mathematics of knots is discussed more in the Section "Braids and Knots". These knots (and links) can arise naturally in knitting. Although cables on sweaters are usually arranged to run up and down on both the body and the sleeves, as in Figure 2, nothing stops us from having a cable go around the body and connecting the beginnings of the strands to their ends. This could be accomplished by choosing a cabled design and knitting it around the cuffs or around the bottom of a sweater. (See, for example, the chapter "Fringes" in [4].) This type of design is what mathematicians call a closed braid. These tangled strands correspond to a knot if the pattern can be completely traced by following one strand around. If following just one

strand leaves some parts of the pattern untraced, the closed braid is a *link*, meaning it is more than one knot, possibly looped together. Whimsical linked and knotted constructions can be found in [5] in the chapter "Cords". Other knitters have found ways to include knotwork in their projects [6, 8].

In the Section "Teaching Ideas", we give several activities that may be used to investigate mathematical braids using knitted cables. The project in Section 4 uses a set of cables that look different but are all mathematically equivalent as braids. This is explained at the end of the Section "The Braid Group", so keep reading!

2 Mathematics

As mentioned above, braids and cables are essentially the same. Mathematicians formally define a braid to be a set of n strands that begin at some horizontal line and end at some other horizontal line, moving only in the same vertical direction, although they may move over and under each other laterally. One result is that any horizontal plane intersecting the braid intersects each strand exactly once. While mathematicians typically read braids from top to bottom to align with gravity, in this chapter we will read them from bottom to top in order to be consistent with knitting charts. In addition to drawn braids, mathematicians use compact notation. Though the notation varies according to the source, we present the standard notation, as given in [1], with the caveat that the braid first be rotated by π since we are reading bottom to top. Let the n strands of the braid be numbered $1,2,\ldots,n-1,n$ from right to left. If there are no twistings of the strands in the braid, it's not very interesting, so we will notate nothing. That is, we will write nothing down to describe this non-braid. A twist of strand i in front of strand $i+1$ is denoted σ_i, and a twist of strand $i+1$ in front of strand i is denoted σ_i^{-1}. Note that these twists are actions, so they refer to whichever strands happen to be in the ith and $(i+1)$st positions just before the twist occurs rather than the original ith and $(i+1)$st strands. An example is given in Figure 3.

We can *concatenate* two braids on the same number of strands by simply placing one above the other and gluing the ends of the strands of the first braid to the starts of the strands of the second braid. In fact, braids on n strands form a group B_n under this concatenation operation. The σ_i generate B_n, but σ_i only commutes with σ_j when $|i-j|>1$, because then none of the same strands are involved in the two twists. An element of B_n is known as a *braid word*, where the "letters" are the twists of the braid.

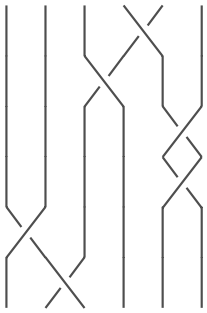


Figure 3. This braid is "read" as $\sigma_4\sigma_5^{-1}\sigma_1^{-1}\sigma_1^{-1}\sigma_3\sigma_2$.

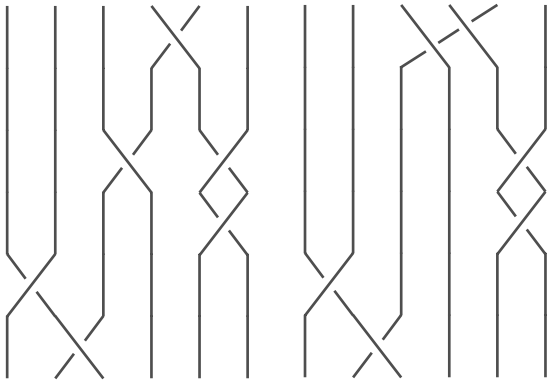


Figure 4. Slightly altered versions of Figure 3 with simultaneous strand-switches, corresponding to the braid words $\sigma_4\sigma_5^{-1}\sigma_1^{-1}(\sigma_1^{-1}\sigma_3)()\sigma_2$ (left) and $\sigma_4\sigma_5^{-1}\sigma_1^{-1}\sigma_1^{-1}()(\sigma_3\sigma_2)$ (right).

Braids versus Cables

The equivalence between knitted cables and mathematical braids is not quite exact. For example, many different cables may represent the same braid, since each cable represents a different braid drawing. However, there are many cables that don't follow the usual mathematical rules for braids. Here we attempt to expand the mathematics-knitting dictionary to translate between cable patterns and braids.

- In a mathematical braid, all the strands have the same width. In knitting, there are cables with different stitch-widths, and thus different strand-widths. For a cable with all strands of the same width, we merely specify how many stitches there are per strand. This methodology also works for cables with strands of varying widths, as long as we choose the number of stitches per strand to be the greatest common divisor of the cable's stitch widths. Likewise, to complete the mathematics-knitting translation for these braids, we need to specify the height of a cable, that is, how many rows should be knitted before another strand-twist happens.
- Sometimes a cable will have two independent strand-twists happen at the same time. Mathematically, it does not matter which one we write first in the braid word because of the commutativity noted above. However, the braid word may not indicate the cable pattern we began with unless we introduce new notation. To denote the fact that these independent strand-twists happen at the same time in a cable pattern, we set them off in parentheses. For example, in Figure 4 (left) we have a cable pattern corresponding to the braid word $\sigma_4\sigma_5^{-1}\sigma_1^{-1}(\sigma_1^{-1}\sigma_3)()\sigma_2$. The () in the braid word signifies that there is a repeat of one cable-height in which no cabling takes place.
- There are many different knitted cables that are all equivalent to the trival braid; two are shown in Figure 5. Some of these have no crossings – the strands move back and forth across the knitted fabric, but never cross each other. How to include such cables in the knitting-mathematics translation dictionary is an open question.

The Braid Group

The braid group B_n surjects naturally to the symmetric group S_n on n letters. The reader should note that while σ_i is an involution in S_n, it is not a involution in B_n, as we know

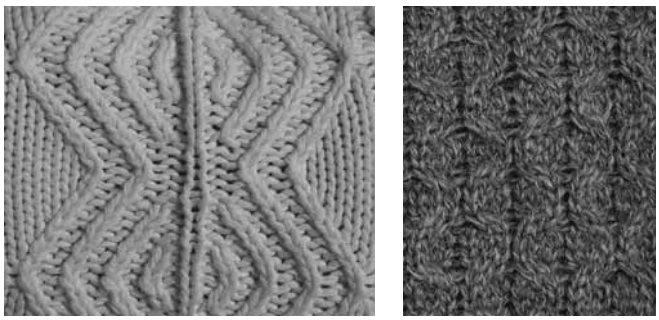


Figure 5. Both of these cables represent the trivial braid

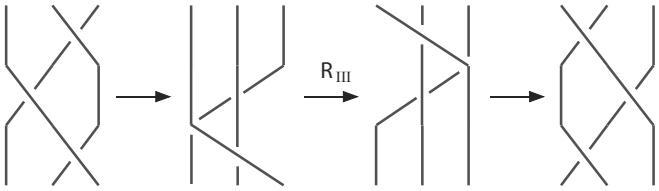


Figure 6. The braid word $\sigma_i\sigma_{i+1}\sigma_i$ is equivalent to the braid word $\sigma_{i+1}\sigma_i\sigma_{i+1}$.

from the experience of repeatedly twisting two strands. Indeed, σ_i does not have finite order in B_n. Yet, B_n is not simply the free group on the σ_i. As we noted above, $\sigma_i\sigma_j = \sigma_j\sigma_i$ for $|i-j| > 1$. Furthermore, we have analogues of the Reidemeister moves, as defined for knots. The cancellation of $\sigma_i\sigma_i^{-1}$ from a braid word produces a Type II Reidemeister move in a drawing of the braid. There is also a Type III Reidemeister move that corresponds to the algebraic substitution of $\sigma_i\sigma_{i+1}\sigma_i$ for $\sigma_{i+1}\sigma_i\sigma_{i+1}$, as shown in Figure 6.

Using both of these algebraic substitutions gives a different Type III Reidemeister move, as in Figure 7. Note that no Type I Reidemeister move can be performed on a braid as this would require a braid strand to change direction.

It turns out that these three braid-word relations, $\sigma_i\sigma_i^{-1} = e$, $\sigma_i\sigma_{i+1}\sigma_i = \sigma_{i+1}\sigma_i\sigma_{i+1}$, and $\sigma_i\sigma_j = \sigma_j\sigma_i$ when $|j-i| > 1$, completely characterize braid-word equivalence.

The braid-word relations are used in the project pattern: it consists of a series of panels, each containing a cable corresponding to a braid. The braids are all equivalent in B_n. In fact, reading the panels left to right across the design results in a series of seven moves, as can be seen in Figures 17–20. Between panels 1 and 2 we apply a Type II Reidemeister move. Between panels 2 and 3 we apply the first sort of Type III Reidemeister move described above, and as shown in Figure 6. Between panels 3 and 4 and between panels 7 and 8, we use $\sigma_i\sigma_j = (\sigma_i\sigma_j)$ for $|j-i| > 1$. The move connecting panels 4 and 5 is used between panels 7 and 8 as well. It amounts to nothing more than collapsing the figure where no switching of strands occurs. This leaves only the moves between panels 5 and 6 and between panels 6 and 7. Both of these moves correspond to the Type III Reidemeister move presented in Figure 7. The original panel braid was $\sigma_3{}^{-1}\sigma_3\sigma_2\sigma_2\sigma_3\sigma_2\sigma_1\sigma_2\sigma_3^{-1}\sigma_2\sigma_1^{-1}$, and the final panel braid is $\sigma_2(\sigma_1^{-1}\sigma_3)\sigma_2(\sigma_1\sigma_3)\sigma_2\sigma_2\sigma_1^{-1}$. The careful reader will note that the first panel could not have been collapsed vertically without using the Reidemeister moves. Therefore, it had to have at least eleven units available for cabling switches, yet the final panel needed only seven vertical units.

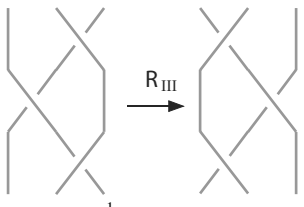


Figure 7. The braid-word $\sigma_i^{-1}\sigma_{i+1}\sigma_i$ is equivalent to the braid-word $\sigma_{i+1}\sigma_i\sigma_{i+1}^{-1}$.

Braids and Knots

It's easy to convert a braid into a knot or link. Just identify the end of the ith strand on the top with the end of the ith strand on the bottom, as in Figure 8. This is called a *closed* braid.

It's less clear how to turn a generic knot or link into a braid, but it can always be done (see [2] for details).

Notice that depending on where we choose to "start" and "stop" a closed braid, we will obtain different braid words. In fact, any two closed-braid words that differ only by a cyclic shift correspond to the same closed braid. Thus conjugating a braid word by σ_k (that is, premultiplying by σ_k^{-1} and postmultiplying by σ_k) is essentially the same as multiplying the corresponding closed-braid word by the identity. In terms of a braid drawing, such a conjugation places a σ_k^{-1} strand-twist below the braid and a σ_k strand-twist above the braid.

Another algebraic operation that has no effect on a closed braid is multiplying a closed-braid word on n strands by σ_n (or equivalently by σ_n^{-1}). This performs a Type I Reidemeister move (finally! – you knew there had to be one in here somewhere) on the nth strand. This can be seen in Figure 9; alternatively, we may view this operation as adding a $(n+1)$st strand and connecting it to the closed braid so that it does not form a non-equivalent link. This operation is known as *stabilization*, perhaps because it stabilizes the equivalence class of our original braid within the braid group.

Fascinatingly, conjugation, stabilization, and the three braid-word relations suffice to distinguish inequivalent closed braids [7].

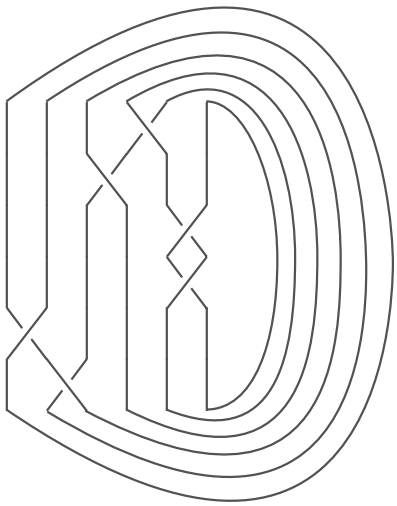


Figure 8. The braid from Figure 3 turned into a knot

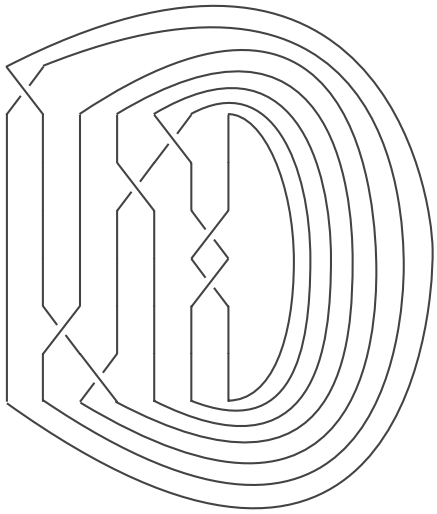


Figure 9. What happens when the closed-braid word from Figure 8 is multiplied by σ_6.

Braids and Symmetry

The standard way of plaiting a three-strand braid (such as commonly used when braiding hair) is to repeat the element $\sigma_1\sigma_2^{-1}$. Generalizations of this braid to n strands are possible, and one n-strand braid uses weaving. Take the first strand and weave it over the second, under the third, over the fourth, and so on, until all the other strands have been crossed; repeat this with the strand that is now the first strand. This can be denoted as taking powers of the element $\sigma_1\sigma_2^{-1}\sigma_3\sigma_4^{-1}\ \ldots$ For example, plaiting a six-strand braid would take powers of $\sigma_1\sigma_2^{-1}\sigma_3\sigma_4^{-1}\sigma_5$, and a seven-strand braid would take powers of $\sigma_1\sigma_2^{-1}\sigma_3\sigma_4^{-1}\sigma_5\sigma_6^{-1}$. (This is how Amy conceptualizes braiding hair.) However, this is not the way that braids are formed in knitted cablework, though the only difference is in the ordering of the elements.

These braids usually feature the product of all of the odd-index elements followed by the product of the inverses of all of the even-index elements. In this method a six-strand braid would be $\sigma_1\sigma_3\sigma_5\sigma_2^{-1}\sigma_4^{-1}$ and a seven-strand braid would be $\sigma_1\sigma_3\sigma_5\sigma_2^{-1}\sigma_4^{-1}\sigma_6^{-1}$. (In contrast, this is how sarah-marie conceptualizes braiding hair.) When $n=3$, these two methods are identical, but for $n>3$ they are not.

3 Teaching Ideas

The braid group can provide useful examples in any class that explores algebraic properties such as the commutative and associative laws. Working with the braid group appeals to students with a variety of learning styles. Students with a visual learning style may wish to make diagrams of the braids, while those with a more hands-on style can work with strands of wire or string.

For informal experiments, it's helpful to have a supply of several colors of yarn or twine. Using different colors for each strand makes it easier to keep track of the permutation generated by the braid. In that case, however, be sure the students understand that for a fixed i, σ_i may act on different colors at different stages of the braid. A configuration made from fiber may be preserved by taping it to an index card. To create more stable models of a braid diagram, use colored fine-gauge electrical wire (such as the wires found inside telephone or networking cables). The ends of the wire can be wrapped around a narrow dowel (or a pencil) to keep the braid from unraveling, or the ends of the braid can be attached to plastic needlepoint canvas.

To have a common language for describing braids and cables, students should first be introduced to notation for the generators of the braid group and the conventions that apply. Advanced students who are able to read articles in the scientific literature should be warned that authors vary in the way they draw and read the braid diagrams (top to bottom, bottom to top, or left to right) and whether σ_i denotes strand i crossing *over* strand $i+1$ or *under* strand $i+1$. Once students can consistently write down the algebraic notation for a braid diagram and translate a braid diagram to its algebraic notation, they can begin to explore the properties of this group.

Working with Basic Properties of Braids and Knots

These questions can be suitably rephrased to be grade-level appropriate for secondary through graduate students.

- Draw three different braids that all have the same number of strands. Concatenate any two of the braids. Now concatenate them in the other order. Do you get the same braid as a result? Does the order of concatenation behave the same way no matter which two braids you pick?
- Choose a braid you have previously drawn. Can you create a second braid that "cancels out" your chosen braid when you concatenate the two braids?
- Use Reidemeister moves to show that the braid relations given in Section 2 hold.
- Can you find an element of B_n that, when converted to a closed braid, is a knot?
- Working the other way, given a knot or link (such as might be found in Celtic knotwork), can you find a braid that represents the knot?
- Can you find elements of B_n that are links with two components? With any number of components up to n?
- How does B_n naturally sit inside of B_{n+1}? Are there more interesting homomorphisms of braid groups? Can you find a homomorphism from the braid group B_n onto the symmetric group S_n?
- What does a normal subgroup of a braid group act like in terms of the strands of the cables?

The project given in Section 4 has been designed to exemplify a range of braid properties. Begin by having students create braid drawings from the cable charts. Then, they can verify that these braid drawings show topologically equivalent braids. Students can be asked to identify Reidemeister moves in the braid drawings. For an algebraic perspective, ask students to write down the braid words associated to the braid drawings and identify the braid-word relations that correspond to moving adjacent drawings of panel braids.

Braids in the Wild

Since cable patterns commonly decorate knitwear, ask students to locate scarves, sweaters, or other items featuring cable patterns and investigate the corresponding braids. If the students have trouble finding garments featuring cable patterns, they can work from photographs that clearly show the cabling (such as in a knitting book about Aran sweaters); a

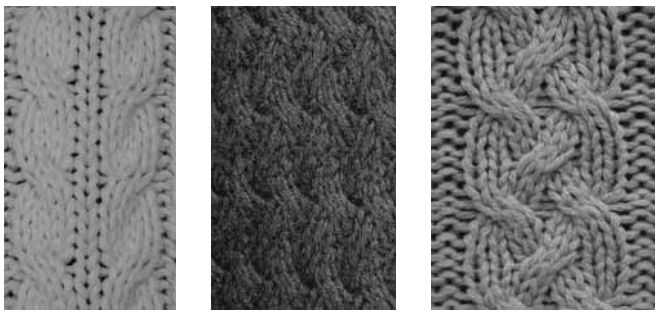


Figure 10. Three mathematically nontrivial (and different) braids. Can you express these using notation in B_n?

few examples are given in Figure 10. Ask the students to use mathematical notation to record which elements of the braid group are found on the items.

Once the class has collected an assortment of cable patterns, the students can begin to look for features that are common (or uncommon) among the patterns. How many strands are in each cable? Is there an even number of strands or an odd number of strands? How often is each of the generators σ_i represented in each cable? If a sweater contains more than one type of cable, is there a relationship among the different cables in the sweater? How often do the cables represent the trivial braid?

Once the students have determined what is "usual" and "unusual" for braid patterns that appear on garments, they can be asked to design their own patterns. Here are some sample exercises.

- Design a cable pattern with the same braid word as a cable you've seen in a garment, but that has a different appearance when realized as knitting.
- Design a cable pattern with a braid word you haven't seen before, but that has features in common with the patterns you have seen in garments.
- Design a cable pattern whose mathematical description is outside the norm of what you've seen on garments.

Wildly Braiding

These questions relate to the symmetry of the two methods of braiding introduced in Section 2.

- Discuss why the action $\sigma_1\sigma_3\sigma_5\sigma_2^{-1}\sigma_4^{-1}\sigma_6^{-1}$ is not symmetric when the braid has an even number of strands, but *is* symmetric when the braid has an odd number of strands.
- Investigate to what extent this symmetry (or lack of symmetry) extends to a diagram of a braid.
- Which of these braids, $\sigma_1\sigma_3\sigma_5\sigma_2^{-1}\sigma_4^{-1}\sigma_6^{-1}$ and $\sigma_1\sigma_3\sigma_5\sigma_2^{-1}\sigma_4^{-1}$ (and their generalizations), can be drawn in such a way so that the diagram has reflectional symmetry? Do they have rotational symmetry in any sense?
- Do the two methods of constructing braids have comparable results? For a three-strand braid, they are exactly the same, but what happens when $n > 3$?
- Consider the two methods of braid construction from Section 2 on a fixed number of strands. Now consider forming the result of each into a closed braid. Are the two closed braids equivalent? If this seems difficult, focus on the cases of four- and five-strand braids.

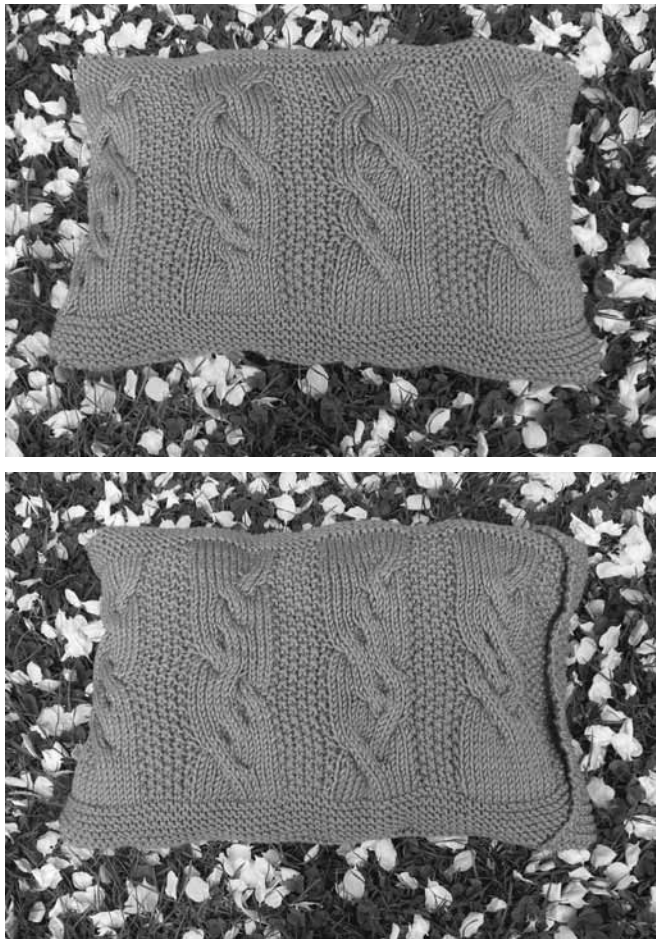


Figure 11. The pillow of braid equivalence, front (top) and back (bottom).

4 How to Make a Pillow of Braid Equivalence

These instructions are for making a pillow cover as shown in Figure 11, but the motif given in the cable charts would work just as well for embellishing other objects. It could be made into wall art (see Figure 14) or part of an afghan; divided into two halves (cable panels 1–4 and 5–8), the motif would work as the front and back of a bag or sweater body or two ends of a horizontally knitted scarf.

Materials

- One size 9, 40″ circular needle on which we will knit back and forth.
- Exactly two 100-gram skeins of Blue Sky Organic Cotton (150 yards each) in your favorite color. We used sage.
- One 12″ × 16″ pillow.

  or
- One size 7 circular needle on which we will knit back and forth.
- Exactly two 50-gram skeins of Valley Goshen (92 yards each) in your favorite color. We used sage.
- One 9″ × 12″ pillow or a pile of fiberfill.

Gauge

- 4.25 stitches per inch by 5 rows per inch (Blue Sky Organic Cotton, abbreviated BSOC)

  or

- 4.5 stitches per inch by 6 rows per inch (Valley Goshen, abbreviated VG).

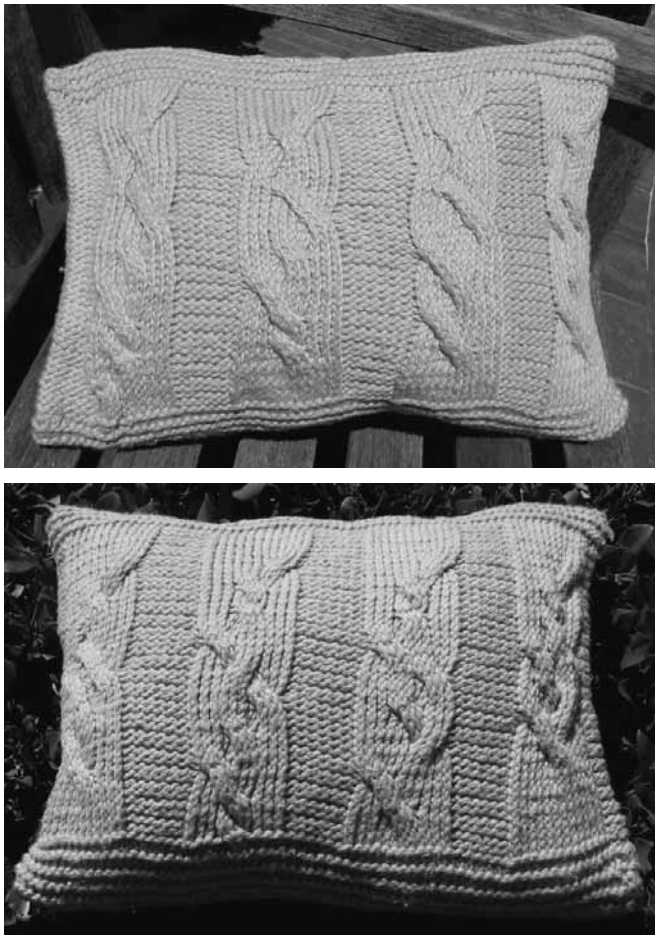


Figure 12. A variant pillow with purl columns, front (top) and back (bottom). This pillow was constructed using hemming instead of lapping.

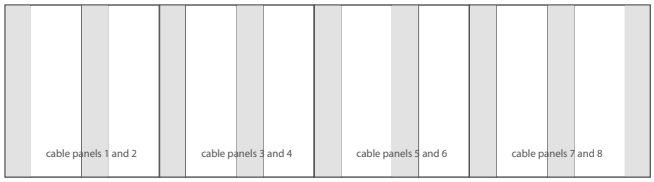


Figure 13. How the cable panels fit together.

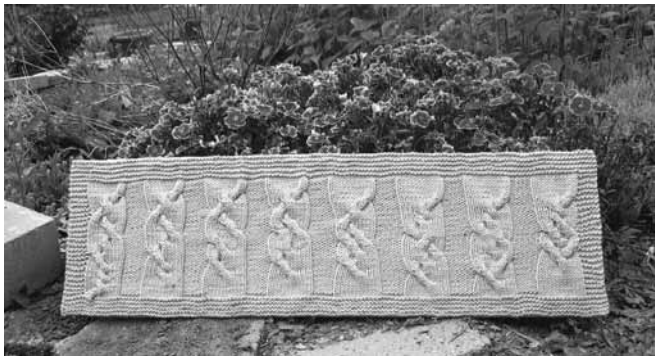


Figure 14. A wall hanging with internal purl columns and external garter columns.

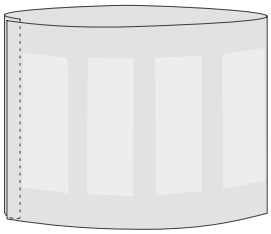


Figure 15. Lapping the work before sewing

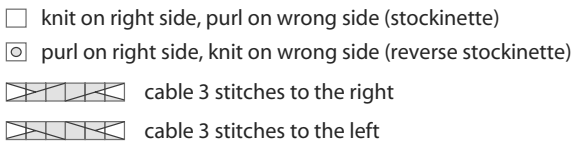


Figure 16. The key to the cable panels

Instructions

Cast on 150 stitches. Work 9 rows in garter stitch (that is, knit 9 rows) if knitting with BSOC, or work 13 rows in garter stitch (that is, knit 13 rows) if knitting with VG. Beginning with row 10 (for BSOC) or row 14 (for VG), follow the cabling charts provided in Figures 17–20. The symbols in the cabling charts are given in Figure 16.

Notice that row 10 (or row 14) is worked on the wrong side, so that the pattern for this row is *P1 K1 P1 K1 P1 K1 P12* P1 K1 P1 K1 P1 K1; this allows the cabling to happen only on right-side (primarily knit) rows. This means that you must read the first row of the chart in the direction opposite what you normally do. The cable charts in Figures 17–20 direct the work for 44 rows (rows 10 through 53 for BSOC; rows 14 through 57 for VG). Figure 13 shows how the four charts fit together.

Two attractive variants on the cable charts are to replace the seed-stitch columns with purl columns or garter columns. (If you substitute purl columns, you may wish to do seed stitch or garter stitch on the first and last three stitches of each row in order to avoid edge curling.) Figure 12 shows a pillow with purl columns, and Figure 14 shows a wall hanging with purl stitches used for the inner columns and garter stitch used for the two outer columns.

Work 8 more rows in garter stitch if using Blue Sky Organic Cotton, or 12 more rows in garter stitch if using Valley Goshen. These are rows 54 through 61 for BSOC or rows 58 through 69 for VG. Bind off.

Now fold the knitted piece as shown in Figure 15. Note that this folding is intentionally asymmetrical; it can be done symmetrically, but the lapped area will be more difficult to sew. Match the short ends together with right sides facing in, then lap the last six seed stitches beneath the first six seed stitches. Using the left-hand edge of the work as a guide, flatten the knitting into a rectangle. (Alternatively, hem the first and last three stitches, align the hemmed edges, and flatten the knitting into a rectangle.) The right-hand fold edge will be between the fourth cable panel and the fifth seed column. Whipstitch or mattress-stitch across the top and across the bottom. Turn right side out. Insert the pillow. Now, take a nap.

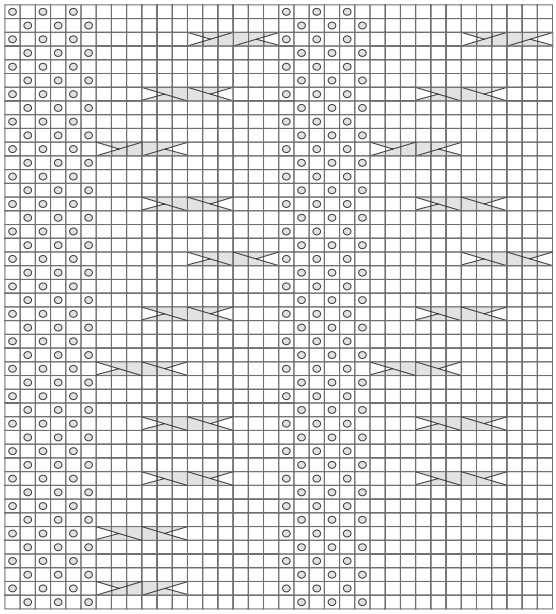


Figure 17. Cable panels 1 and 2

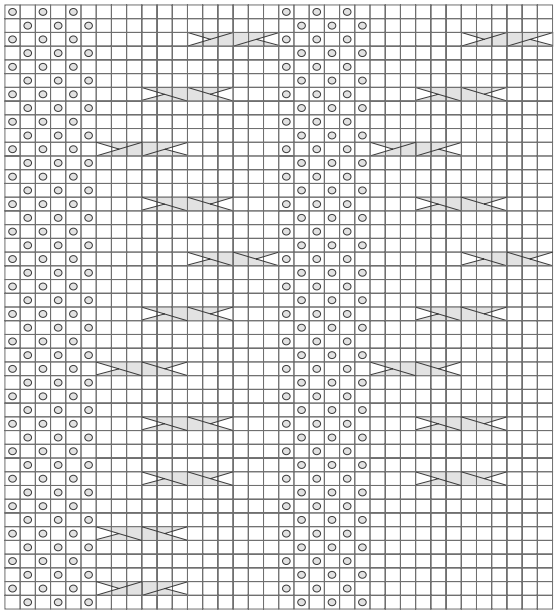


Figure 18. Cable panels 3 and 4

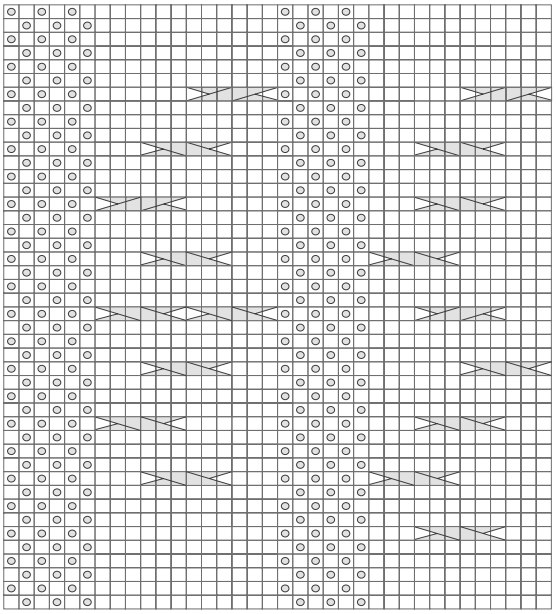


Figure 19. Cable panels 5 and 6

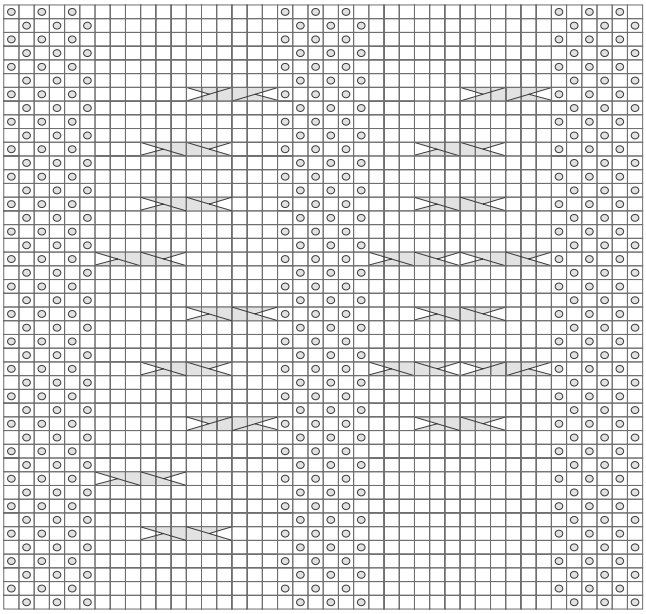


Figure 20. Cable panels 7 and 8

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The focus of this book is on the relationship between mathematics and the fiber arts (including knitting, crocheting, cross-stitch, and quilting). Each chapter starts with an overview of the mathematics and the needlework at a level understandable to both mathematicians and needleworkers, followed by more technical sections discussing the mathematics, how to introduce the mathematics in the classroom through needlework, and how to make the needlework project, including patterns and instructions.

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Yakov Berkovich

■ Groups of Prime Power Order

Volume 1

November 2008. XX, 512 pages. Hardcover.
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Yakov Berkovich/ Zvonimir Janko

■ Groups of Prime Power Order

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Why I am a Platonist

David Mumford

Like the previous authors of this ongoing debate,[1] I have to begin by clarifying what "Platonism" means to me. Here's my phrase:

> The belief that there is a body of *mathematical objects, relations and facts about them* that is independent of and unaffected by human endeavors to discover them.

This is essentially Davies' first flavor of Platonism, but in his article he isn't content with my phrase "there is" a body of objects etc., but feels he must characterize this belief as existence in a realm *outside* or *beyond* spacetime. I think using these prepositions already implies certain philosophical, specifically ontological, assumptions. Hersh is more tolerant, merely adding the qualification that this body of objects, etc. is *objective*, which still puts a special ontological spin on the belief. Mazur seems closest to my simple statement above when he appropriates Huck Finn's words saying that this body of objects etc. *just happened* (instead of being invented by people). "Just happened" implies that, one way or another, they are there, without further characterization of how they exist or especially 'where' they exist.

Probably most mathematicians get a gut feeling that math is "out there" from their personal experiences struggling to understand some mathematical situation, to prove or disprove some theorem. But this is such a slippery subjective argument that I want to take a somewhat different tack. I want to say why studying the History of Mathematics makes mathematics seem to me to be universal and unchanging, invariant across time and space. Historians are disposed to dismiss amateurs like me as being naïve by imposing their modern point of view on ancient writings and not understanding the cultural influences, the proper historical context in which the work was done. I would counter: is a metallurgist imposing modern biases when he/she analyzes the metallic content of an ancient weapon, using the periodic table? It really all depends on whether you accept the Platonic universal view of mathematical truth or not. If you accept this view, using modern mathematics to analyze writings from other times and places is no different from the metallurgist's using modern knowledge of metals. So let me present my reading of several historical writings which seem to me to shout out that all mathematicians are working on one and the same body of truths.

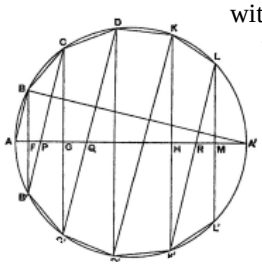
Universality: Exhibit I – Archimedes

I picked up the Dover paperback *The Works of Archimedes* sometime as an undergrad at Harvard. He is said to have wanted his gravestone carved with the figure of a sphere inside a cylinder tangent to it along the equator – certainly he felt one of his crowning achievements was calculating the surface area and the volume of the sphere. You open "On the Sphere and the Cylinder I" and you find this assumption (I have slightly changed Heath's translation[2] to conform with contemporary mathematical usage):

> *Curves in the plane having the same endpoints have different lengths whenever both are concave in the same direction and one is included between the other and the straight line with the same endpoints; and the curve which is included is the shorter.*
>
> *Surfaces with a common planar boundary have different areas whenever both are concave in the same direction and one surface is included between the other and the plane containing their common boundary, and the surface which is included has smaller area.*

I was astonished by these axioms. The reason was that they are so elegant, so exactly right for the arguments which follow, which depend on a whole series of estimates using these assumptions. Today, we would say that the fact that he doesn't *prove* them is a shortcoming! OK, but anyone (for instance the slave boy who finds the diagonal of a unit square to be $\sqrt{2}$ in Plato's *Republic*) with any experience of the world, finds them evident. Finding exactly the right way to pin something down was a thing I had found in my personal experience to be one of the most satisfying and beautiful aspects of math. Clearly, I thought, he worked like the best mathematicians I knew – no allowance for the years was needed.

Then there is a second breathtaking thing in this "paper" of Archimedes. You find the complicated diagram below in his proof of Proposition 22. Here L is any point on the upper hemi-circle and $A,B,C,D,\ldots,K,L$ is an equal subdivision of the arc between A and L. His reasoning with the sphere has led him to a point where he needs to *add* the lengths of all the line segments BB', CC', $DD',\ldots,KK'$, LL'. He notes that all the slivers of triangles like PCG, $GC'Q$, etc are similar, so this sum is a multiple of



$$AF+FP+PG+GQ+\ldots+HR+RM$$

What is he doing? If θ is the angle subtended by the arc AL and the radius of the circle is 1, then this sum equals $1-\cos(\theta)$ and he is evaluating a Riemann sum of

1 E.B.Davies, *Let Platonism Die*, this Newsletter, June 2007; Reuben Hersh, *On Platonism*, and Barry Mazur, *Mathematical Platonism and its Opposites*, this Newsletter, June 2008.

2 *The Works of Archimedes*, edited by T.L.Heath, Dover.

$$\int_0^{\theta} \sin(\phi)\, d\phi\,,$$

the indefinite integral of sine,[3] which, as we know, is equal to 1–cos(θ). He is some 2000 years ahead of the time when this was rediscovered in the West (but actually not very far ahead of the time when Indian Mathematicians discovered it). No historian will convince me that his idea is not the same of mine when looking at this mathematical proposition. For lack of space, I will not go into the highly abstract Book V of Euclid's *Elements*. As I read it, it is pure Dedekind and Bourbaki, an abstract analysis of geometric arithmetic from first principles. Its culmination is the assertion that there is a well-defined operation of addition on the equivalence classes of line segment pairs which define ratios.

As Littlewood said to Hardy, the Greek mathematicians spoke a language modern mathematicians can understand, they were not clever schoolboys but were "fellows of a different college". They were working and thinking the same way as Hardy and Littlewood. There is nothing whatsoever that needs to be adjusted to compensate for their living in a different time and place, in a different culture, with a different language and education from us. We are all understanding the same abstract mathematical set of ideas and seeing the same relationships.

Universality: Exhibit II – Madhava and Gregory

My second set of examples involves how very different cultures, at different times and places, often converge to identical results. The conventional History of Mathematics hypothesizes a single line of development, from Babylonians to Greeks to Arabs to Renaissance Europe to the Enlightenment to today. But from a more multicultural perspective, one finds that both Indian and Chinese mathematics developed largely as distinct streams, with some possible exchanges. This allows one to study of whether or not the 'same' mathematics was discovered independently by very different cultures. In my work on this in the last few years, my overall conclusion is that sometimes the order of discovery changes but there is a strong tendency to converge.

A very striking example is the formula:

$$\pi/4 = 1 - 1/3 + 1/5 - 1/7 + \ldots$$

This is known as Gregory's formula in the West, from its discovery by James Gregory in 1672. But it had also been written down sometime around 1550 in the *Ganita-Yukti-Bhasa*,[4] which is an exposition by Jyesthadeva of the results attained by the school of Madhava in Kerala, India during the previous two centuries. One can compare the histories which led up to each discovery and it is striking what distinct routes the two cultures took. In India, a Leibnizian version of the calculus of trigonometric functions using finite differences goes back as far as Aryabhata c.500 CE. Why did they look at finite differences? Apparently *in order to facilitate memorizing tables of sines*! Whatever its roots and in spite of many political upheavals, there is a more or less continuous development of mathematical ideas in India, from Aryabhata through Jyesthadeva. They were led to sum powers of integers, then to integrate powers and finally to power series expansions of sine, cosine and arctan (which gives the above formula). In contrast, in Europe, there is a total break during the dark ages, then a revival in which Euclid played a dominating role in defining what mathematics ought to be. Interestingly, for both Gregory and the Kerala mathematicians, the question of the irrationality of pi was a major driving force: both believed it to be true (this was explicitly asserted by Nilakantha in India[5]) but neither could find a proof.

In my own research, I have been fascinated by the example of negative numbers. It is a little known fact that negative numbers were not universally accepted in Europe until the creation of abstract algebra in the mid 19th-century. As late as 1843, Augustus de Morgan[6] could say

> *It is not our intention to follow the earlier algebraists through their different uses of negative numbers. These creations of algebra retained their existence, in the face of the obvious deficiency of rational explanation which characterized every attempt at their theory.*

In Britain especially, a controversy raged during the 18th century about the acceptability of negative numbers. In contrast, negative numbers were incorporated into counting boards from something like 200 BCE in China. Red rods (the auspicious color) were used for positives, black (very inauspicious) was used for negatives. Likewise, the rules for the arithmetic of negatives are explicitly stated by Brahmagupta in India c.650 CE.[7] In other words, there was a deep cultural division between the East where negative numbers were accepted from the beginning and the West, where, under Euclid's influence, arithmetic remained the calculus of lengths and areas, both automatically positive quantities. But, as a Platonist, I feel there is only one true science of mathematics and so, indeed, these different cultures eventually passed the same milestones as they dug deeper.

3 The Riemann sum is, of course, not equal to the integral: this is why he has a constant multiplier. He proves rigorously in the end that the multiplier tends to 1 as the subdivision gets finer.

4 *Ganita-Yukti-Bhasa*, translated and edited by K.V.Sarma, K. Ramasubramanian, M.D.Srinivas and M.S.Sriram, Hindustan Book Agency, 2008.

5 The Kerala mathematicians had most of the ingredients which came together in Lambert's 1761 proof of the irrationality if pi. They did not have the idea of continued fractions, although they did know the Euclidean algorithm for gcd's. They also never used and were quite averse to proof by contradiction.

6 Article on *Negative and Imaginary Numbers*, in the *Penny Cyclopedia*, 1843.

7 For the Chinese material, see *The Nine Chapters on the Mathematical Art: Companion and Commentary*, Shen Kangshen, John N. Crossley, and Anthony W. -C. Lun, Oxford University Press, 1999. For the Indian material, see *Mathematics in India, 500 BCE–1800 CE*, Chapter 5, Kim Plofker, Princeton University Press, 2009.

Is mathematics the unique occupant of the Platonic realm?

As mathematicians, we have been trained to seek the most general setting for any theorem. Only when we find this do we feel we have understood the real nature of a result. So if we believe that mathematical truth is universal and independent of culture, shouldn't we ask whether this is uniquely the property of mathematical truth or whether it is true of more general aspects of cognition? In fact, "Platonism" comes from Plato's *Republic*, Book VII and there you find that he proposes "an intellectual world", a "world of knowledge" where all things pertaining to reason and truth and beauty and justice are to be found in their full glory (cf. http://classics.mit.edu/Plato/republic.8.vii.html).

The ethical realm of laws and moral plays a central role in Plato's Republic. Hersh uses the example of the "divine right of kings" to ridicule the idea that ethical principles can have a universal Platonic existence. But cannot we imagine that humanity can discover deeper ethical principles over the centuries, just as our mathematics discovers deeper theorems? Jefferson's phrase "all men are created equal" has a good claim to be a universal ethical principle, not contingent on one specific culture's beliefs, and even applicable to other actual or potential civilizations in our galaxy.

Another hint of universality, I suggest, is that all human languages can be translated into each other with only occasional difficulties. This seems a quite non-trivial fact to me and suggests considerable universality to all the concepts we use in thinking. My cousin wrote a children's book[8] in which the first sentence was "Albert John was a loyal cat". Loyalty is a highly abstract notion, yet no parent reading this to a child would consider the concept of loyalty to be a major challenge to the child's understanding. All children at a rather early age seem to access this concept. Doesn't this suggest that the concept of loyalty has a universal existence, applicable to any society of intelligent beings?

Concepts in general are slippery things: they come with illustrative examples, with typical properties (but usually with exceptions, e.g. most but not all birds fly), with links to more general, less general and sibling concepts. In order to put some order into the world of concepts, people have made *graphs* out of concepts for a long time. Roget wrote his thesaurus in 1852: taking each word as a vertex, his thesaurus puts edges between any two closely related concepts. A major structure in early AI was the *semantic net* which introduced a variety of directed edges such as *is-a* links, as in "a robin is-a bird". Statisticians studying AI introduced *causal Bayesian networks* where edges modeled causal effects. Case grammar equips concepts with multiple slots, such as the temporal and spatial location of an act and filling these makes a grammatical *parse graph*. Grenander has proposed a general framework for such graphical models.[9] There is no definitive formalism for all these graphical structures but it seems clear that such graphs are part of the life and what gives structure to the objects of the world of knowledge.

The idea that such a spider web is the key to understanding the Platonic world is very familiar in mathematics. Everyone has heard of the bizarre circumlocutions used in books on the Foundations of Mathematics to define natural numbers, e.g. 5. Frege's approach was to make 5 equal to the set of all sets with 5 elements in them. This loose use of sets led to those nasty paradoxes. Von Neumann's idea was to make 5 the specific set with 5 elements {0,1,2,3,4}. Doing this recursively, starting from 0={} (the empty set), one finds the rather bizarre definition:

$$5 = \{\{\}, \{\{\}\}, \{\{\}, \{\{\}\}\}, \{\{\}, \{\{\}\}\}, \{\{\}, \{\{\}\}\}\},$$
$$\{\{\}, \{\{\}\}, \{\{\}, \{\{\}\}\}, \{\{\}, \{\{\}\}\}, \{\{\}, \{\{\}\}\}\}$$

This seems pretty *ad hoc*! Children certainly prefer their fingers as a model set. I think it is much better to follow the standard idea of defining natural numbers by axioms for the successor relation and proving that all models of these axioms are isomorphic. More generally, it is widely accepted that *categories* are the natural setting for all mathematical objects: a specific mathematical object ought to be defined as an object of some type in a category, *unique up to unique isomorphisms*. In other words, mathematical objects don't exist as specific things, but are pure structure. They can only be defined in their own terms. I would argue that categories are simply a mathematical example of the class of cognitive graphs which connect Platonic concepts in general.

Brian Davies argues that we should study fMRI's of our brains when think about 5, about Gregory's formula or about Archimedes' proof and that these scans will provide a scientific test of Platonism. But the startling thing about the cortex of the human brain is how uniform its structure is and how it does not seem to have changed in any fundamental way within the whole class of mammals.[10] This suggests that mental skills are all developments of much simpler skills possessed, e.g. by mice. What is this basic skill? I would suggest that it is the ability to convert the analog world of continuous valued signals into a discrete representation using concepts and to allow these activated concepts to interact via their graphical links. The ability of humans to think about math is one result of the huge expansion of memory in *homo sapiens*, which allows huge graphs of concepts and their relations to be stored and activated and understood at one and the same time in our brains.

The discrete representation does have a cortical instantiation, a reduction to physical effects which are continuous at a micro level but honed to produce a sharp flip-flop digital behavior (e.g. in the production of a neural spike) on a larger scale. But this does not mean that this discrete concept-based parse of the world is not as true and fundamental a reality as that of the physical neurons. The

8 Ruth Silcock, *Albert John Out Hunting*, Viking Kestrel Books, 1980.

9 Ulf Grenander, *General pattern Theory*, Oxford University Press, 1993.

10 I have martialled the evidence for this in several articles: On the Computational Architecture of the Neocortex, *Biological Cybernetics*, 1991 and Neuronal Architectures for Pattern-theoretic Problems, in *Large Scale Neuronal Theories of the Brain*, C. Koch editor, MIT Press, 1994.

firing of a neuron and the occurrence of a concept-based situation are totally different sorts of existence. How do I personally make peace with what Hersh calls "*the fatal flaw*" of dualism? I like to describe this as there being two orthogonal sides of reality. One is blood flow, neural spike trains, etc.; the other is the word 'loyal', the number 5, etc. But I think the latter is just as real, is not just an epiphenomenon and that mathematics provides its anchor.

David Mumford [David_Mumford@brown.edu] was a student of Oscar Zariski and taught at Harvard for 35 years. His early work was in Algebraic Geometry. He later switched to Applied Math, studying the mathematics of vision, and moved to the Division of Applied Math at Brown.

Why I Am A (Moderate) Social Constructivist

Philip J. Davis

> "*Verum esse ipse factum" (Truth itself is constructed.)*
> *Giambattista Vico (1688–1744).*
>
> "*Just as houses are made of stones, so is science made of facts; but a pile of stones is not a house and a collection of facts is not necessarily science."*
> *Henri Poincaré.*

Having cited Vico, I might put down my pen: what more is there to say?

But the corpus of mathematics is so extensive, so diverse, so expansive both by the emergence of genuinely new concepts and by amalgamation, so variously interpreted from generation to generation, that one must say more. Yet, how can a sentence, a paragraph, even a whole book, provide a definitive and cogent or final philosophical characterization of this vast corpus? One sentence particularly from Vico whose philosophic mind whose scope was itself so extensive and diverse. It cannot and yet we try.

I will exhibit how a certain mathematical idea, that of negative numbers, an idea currently well accommodated into the mathematical corpus, was put together painfully, stone by stone, over the millennia. For this history, I am completely indebted to a splendid book by Gert Schubring: *Conflicts Between Generalization, Rigor, and Intuition: Number Concepts Underlying the Development of Analysis in 17-19th Century France and Germany*.

Schubring is Department Head at the Institut für Didaktik der Mathematik at Bielefeld University, Germany, and has given us, in a work of many years, a detailed presentation of the development, beginning in antiquity, of the number field. He has dug out opinions and comments from an the writings of an enormously large number of mathematicians and mathematical educators, many of whom do not find places in standard histories of the subject.

The negative numbers form only a short chapter of this long and complicated story, but the persistent questioning about them forms the leitmotiv in the book in delineating the larger picture. I will limit myself here to a few words about the negative numbers, admitting that this limitation seriously misrepresents the scope of the book.

Here is a sampling of old opinions about the negative numbers.

In Babylonian days (2nd millennium BCE and later), the current judgment of experts seems to be that while subtraction was certainly around, minus quantities as isolated entities were not.

The Chinese (c. 250 BCE) computed with rods; red for positive, black for negative. Negatives were allowed for intermediate computations , but not for final answers.

Hindu mathematics in the 7th Century had ambiguous feelings towards the negative.

In the 15th and 16th Centuries, most European mathematicians did not accept negative numbers; they were considered absurd.

The great Cardano (1501–1576) gave a refutation of the rule of signs arguing from the area of a square split into two sub-squares and two rectangles.

René Descartes (1596–1650) turned the "false" roots of equations into real roots by monkeying with the equations. I suspect negative roots gave him heartburn even as he was working out his famous "rule of signs."

Consider the views of Antoine Arnaud (1612–1694) a French mathematician and theologian who got into a controversy with Jean Prestet (1648–1691.) Arnaud gave four reasons as to why he had conceptual reservations about the existence of isolated negative quantities.

1) It was impossible to subtract 7 toises (i.e., weights) from 5 toises.
2) How could the square of –5 be the same as the square of +5?
3) How could the comparison –1:1 :: 1:–1 possibly be true? How could a smaller quantity be to a greater as a greater is to a smaller? On an intelligence test today, would you answer that a cat is to a lion as an ostrich is to a sparrow?

4) One could say that a man had –10000 ecus only if he had the power to find to obtain 10000 ecus to satisfy his creditors.

Replying to Arnaud, more epistemologically, Jean Prestet raised the question whether abstract concepts were allowable. What is existence? The positive numbers existed but not the negatives.

Come now to John Wallis (1616–1703), who invented the symbol for infinity that we now all use: ∞. In his 1655 *Arithmetica infinitorum* Wallis made an interesting continuity argument. With A and B both positive , consider A/B. With A fixed and B –> 0, the ratio gets larger and larger as B gets smaller. When B is 0, A/0 is ∞. When B goes negative it is smaller than 0 and hence the ratio becomes a super infinity. Who , then, needs Georg Cantor to produce super-infinities? But how would you then graph y = 1/x through the point x = 0 ? And what would become of the Dirac function $\delta(x)$ and its derivatives ?

Alexis C. Clairaut (1713–1765) worried that readers of his fine textbooks, in contemplating such expressions as (–400)/(–10) would get involved in metaphysical problems. Reinterpreting the negative as positive, "Clairaut explained that he was liberating the operations with negative quantities from everything that was `shocking'."

The eminent Jean le Ronde d'Alembert (1717–1783) wrote *Eclaircissiment sur les élements d'algebra* (c. 1765) in an effort to clear up matters.

> *"Some regard these quantities as* below nothing *, an absurd notion in itself: others as expressing debts, a very restricted notion and for that reason alone hardly exact: others, still, as quantities that must be taken in an opposite sense to quantities which are supposed to be positive; an idea for which geometry provides examples, but which is subject to frequent exceptions."*

In his 1758 treatise *Dissertation on the Use of the Negative Sign in Algebra*, Francis Maseres (1731–1824), Fellow of Clare College, Cambridge, did not admit isolated negative quantities. As a matter of principle, he denied that that a number had two square roots.

William Frend's (1757–1841) algebra textbook *Principles of Algebra* (1796), rejected negative numbers, and multiple roots. Augustus de Morgan, Frend's son-in-law, in his 1831 *On the Study and Difficulties of Mathematics* waffled around on this issue.

António José Teixeira (1830–1900) in 1890, did not like the proportion 1: -1::–1:1 and asserted that "the negative quantities do not possess any arithmetical existence."

And so it went. What we observe here is the community of mathematicians maintaining doubts, overcoming doubts, hacking out and constructing ,over time, by a painful process both operationally and philosophically, achieving acceptance and arriving at what is now considered the mainstream view. The number field is now extended to what is called the real number system, R, accepted by all mathematicians who are not "constructivists" or "finitists." Here is social constructism at work.

One may claim that one observes here a striving, admittedly incomplete, towards a platonic concept of number that transcends the historic individual accomplishment. But then one can point to the seemingly endless construction of number systems that goes on and on: complex numbers, quaternions, infinities of all sorts, infinitesimals, p-adic numbers, pseudo-numbers, "inaccessible" numbers, etc., accompanied by acceptances, or rejections,[1] all serving purposes whether in the sciences or within mathematics itself, or possibly created only for the sheer joy of setting out systems of symbols and pushing them around. What , then, is the ultimate platonic concept that transcends the historic immersion?

Considering this story, I conclude that the elements of number systems which are a small but vital part of the mathematical corpus, cannot be found in the clouds or in a Platonic heaven, but reside in the shared beliefs and actions of an extended community of mathematicians and the utilizers of their symbolisms and – some of them – in the guts of physical equipment that mimic their symbolic behavior.

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Philip J. Davis [Philip_Davis@brown.edu] received both of his undergraduate and doctoral degrees from Harvard in the field of pure mathematics. He was Chief, Numerical Analysis, National Bureau of Standards, Washington, D.C., for five years. He joined the faculty of Applied Mathematics at Brown University, Providence, Rhode Island, in 1963 and is now Professor Emeritus. His extensive work in numerical analysis and approximation theory includes many research papers and several books. Two books, The Mathematical Experience *and* Descartes' Dream, *written jointly with Reuben Hersh of the University of New Mexico, explore certain questions in the philosophy of mathematics, and the role of mathematics in society.* The Mathematical Experience *won an American Book Award for 1983.*

1 "I know that the great Hilbert said 'We will not be driven out of the paradise Cantor has created for us,' and I reply 'I see no reason for walking in!'" – Richard Hamming

Sergei L. Sobolev

Gennadii V. Demidenko (Russia)

Sergei L'vovich Sobolev was born in Saint Petersburg on 6 October 1908. His father Lev Aleksandrovich Sobolev, a lawyer, participated in revolutionary activities. His mother Natalia Georgievna Soboleva was also a revolutionary in her youth. She taught literature and history in a private school. Later she graduated from a medical institute and became an associate professor at the First Leningrad Medical Institute. S.L. Sobolev sadly lost his father at an early age but his mother brought him up to be a man of principle, honesty and firmness of purpose.

In 1925 Sergei L'vovich Sobolev enrolled as a student at the Physics and Mathematics Department of Leningrad State University, also continuing his studies in the piano class of the arts school.

Leningrad State University was an outstanding mathematical centre that maintained the remarkable traditions of the Petersburg mathematical school, famous for the scientific discoveries of P.L. Chebyshev, A.N. Korkin, A.M. Lyapunov, A.A. Markov and V.A. Steklov among others. At the university Sobolev attended lectures by Professors N.M. Gyunter, V.I. Smirnov and G.M. Fikhtengolts, who considerably influenced his rise as a scientist. N.M. Gyunter supervised Sobolev's diploma paper on analytic solutions to a system of differential equations with two independent variables, which was published in the Doklady (Proceedings) of the USSR Academy of Sciences.

After graduation from university in 1929 Sobolev was accepted at the Seismological Institute of the USSR Academy of Sciences at the Theoretical Department, headed by V.I. Smirnov. The young scientist actively joined the scientific activity of the department. He wrote four papers on elasticity theory and wave propagation in elastic media in 1930. Unfortunately, these articles were published in the Proceedings of the Seismological Institute and were inaccessible for a wide range of mathematicians. However, one of the papers "The Wave Equation in an Inhomogeneous Medium" was presented at the First All-Union Mathematical Congress in Kharkov and became well-known. In this paper Sobolev proposed a new method of solving the Cauchy problem for the wave equation with variable coefficients. The famous French mathematician J. Hadamard, who attended the congress, said to Sobolev: "My young colleague, I would be very happy if you could keep me updated on your subsequent work which I find greatly interesting".

During his work at the Seismological Institute Sobolev carried out a number of profound scientific investigations. The famous Lamb problem of finding the displacement of an elastic half-plane subject influenced by a concentrated impulse was solved by him. In collaboration with V.I. Smirnov he developed the method of functionally invariant solutions that was later on applied to solve a series of dynamical problems of elasticity theory. This method provided a foundation for the theory of elastic wave propagation. In particular, the problem of elastic wave diffraction near a spherical surface was solved, the problem of oscillations of a half-plane and an elastic layer with arbitrary initial data was investigated and a rigorous theory of Raleigh surface waves was constructed.

Sobolev's results concerning the dynamical problems of elasticity theory are used in the modern mathematical methods of mineral prospecting, in the inverse problems of seismology and in studying cracks in elastic media.

The applied problems related to wave propagation in elastic media required new approaches to solving partial differential equations. During this period Sobolev began to study the propagation of strong discontinuities in the problems of elasticity and the Cauchy problem for second order hyperbolic equations with variable coefficients.

In 1932 Sobolev started working in the Department of Differential Equations of the Steklov Mathematical Institute and a year later, for his outstanding achievements in mathematics, he was elected as a corresponding member of the USSR Academy of Sciences.

The "Moscow period" of Sobolev's career began in 1934. Together with the Steklov Mathematical Institute he moved to Moscow and was appointed the head of a department. During this period Sobolev obtained some fundamental results in the theory of partial differential equations and functional analysis that are considered to be parts of the gold reserve of the world of mathematics. The ideas and methods described in his articles were subsequently developed by many mathematicians from Russia and abroad.

Dealing with the Cauchy problem for hyperbolic equations and discontinuous solutions to elasticity theory equations led Sobolev to the concept of a generalized solution to a differential equation, which plays a fundamental role in the modern theory of partial differential equations. In 1934 at the Second All-Union Mathematical Congress in

Leningrad Sobolev presented three reports: "The Problem of Diffraction on Riemann Surfaces", "A New Method of Solving the Cauchy Problem for Hyperbolic Partial Differential Equations" and "Generalized Solutions to the Wave Equation". It was the birth of the theory of generalized functions. In 1935–1936 Sobolev gave a detailed exposition of the results presented in those reports in two famous articles "General Theory of Diffraction of Waves on Riemann Surfaces" and "A New Method of Solving the Cauchy Problem for Linear Normal Hyperbolic Equations". In these articles the fundamentals of the theory of generalized functions were explained and the concept of a generalized solution was given and investigated in detail for the first time. Using the apparatus of the theory of generalized functions, Sobolev proposed a new method of solving the Cauchy problem for hyperbolic equations with variable coefficients. It is worth mentioning that for Sobolev his generalized functions were primarily an apparatus crucial for applications.

The emergence of the theory of generalized functions had been based on the development of real analysis and theoretical physics. The well-known ideas of Heaviside, Dirac, Kirchhoff and Hadamard aided in the emergence of this theory. However, the works of predecessors contained neither concepts nor constructions similar to the rigorous constructions of Sobolev.

During the subsequent years Sobolev advanced the theory of generalized functions in a new direction. Based on the concept of a generalized derivative he introduced and studied new functional spaces that became known in the literature as Sobolev spaces. For these spaces Sobolev proved the first embedding theorems. He used the spaces to investigate boundary value problems for polyharmonic equations (1937) and the Cauchy problem for second order quasilinear hyperbolic equations.

In 1939, for his outstanding mathematical discoveries, Sobolev was elected into the USSR Academy of Sciences, remaining for a long time the youngest member of the Academy. His wife Ariadna Dmitrievna Soboleva recalled that Sobolev had often said that he had been in debt to the USSR Academy of Sciences and that he would try to live up to his status of an academician. Many years later while talking to journalists, Sobolev said: "As for my works, at the time of my election no one could foresee what would grow out of them, and so my election into the Academy was a credit given to me."

In 1941, at the very beginning of the Great Patriotic War, the responsibilities of Director of the Steklov Mathematical Institute were entrusted to Academician S.L. Sobolev. In the difficult conditions of evacuation to Kazan Sobolev contributed much to the organisation of applied research in the institute and to the effective help of the Soviet Army.

When the Steklov Mathematical Institute returned to Moscow in 1943, Sobolev was transferred to Laboratory No 2 (LIPAN, the Russian abbreviation for the Laboratory of Measuring Instruments of the USSR Academy of Sciences) headed by Academician I.V. Kurchatov. Later on this laboratory was transformed into the Kurchatov Institute of Atomic Energy. Sobolev was appointed the

S.L. Sobolev at the building site of what now is the Sobolev Institute of Mathematics

First Deputy Director and the Head of the Scientific Council of the institute. After that the name Sobolev disappeared from the press for a long time.

The laboratory worked intensely to build a nuclear shield for the USSR. This was a period of hard creative work for the members of the institute staff to create new equipment. Sobolev collaborated with physicists I.V. Kurchatov, I.K. Kikoin, M. A. Leontovich and others. He faced applied mathematical problems that required tremendous effort because it was necessary to calculate, optimize and predict extremely complicated processes never studied before. The extraordinary mathematical intuition and great work were needed in order to solve the intricate and precise problems thoroughly and timely. His wife Ariadna Dmitrievna recalled: "During his work at the Institute of Atomic Energy he might be absent from home for months and frequently left for long and distant trips".

In 1950 Sobolev published his famous book "Some Applications of Functional Analysis in Mathematical Physics". The systematic exposition of the theory of function spaces W_p^l, embedding theorems for these spaces, trace theorems and the application of these results to problems in partial differential equations and equations of mathematical physics are set forth in the book. The book became a standard reference not only for mathematicians but also for those working in many other areas of science and was translated into many languages. The concepts of a generalized derivative and a generalized solution became universal. The theory of Sobolev spaces appeared as a new section of study in mathematics. Sobolev's ideas and methods have been intensively developed and were extensively applied in differential equations, equations of mathematical physics and computational mathematics. His embedding and trace theorems have turned into one of the most important tools of modern mathematical analysis.

In 1954 Sobolev's outstanding article "On a New Problem of Mathematical Physics" initiated the systematic investigations of the new classes of equations and systems not solvable with respect to the highest order derivative. Such equations are now called "Sobolev type equations" in the literature. This subject matter arose in connection with the study of rotating fluids (1943). For this work Sobolev was awarded a State Prize in 1986.

Moreover, during the 1950s Sobolev paid great attention to the problems of computational mathematics. Later on Sobolev recalled: "Working in the Institute of Atomic Energy, I got interested in computational mathematics and realized its exceptional potential. Thus, I accepted with great pleasure an offer made by I.G. Petrovskii to head the Chair of Computational Mathematics at Moscow State University, the first chair in this area in our country."

In 1956 Academicians M.A. Lavrentiev, S.L. Sobolev, and S. A. Khristianovich came forward with a proposal to work out a plan for creating scientific centres in the eastern regions of the USSR. In 1957 the Government decided to organise the Siberian Branch of the USSR Academy of Sciences, which would consist of several research institutes, including the Institute of Mathematics. Academician S.L. Sobolev was appointed the Director of the Institute. In 1958 the "Siberian period" of Sobolev's career began. He spent a year in Moscow to staff several departments of the future Institute of Mathematics and then he moved with his colleagues to Novosibirsk for permanent residence. "Many people, even friends, could not understand what exactly had driven me", Sobolev said, "to leave the strong chair at Moscow State University and go to Siberia which in reality was in a scientifically virgin land." His own answer to this question was, as always, remarkably modest. "It was the natural desire of a man to live several lives, to start something new."

Heading the Institute of Mathematics, Sobolev aspired to represent in the institute all principal directions of contemporary mathematics. The Department of Algebra and Logic in the institute developed successfully under the guidance of Academician A.I. Mal'tsev; Academician A.D. Alexandrov led geometric research; Academician L.V. Kantorovich headed the Department of Mathematical Economics; Academician G.I. Marchuk led the Department of Computational Mathematics; and A.A. Lyapunov, Corresponding Member of the USSR Academy of Sciences, headed the Department of Theoretical Cybernetics. Sobolev himself led research into differential equations and functional analysis. In a very short time the Institute of Mathematics became a world renowned mathematical centre.

During his "Siberian period" Sobolev began research into a new area: cubature formulas. He said: "After the transfer from Moscow to Novosibirsk I got preoccupied with cubature formulas. It happened so that they made me come back to the classical works of Euler. I had to investigate some properties of Euler polynomials that had not been known to the great mathematician. It was like returning back to the origin."

The approximate integration of a function is among the main problems of computation theory. The case of multidimensional integrals is extremely laborious in its computational aspects. As a result of studying new problems of functional analysis, partial differential equations and function theory, with a view towards solving the problems of computational mathematics, Sobolev expounded and created the theory of cubature formulas. In Novosibirsk he wrote the fundamental monograph "Introduction to the Theory of Cubature Formulas", which was published in 1974. The book summarised the author's research into cubature formulas in the lapse of many years.

In 1983 the "Siberian period" of Sobolev's career was over, and in 1984 he returned to Moscow to continue his work at the Steklov Mathematical Institute at the department headed by Academician S.M. Nikolskii.

The brilliant scientific career and public activity of Sobolev, which gave him a great reputation in the USSR, received proper international recognition. He was a foreign member of the French Academy of Sciences, the Accademia Nazionale dei Lincei in Rome, a foreign member of the Academy of Sciences in Berlin, an honorary member of the Edinburgh Royal Society, the Moscow Mathematical Society and the American Mathematical Society. He received honorary degrees from various universities all over the world. The contributions of Sobolev had earned him many state awards. In 1988 Sobolev was awarded the highest prize of the USSR Academy of Sciences, the Lomonosov Gold Medal, for his outstanding achievements in mathematics.

Sergei L'vovich Sobolev passed away in Moscow on 3 January 1989. He is buried at Novodevichy Cemetery.

Toward the centenary of Seregei L'vovich Sobolev two volumes of his selected works were published at the Sobolev Institute of Mathematics. The volumes contain his fundamental papers on partial differential equations, equations of mathematical physics, functional analysis, function theory, computational mathematics and the theory of cubature formulas.

Gennadii V. Demidenko [demidenk@math.nsc.ru] received his PhD in Mathematics at the Institute of Mathematics (Novosibirsk, Russia) and his DSc in Mathematics at the Steklov Mathematical Institute (Moscow, Russia). He is Head of the Laboratory of Differential and Difference Equations at the Sobolev Institute of Mathematics (Novosibirsk, Russia) and he is a professor at the Department of Mechanics and Mathematics, Novosibirsk State University. His research interests include partial differential equations, ordinary differential equations, difference and delay equations, and function spaces. He is author of a great many research studies published in national and international journals and conference proceedings. He has also written three monographs.

Sergei L. Sobolev conference

The international conference "Differential equations. Function spaces. Approximation theory" dedicated to the 100th birthday of Sergei L'vovich Sobolev was held in Novosibirsk, Russia. The Sobolev Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences and Novosibirsk State University were the organisers of the conference.

The opening ceremony was held on 6 October (the birthday of S.L. Sobolev) in the large hall of the House of Scientists. S.L. Sobolev's daughters E.S. Soboleva and T.S. Soboleva, his colleagues, pupils and collaborators spoke about him: his personality, his scientific activity and the influence of his fundamental works on contemporary mathematics. The Chairman of the Siberian Branch of the Russian Academy of Sciences A.L. Aseev and the Head of the Soviet district of Novosibirsk A.A. Gordienko declared the decision to call one of Novosibirsk streets Sobolev's name.

During the opening ceremony, the Director of the Sobolev Institute of Mathematics Yu. L. Ershov stated that the institute had established Gold and Silver Medals for Outstanding Achievements in Mathematics and listed the names of the first awardees. Two eminent mathematicians S.M. Nikolskii and I.M. Gelfand were awarded Gold Medals. A Silver Medal was awarded to G.I. Marchuk.

The conference went on for six days. Sessions were held in the large hall of the House of Scientists, the conference hall and rooms of the Sobolev Institute of Mathematics and the Sobolev room in Novosibirsk State University. The conference was one of the largest mathematical meetings that has been organised in Novosibirsk. There were more than 400 representatives from 25 countries: Azerbaijan, Belarus, Czech Republic, Finland, France, Germany, Hungary, Iran, Israel, Italy, Japan, Kazakhstan, Kyrgyzstan, Mexico, Poland, Portugal, Russia, Spain, Sweden, Switzerland, Turkey, UK, Ukraine, USA, and Uzbekistan. Such interest in the conference was inspired by the great contributions of S.L. Sobolev to the world of science.

The program of the conference consisted of plenary lectures, invited lectures, short communications and poster presentations. Plenary and invited lectures on recent advances in mathematics were given by well-known mathematicians including S. Antontsev, O.V.Besov, B. Bojarski, V.I. Burenkov, M. Chipot, S.K. Godunov, E. Feireisl, A.V. Fursikov, L. Hatvani, A.M. Il'in, G. Iooss, V.A. Kondratiev, D. Kroener, A. Kufner, A.G. Kulikovskii, A. Laptev, M.M. Lavrentiev, V.I. Lebedev, R. McOwen, V.P. Mikhailov, B.A. Plamenevsky, Yu.G. Reshetnyak, V.G. Romanov, M. Solomyak, V.A. Solonnikov, V.D. Stepanov, Yu.N. Subbotin, A. Tani, A.A. Tolstonogov, H. Triebel and N.N. Uraltseva. More than 300 short communications and 100 poster presentations were given by participants. The wide range of topics included ordinary differential equations, partial differential equations, equations of mathematical physics, operator theory, spectral theory, function spaces, embedding theorems, numerical methods, approximation theory, cubature formulas and mathematical modelling.

An evening of remembrances about Sergei L'vovich Sobolev took place in the conference hall of the Sobolev Institute of Mathematics on 10 October. There were speeches by the first employees of the institute L.V. Voytishek, M.M. Lavrentiev and Yu.G. Reshetnyak, colleagues and pupils of S.L. Sobolev, participants of the conference, guests, S.L. Sobolev's daughter E.S. Soboleva and his granddaughter L.L. Sabinina.

The conference finished on the evening of 11 October.

The conference was supported by the Russian Foundation for Basic Research, the Siberian Branch of the Russian Academy of Sciences, the Administration of Novosibirsk Region, the International Mathematical Union, the Abdus Salam International Centre for Theoretical Physics, the Department of Mechanics and Mathematics of Novosibirsk State University and the Intel Corporation.

Further information on the conference can be found at the conference website http://www.math.nsc.ru/conference/sobolev100/english.

An interview with Hans Triebel

António Caetano (University of Aveiro) and Dorothee Haroske (University of Jena)

July 26, 2008

Hans Triebel (born February 7, 1936 in Dessau) has retired from FriedrichSchiller-University Jena (Germany) in 2001, where he was Professor (Chair) in Analysis for more than 30 years, after earning there his Ph.D. (1962) and Habilitation (1966). He also served as Dean of its Faculty of Mathematics and Computer Science for the period 1990-93 and as Speaker of the Graduate College "Analytic and Stochastic Structures and Systems" between 1993 and 2002.

Professor Triebel has written more than 170 papers in the areas of Function spaces, Functional Analysis, Interpolation Theory, Partial Differential Equations and Fractal Analysis and has 13 titles in the list of written textbooks and monographs (one further addition to this collection being in preparation at this moment). Perhaps he is best known by the series of books he has written on the Theory of Function Spaces and its relations with other parts of Mathematical Analysis. He also served as editor of 7 volumes of Proceedings, belongs to the editorial boards of 7 international journals in mathematics and, as yet, supervised 36 Ph.D. theses.

He was a corresponding member of the Academy of Sciences of the former GDR between 1978 and 1987 and a full member of the same Academy between 1987 and 1992. Since 1993 he is a regular (full) Member of the Academy of Sciences of Berlin-Brandenburg. He was awarded, in 1983, the National Prize (of third order) of the former GDR for Science and Technology and, in 1990, a D.Sc.h.c. by the University of Sussex at Brighton (UK).

Hans Triebel (photo by Alexandre Almeida, used with permission).

Hans, you are immediately recognized in the mathematical analysis community by your expertise within the theory of function spaces, your books on the subject serving as unavoidable reference. Can you tell us a little about how this interest started?

Thank you for the compliments, António, you are very kind. Indeed, you may be surprised that this interest developed somehow by chance. My Ph.D. project, supervised by Professor Maier in Jena, was concerned with Lamé's differential equation, that is, complex function theory. Later an elder colleague recommended me Sobolev's book from 1950, which I studied with great interest since I was always fascinated both by mathematics and physics. In the past it was also quite usual in an academic career in the former GDR (East Germany) to go for one year abroad, but the difference was that there was not a big choice. Certainly one could apply for one or the other university in the East, mainly within the Soviet Union, but the decision was made somewhere else by the authorities. In my case it finally turned out to be a rather lucky circumstance to send me to Leningrad (now St. Petersburg) though this has not been my first choice. So before leaving to Leningrad I polished up my Russian learned at school – but even then it was not so easy at the beginning. Later my pronunciation improved such that people did not immediately recognise me as a foreigner, but at the beginning… you may recall that in 1963/64 when I came to Leningrad, less than 20 years had passed since the end of World War II. In other words, there still lived many people who had suffered from the Germans, especially in this town. So I was a bit afraid when I arrived, but my experience was that I was met with a kind reception. What concerns Leningrad university, I had no direct personal contact there, I mainly worked on my own and read a lot of books. But I enjoyed the very active and inspiring atmosphere due to many great mathematicians working there. In particular, I had the great pleasure to attend lectures by Birman on functional analysis, spectral theory, quantum mechanics – he really was an impressive lecturer. His main concern was at that time applications to the spectral theory of partial differential equations, using methods from functional analysis. So to study function spaces was a natural task in this direction. Other people working there included, of course, Solomyak, but also Uraltseva and Ladyzhenskaya whose seminar I attended. Later, back in Jena, I read Nikol'skiĭ's book from 1969… but at that time I had already started working on function spaces myself.

Occasionally, when talking about function spaces with other people, I have heard them wondering about the reason the letter F is used for the so-called Triebel-Lizorkin (or Lizorkin-Triebel) spaces ...

Honestly, there is no mystery at all about this letter (in contrast to other spaces and their letters which caused longstanding stories and discussions afterwards). As I occasionally explained, it was the first 'suitable', i.e., free letter when I needed one for the new spaces and invented this symbol around 1970. I even had some concern that it may cause confusion with Fŕechet spaces, but it turned out later that this was not the case. As far as I remember, the symbol made its first official appearance in two of my papers in 1973 (it always took very long to get all the necessary permissions to publish some paper abroad).

Before choosing function spaces, you had to choose mathematics as a subject to study. Was it already your childhood dream to become a (famous) mathematician ?
Not at all! I really liked all the science subjects in school, mainly mathematics, physics and chemistry. So when it came to choose a subject to study I hesitated what to take. But then someone suggested that I should try physical chemistry since this was expected to have a bright future soon — and shared the advantage to combine at least two of my favourite subjects. As recommended, I applied for physical chemistry in Jena. As a second choice only I had named mathematics. Unfortunately my application was not approved probably because of a rather bad evaluation of my insufficiently developed socialistic personality. Nevertheless the university in Jena invited me to follow some other career: they offered me a place to study mathematics and physics to become a teacher. Though I really never wanted to teach at schools, I accepted this offer since I was told that at the beginning many lectures are the same for diploma students and teacher students in mathematics and physics and changing after a while would be much easier. This was in fact the case and I followed both, mathematics and physics, almost up to the end in a parallel way. Apart from very few tasks at the end I could have also completed physics with a diploma like mathematics, but for some reason I only did it in mathematics.

I was looking in the Mathematics Genealogy Project and found out that you are a mathematical descendant of Gauss and Weierstrass. What does it mean to you?
Nothing particular, I would say. I was amused when I discovered it first time – and I enjoy to point it out to my Ph.D. students and their Ph.D. students that they now enter the famous descendant line of Gauss and Weierstrass in n + 1st, n + 2nd generation with my humble person in between.

You obtained your Ph.D. from the University of Jena in 1962 and I have always known of your name in connection with this same university. Apart from the one year abroad which you have already mentioned, have you been there all this time, and if yes, for what reason?
An academic career in GDR times was in some sense very much different from what you would expect nowadays – and what all my younger Ph.D. students experience now. Almost everything was more restricted, not only publication in 'Western' journals as already mentioned,

With S.M. Nikolskii in May 2005 (Moscow), at the Conference celebrating his 100th birthday (photo by Alexandre Almeida, used with permission).

and – of course – going abroad for research stays or only to take part in conferences was very difficult. But also life was more steady and more regulated at that time, so for many reasons it was not easy and also not usual to move too often. Apart from the year in Leningrad I worked a year outside of the university in a company after I had received my diploma. Otherwise I followed the academic career in Jena. Only at the beginning of the 1970s I really thought of leaving Jena for many different reasons, including professional ones. Finally I decided otherwise and stayed there until my retirement some years ago. But as you know, António, we have so many fine, well-equipped spaces with sufficiently many dimensions, what influence should a three-or four-dimensional world in a medium-sized town like Jena have then in the end?

Can you tell us about mathematicians that have influenced you most? Also some that you interacted with in some crucial moments in the development of the theory of function spaces.
Apart from Birman and Solomyak who I met first during my time in Leningrad, I would name here S. G. Krejn. I think it was at the mathematical congress in Moscow 1966 where I first get to know him. Another colleague that influenced and motivated my studies essentially at some time is certainly Jaak Peetre from Lund. As far as I remember we first talked in Berlin in 1969, where I really understood some advantage of Besov spaces (defined by differences) showing up as interpolation spaces from Sobolev spaces. Later in Lund he directed my interest to the book of Stein from 1970, which also had consequenc-

Giving a lecture during the OTFUSA Conference held in Aveiro in July 2005.

es on my further studies in function spaces. Indeed, in 1975 when I stayed for some time in the Banach Center in Warsaw I really considered to change subjects and turn to the theory of relativity where I already lectured about in Jena. This fascinated me very much – and, in addition, I thought that I am finished at some level with function spaces. I had completed my habilitation thesis about function spaces and nonlinear analysis, had already become a professor at the age of 34. So I thought it a good opportunity to concentrate on something else. But just in Warsaw I read some papers from Fefferman and Stein about the Fourier analytical approach to function spaces … and this convinced me that research in function spaces is not outdated. As you know yourselves, António, there is still a lot to do and, even worse or better, there are so many new surprising connections to other areas, not only of analysis, and further ideas, open questions that serve as source of Ph.D. projects, admit to write papers and books, collaborate with colleagues…

You are always full of new ideas in your research. Is there some recipe we can learn about? How do your new ideas usually come ?

Unfortunately I do not have a special method or secret that I could share with you. Ideas come from time to time, I rather have the belief of a sea of potential thoughts and ideas, that only partly and occasionally become more detailed and visible. Certainly essential from my point of view is to read a lot of specific literature, I always consumed various monographs and papers, but also textbooks. Moreover, I meanwhile get many questions, whether in seminars or at conferences, that initiate further conclusions or interesting questions. Nowadays I even receive many emails with more or less tricky problems. But I would not say that I systematically search for new ideas, they rather come to me sporadically.

I think one of the first impressions people have when meeting you is that you are a very happy person, always willing to play with words or with unusual (or even common) situations. Together with your easiness in getting a good laugh and the expressive way you put in teaching, maybe this is one of the explanations for the huge number of Ph.D.'s that you have supervised: the number 36 is impressive, and still growing. Do you have a secret recipe for this?

Sorry, but I have to disappoint you again: there is no special trick at all. Even worse, I never really propagated fascinating Ph.D. topics in order to attract especially good students, they rather came by themselves and asked for something to concentrate on. Of course, when I was very much involved in teaching duties I knew many students – and they knew me. So it was easier to come in contact and to promote some of them. Later, in particular when we had the graduate school in Jena, there sometimes appeared the phenomenon that young students were directly sent to me from their supervisors abroad, in order to do a Ph.D. in Jena under my supervision, sometimes already with some special interest and well-prepared mathematical knowledge.

Let us still talk about this graduate school in mathematics, which you have had in Jena, already for some years. Can you tell us how this works? ... This is a topic of special interest nowadays for Portuguese universities, because there has been a trend to set such doctoral programs, though not always backed up with the funds necessary to support students!

We hosted two graduate schools during the last 15 years: the first one with the title 'Analytic and stochastic structures and systems' lasted for the maximal number of years from 1992 until 2002. At that time usually around 10 professors of a faculty (or different faculties) submitted an application and described some topic of joint interest which was wide and promising enough to admit sufficiently many Ph.D. projects and further research, but should also be concentrated enough to have a substantial kernel of collaboration within the different research groups. In the lucky case it is then approved for 3 years and this procedure can be repeated twice at most. The final year is then given to complete the last projects. In our case we had grants for 12 Ph.D. students and 2 Postdoc positions (per three year period), that is, the Ph.D. grants were given usually for 2+1 year, the Postdoc position for one or two years. Students had to apply and were chosen by this small group of professors forming the graduate school in view of their submitted documents and a talk before the audience. In addition to the personal grants for the graduate students (around 1000 Euros at that time, as far as I remember) we received extra money to invite guests, to finance a small separate special library, to support research and conference stays of the students in a modest way, and to organise two workshops or conferences per year. For a long time I was the speaker of this graduate school which was the first mathematical one within the former GDR territory and the first at all that was installed in Thuringia, the federal state Jena belongs

to. Apart from the convenient situation to have Ph.D. positions at all and to have some money to spend for conferences, guests and books, the main advantage was in my opinion the uncomplicated and direct administration with short connections between all the people involved, Ph.D. students as well as professors. Our graduate school really worked successfully, almost all Ph.D. theses could be completed. There existed a second graduate school from 2002 until 2006 in our faculty, this time in combination with applied mathematics and computer science, called 'Approximation and algorithms'. It followed essentially the same scheme.

Would you like to comment about other avenues that your research has taken, besides the concern with the function spaces? I'm thinking, in particular, that for quite some time the underlying domains which you were considering were smooth ones, and afterwards, maybe during the 1990s, you started to systematically consider irregular, even fractal, sets.

The close connection to fractal geometry turned out within the Ph.D. project of Heike Winkelvoss (who, by the way, also had a grant from the graduate school we talked about before). At that time the atomic decomposition in function spaces was already available and sufficiently developed to serve as building blocks also for spaces on fractals. This localised description fits pretty well to the nature of fractals, or, more precisely, d-sets and generalisations like h-sets, which were investigated by Michele Bricchi, another of my Ph.D. students living on a grant from the graduate school. Similarly other areas like wavelet theory entered function spaces scene whenever needed and appropriate. Of course, these extensions to the theory of function spaces are very much welcome.

And what about outside mathematics? Is there anything – certainly less interesting than function spaces – that you enjoy doing when not concerned with mathematics?

Well, it is not very exciting, I confess: it is again reading what I like. In particular, I am more and more interested in historical topics, especially linked to mathematics or physics. I am fascinated by the way in which scientists and science developed in the past. You may imagine me sitting in my garden, reading and reading – and the only witnesses for this picturesque scene are brave birds, shy deer and old trees …

Which mathematicians do you admire particularly? Do you have a favourite mathematician from before the 20th century? And from the 20th century?

Certainly Archimedes, Pythagoras and Riemann. Concentrating on the last century, then I would first mention Einstein, especially how he came from special to general relativity. Secondly, there is, of course, David Hilbert who can be seen in some sense as successor of Pythagoras in his approach of assumptions and proofs. One of his great credits may be the idea to mathematise physics by models. Finally, related to my field of analysis, let me refer to Sobolev and Laurent Schwartz.

If you had to mention one or two great moments in 20th century mathematics which ones would you pick?

Probably one should allude to the proof of Fermat's Last Theorem by Andrew Wiles here, and to the contribution to the continuum hypothesis by Paul Cohen. But related to my field of research, this is doubtless the discovery of distributions by Laurent Schwartz. One can read in his memories that in the beginning the mathematical society behaved rather hostile against this new ideas, or better to say, the general opinion was split: a smaller part of his colleagues regarded this approach to be ingenious, whereas the majority thought it too simple to be useful and far-reaching. But they were wrong obviously. Nowadays, this theory well-equipped with the tools of Fourier analysis, essentially included and further developed within the concept of function spaces, becomes more and more the language of numerical analysis, too. It took some time until Laurent Schwartz became famous for his discovery.

One of your former students once told me that you know exactly where things should lead to in your area of research and that you have a program to get there. I myself can testify that you have strong feelings about the truth or falsity of some conjectures. Would you like to share with us some clues about important results in your areas of interest that should be possible to prove in the near (or not so near) future?

You are very kind, thank you. But thinking about it, yes, I guess you are right, there are very rare occasions when I was mistaken in my assumptions. The reason might be, that I have a certain feeling for the topography of the territory of function spaces. So I rather have the idea to inspect hidden caves, whether they are promising or boring. There is some inner voice which usually prevents me from falling into a trap, that is, I better circumvent dangerous parts of this area. Sometimes I find something what I have not looked for, this may lead to a Ph.D. topic or a paper afterwards, but not always. In such cases I collect these pieces of new ideas in some small booklet. I see myself strolling around on my own, sometimes listening to music by Bach during these walks . . . But to avoid misunderstanding, I do not systematically dig and find new plants in this function space territory, I rather feel like promenading in a fog of thoughts and ideas which only by chance get caught by me. In other words, I cannot predict what I will find next – or what you asked me about future developments. Probably we should meet in some years again and then I will review and honestly tell you what important results could be proved in the past.

Interview by António Caetano (University of Aveiro) and Dorothee Haroske (University of Jena).

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Educational interfaces between Mathematics and Industry An ICMI-ICIAM International study (2008–2011)

Alain Damlamian (France, co-chair), Rudolf Strässer (Germany, co-chair)

Since the mid-80s, ICMI has found it important to involve itself directly in the identification and investigation of issues or topics of particular significance to the theory or practice of contemporary mathematics education, and to invest an effort in mounting specific studies on these themes. The main emphasis of a given study may be on analytical or action-oriented aspects but some analytical component will always be present. Built around an international seminar, each study is directed toward the preparation of a published volume intended to promote and assist discussion and action at the international, national, regional and institutional level.

An ICMI study is composed of a series of steps. Once a theme has been decided upon by the Executive Committee (EC) of the ICMI, the EC appoints an International Program Committee (IPC), which on behalf of ICMI is responsible for conducting the study. Usually a country that is willing to host the corresponding Study Conference has been identified concurrently with the appointment of the IPC. The first task of the IPC is to produce a Discussion Document in which a number of key issues and sub-themes related to the theme of the study are identified, presented and described in a preliminary way. The Discussion Document is circulated internationally as widely as possible in journals, magazines, newsletters, etc. Readers are invited to react in writing to the IPC, which then organises an international ICMI Study Conference with a limited number (50–100) of invited participants. This conference forms a working forum for investigating the theme of the study. Particular emphasis is given to bringing together experts in the field and newcomers with interesting ideas or promising work in progress, as well as gathering representatives with a variety of backgrounds from different regions, traditions and cultures.

The final outcome of an ICMI study is a Study Volume, appearing in the (new) ICMI Studies Series edited by the president and the secretary of the ICMI and published (since 1993) by Kluwer Academic Publishers.

A short presentation of a forthcoming ICMI study is given below by the two co-chairs: Alain Damlamian (France) and Rudolf Strässer (Germany).

This study is interesting, as it is a joint study between the International Commission on Mathematical Instruction (ICMI) and the International Council for Industrial and Applied Mathematics (ICIAM). In a few weeks the Discussion Document will be launched.

A recent OECD Global Science Forum on "Mathematics in Industry" has recognised the intimate connections between innovation, science and mathematics and has recommended a new strategy for education of students, including more interdisciplinary training.

Classically, students on all levels have been taught the tools of mathematics with little or no mention of real world applications and with little or no contact with what is done in the workplace (be it the classical engineering industry or other more recent activities in biotechnology, biomedicine, the financial, insurance and risk sectors and consultant engineering companies).

Nowadays, one needs to solve highly complex problems and hence some training, in particular with real life problems, has to be given. More and more powerful computers make it possible to treat such complex problems and this is not just done using shelf software but with innovation, often mathematical innovation.

An international study on Education and Training on Applied and Industrial, Technical and Vocational Mathematics on the secondary and tertiary level is therefore necessary and timely and is being launched as ICMI Study 20. This includes secondary school, high school (possibly in parallel with an apprenticeship) and tertiary education at polytechnics and universities. In addition, postgraduate education and retraining during the professional life must also be considered. The study should include:

- Survey and analysis of experiences, programmes and consortia at regional and world levels, including industrial internships, mathematics clinics, modelling camps and summer schools.
- Identification, development and assessment of curricula that include innovative applications of mathematics, highlighting industry-driven problems (including undergraduate and postgraduate programmes in conjunction with industry).
- Characterizing mathematical literacy at work in various kinds of jobs, i.e. what is needed to have professionals of an adequate level.

- Student activities and interdisciplinary training, including didactic materials to support teaching and learning, and high school, undergraduate and graduate mathematical modelling contests (e.g. applied mathematics olympiads).
- How to set up opportunities for secondary school teachers to participate in academic-industrial initiatives.
- Visions and perspectives from industry and academia.

The EIMI study (Education Interfaces between Mathematics and Industry) will be a first joint collaboration between the *International Commission on Mathematical Instruction* and the *International Council for Industrial and Applied Mathematics*. It was proposed by the Portuguese *National Committee of Mathematicians*, who will host the EIMI Conference in Portugal in early 2010, and the study aims to publish a book in the ICMI Study Series to be launched at the *ICIAM 7th Congress* of Vancouver, Canada, 18-22 July 2011.

The *International Program Committee* (IPC) is composed of Alain Damlamian (France, co-chair), Rudolf Strässer (Germany, co-chair), José Francisco Rodrigues (Portugal, host country), Marta Anaya (Argentina), Helmer Aslaksen (Singapore), Gail Fitzsimons (Australia), José Gambi (Spain), Solomon Garfunkel (USA), Alejandro Jofré (Chile), Henk van der Kooij (Netherlands), Li Ta-tsien (China), Brigitte Lutz-Westphal (Germany), Taketomo Mitsui (Japan), Nilima Nigam (Canada) and Fadil Santosa (USA).

Websites: http://www.mathunion.org/ICMI/, http://www.iciam.org/.

AARMS SUMMER SCHOOL 2009

The eighth annual Summer School sponsored by the **Atlantic Association for Research in the Mathematical Sciences (AARMS)** will take place at the University of New Brunswick in Fredericton, New Brunswick, Canada from **July 12 through August 8, 2009**. The school, which offers courses in the mathematical sciences and their applications, is intended for graduate students and promising undergraduate students from all parts of the world. Each participant will be expected to register for two courses, each with five ninety-minute lectures per week. These are graduate courses, approved by the University of New Brunswick, and we will facilitate transfer credits to the extent possible.

For 2009, the following courses are planned:

Algebraic Topology, by Gustavo Granja of the Instituto Superior Técnico, Lisbon, Portugal.

Cryptography, by Mike Jacobson, University of Calgary.

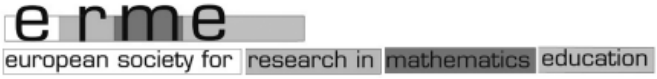
Introduction to Quantum Computing, by David Kribs, University of Guelph.

Topological Combinatorics, Daniel Matei, Institute of Mathematics (Simion Stoilow) of the Romanian Academy, Bucharest, Romania.

For more information, or to express interest in attending, send e-mail to Barry Monson (bmonson@unb.ca) and/or visit the school's website: http://www.aarms.math.ca/summer.

The European Society for Research in Mathematics Education (ERME)

Barbara Jaworski (President of ERME)



In May 1997, a group of 16 scholars from different European countries met in Osnabrück, Germany, for three days to discuss the formation of a European society in mathematics education. The initiative had come from a group in Germany, based on discussion at other international meetings during the 1990s, and a small conference in Germany in 1995 attended by about 50 participants. I was a participant in this conference and a member of the 1997 group. I remember it being a stimulating meeting and in retrospect an historic one. Here was the opportunity to form something new, and fundamentally European, with exciting possibilities for the future.

In true European spirit, we decided that we wanted a society that would bring together researchers from across Europe, particularly including colleagues from Eastern Europe, fostering *communication, cooperation* and *collaboration*. We wanted a conference that would explicitly provide such opportunity. We especially wanted to encourage and contribute to the education of young researchers. Thus ERME was born and began to take shape.

We decided on a biennial conference, or *congress* as it later became known, and the name CERME emerged – Congress of the European Society for Research in Mathematics Education. Considerable time was spent talking about the nature of the conference. How were we going to achieve the communicative, cooperative and collaborative spirit we envisaged? After some discussion, it was agreed that the conference might valuably provide opportunity for groups in a particular scientific area really to work together on their area of research. Thus the conference should be more than just a platform for presenting and listening to papers. Many other conferences provided such opportunity. It was said that at conferences which offered multiple paper presentations, with discussion for a short time only at the end of a paper, that it was only at the end of a session that one felt really ready to engage with the ideas and take them forwards in discussion and debate – but then everyone went off to the next presentation. CERME should have a group structure in which researchers would have sufficient time to really get to know each other, share and discuss their research and engage in deep scholarly debate.

The first CERME was planned for February 1999 at Osnabrück. The Programme Committee (PC) was a small group consisting of Elmar Cohors Fresenborg from Germany, Joao Pedro da Ponte from Portugal, André Rouchier from France, Milan Hejny from the Czech Republic and Barbara Jaworski from the UK. The PC took very seriously the aims for the conference expressed at the 1997 meeting. Seven working groups were planned and 12 hours were provided for work in a group. Group leaders of international standing were invited and agreed to coordinate the groups; each group had 3 or 4 leaders. It was up to the group leaders to receive papers, organise a peer review process, select papers for presentation and organise a programme of work. To avoid most of the conference time being taken up by paper presentation, it was decided there would be no oral presentations at the conference. Papers would be presented in written form before the conference with sufficient time for group participants to read the papers. The 12 hours would be spent discussing the papers and working on themes and issues suggested by the papers and the group leaders. In addition we had keynote talks from Jeremy Kilpatrick (US) and Guy Brousseau (France) and poster presentations. Further details can be found in Schwank, 1999, Volume 1, pp. 23-33.

I remember vividly that as we arrived at that first conference Colette Laborde asked me: "What are we going to do with twelve hours?" As leader of the technology group, she was worried about how to spend this large amount of time. At the end of the congress, she declared herself amazed and delighted: the quality of discussion had been high, the engagement deep and stimulating and the time had flown. On the last morning each group presented themes and issues from their discussion and it was clear that time had been used effectively and that there was no problem of too much time! Subsequently each group reformulated their papers and discussion to provide a written set of proceedings published by the German group and circulated to all participants (Schwank, 1999).

Also at this first congress were the early meetings of a committee that was to grow in later years into the ERME Board. Led at that time by Jean Philippe Drouhard (France), the committee held open forum at the conference to seek views and formulate policy for ERME. Two principles developed clear importance, the first to encourage colleagues in Eastern Europe to become part of the society and the second to support young researchers (young in research terms – not necessarily in age) throughout Europe. It was agreed to encourage young researchers to attend CERME but perhaps more was needed. Perhaps ERME could offer a summer school for young researchers.

Over the succeeding years, a group led by Konrad Krainer (Austria) and Paolo Boero (Italy) developed a plan and style for a YERME summer school (YESS). The first summer school was held in Klagenfurt, Austria, in August 2002. Like CERME, the summer school was based around working groups, each with an internation-

al "expert" as group leader. Group work was based on papers submitted by the young researchers and groups were convened around themes suggested by the submitted papers. Young researchers were encouraged to read and react to each other's papers and to engage in scholarly debate within their groups.

The pattern of CERME and YERME has developed so that they take place on alternate years, the group structure being developed and carried forward from one to the next. We had: CERME 2 in Marianske Lazne, Czech Republic, in 2001; CERME 3 in Bellaria, Italy, in 2003; YESS 2 in Podebrady, Czech Republic, in 2004; CERME 4 in Saint Feliu, Spain, in February 2005; YESS 3 in Jyväskylä, Finland, in August 2006; CERME 5 in Cyprus in February 2007; and YESS 4 in Trabzon, Turkey, in August 2008. CERME 6 will take place in Lyon, France, in 2009 and YESS 5 in Palermo, Italy, in 2010.

Although I was not able to take part in all these events – I missed one conference and one summer school – it became clear to me that we had initiated something exciting, significant and of important consequence for the future. People came from these events speaking of *inspirational* experiences. It seemed clear that the events generated something that we came to call the *CERME Spirit*. Based fundamentally on the three Cs: communication, cooperation and collaboration, the CERME Spirit was about the inspiration that derives from serious scholarly tackling of ideas and concepts in key areas and of mathematics education research with colleagues from multiple nations, facilitated by the group design of the events.

The scientific areas on which we have worked in the most recent conferences are as follows: The role of metaphors and images in the learning and understanding of mathematics, Affect and mathematical thinking, Building structures in mathematical knowledge, Argumentation and proof, Stochastic thinking, Algebraic thinking, Geometrical thinking, Mathematics and language, Tools and technologies in mathematical didactics, Mathematics education in multicultural settings, Different theoretical perspectives/approaches in research in mathematics education, From a study of teaching practices to issues in teacher education, Applications and modelling, Advanced mathematical thinking, Comparative studies in mathematics education, Early years mathematics, and The role of history of mathematics in mathematics education. Fifteen of these groups will work at CERME 6.

However, the group design was not without its critics. Some critics felt constrained by the requirement to spend a conference largely in just one group. Some felt that a conference ought to offer a greater variety of opportunity to participants. Participants should be free to choose where to be at any time. However, the group work at CERME or YESS would be seriously disrupted if participants were to hop from group to group, not engaging seriously with the work in any one. Some suggested that perhaps planning could allow participants to take part in two groups, so that engagement in both could be serious. Such ideas have been considered by the ERME Board and Programme Committees but so far we have remained faithful to the initial conception. Many participants have said in evaluation of the events that the opportunity to spend serious time in one group allowed them to really get to know researchers from other countries and that this contributed significantly to the depth of thinking that was possible.

It is not possible here to describe all the events in detail. Each event had its own characteristics related to the particular location and planning. The first two CERMEs were quite small, but CERME 3 in Bellaria attracted over 200 people and at CERME 4 in Spain numbers were up to 350. We felt that CERME had really taken off! These numbers have been maintained since then. YESS 3 had more than 50 applicants – a big effort, both organisationally and financially was made to include them all. The first committee guiding ERME grew into the ERME Board, with the first president being Paolo Boero (Italy). Paolo was tirelessly hardworking and optimistic about possibilities for ERME, CERME and YERME and he was a strong force for encouraging others to contribute to their development. The ERME Board worked hard to encourage the organisation of events, to fund the YESS and to fund participants from Eastern countries. It was decided to establish ERME legally with charitable foundation in the UK, and this is now finalised with formal constitution and by-laws. With a solid legal foundation, we are now seeking to develop a strong financial footing.

Before ending, I must point briefly to two important issues with which we have been grappling in CERME and YERME over the years. The first concerns language. The language of our events is English, as this is the only workable common language. However, we recognise that many participants are disadvantaged by having to work in English. Thus we try to encourage all to speak as slowly and clearly as possible, and we try to devise innovative ways of using multiple languages in our sessions. The second concerns a dichotomy between *quality* and *inclusion*. We aim for high scientific standards in our work, reflected in our reviewing of papers. However, we want to include all who wish to come, and for most this involves presenting a paper. So group leaders try to help presenters to improve the quality of their papers for presentation, and have more rigorous requirements for papers to be published in our proceedings. Finding the balance is something on which we continue to work. Proceedings are published after each CERME and are circulated on CD forming, as years go by, an important record of Mathematics Education Research in Europe.

As I write this we look forward to the coming meeting in Lyon and to ongoing activity in our society. We want to encourage wider participation with more nations contributing to hosting events and a secure financial platform for continuing our inclusive communication, cooperation and collaboration within Europe.

References

Schwank, I. (1999). *European Research in Mathematics Education*. Osnabrück: Forschungsinstitut für Mathematikdidaktik.

Further details of ERME and CERME 5 can be found at the following sites: http://cerme6.univ-lyon1.fr/call.php, http://ermeweb.free.fr/ .

ERCOM: The Erwin Schrödinger International Institute for Mathematical Physics (ESI), Vienna, Austria

In April 2008 the ESI celebrated its 15th anniversary. When the ESI opened in 1993 it quickly made a difference to the scope, quality and international orientation of research in mathematics and mathematical physics in Austria. Before 1992, Austria was home to some outstanding individual scientists but it had no internationally visible research centre for the mathematical sciences that could help to put the country back on the world map after the terrible intellectual losses during the Nazi era. After the ESI had come into existence it began to offer scientific activities on a wide range of topics both in mathematics and mathematical physics, many of which had been represented insufficiently in Austria. It has attracted, and continues to attract, many of the world's top researchers to work in Vienna and has been instrumental in filling faculty positions at local universities with top quality applicants.

History

In August 1990 Alexander Vinogradov (Moscow) wrote to Peter Michor in Vienna with the proposal of setting up an institute devoted to mathematics and physics in Vienna. This proposal had been preceded by discussions between Vinogradov and Michor focusing on the preservation of the scientific communities of Eastern European countries in the aftermath of the fall of the communist governments in these countries. At that time the entire region was threatened with a huge brain-drain involving many of these countries' best scientists.

Setting up an institution at the interface between mathematics and physics in Vienna was seen as a potentially valuable contribution at this time of crisis. Based on the cultural and scientific tradition of Vienna from Ludwig Boltzmann to Erwin Schrödinger and Walter Thirring, especially in the field of mathematical physics, a new institute in Vienna would provide a focal point for both Eastern and Western science and an international platform of research in the field of mathematical physics.

This initiative was warmly welcomed by Walter Thirring in Vienna. In a letter to Erhard Busek (the Minister of Science and Research at that time), Thirring proposed in October 1990 to establish an international research institute in Vienna, devoted to mathematical physics with the name 'Erwin Schrödinger International Institute for Mathematical Physics' (ESI). Thirring's proposal immediately won the support of eminent scientists all over the world, and Busek responded favourably in December 1990. A non-profit private society was founded that formally runs the institute and receives its funding directly from the Austrian Federal Ministry for Science and Research.

The institute became operational in January 1993 under the directorship of Walter Thirring and Peter Michor in the very building on Pasteurgasse in Vienna's 9th district where Erwin Schrödinger had spent his last years.

With the growth of the institute its original premises in Pasteurgasse soon became too small and in the summer of 1996 the institute moved to its current location at Boltzmanngasse 9, next to the Physics Institutes of the University of Vienna.

The Building

Visitors to the ESI have often asked about the history of the building in which the institute is located and commented on its monastic atmosphere. Here we give a brief history of this building.

Under the Austrian Emperor Charles VI, the relationship of the Austrian court to the Spanish monarchy brought to Vienna a great number of Spaniards, as well as people from Milan, Naples, Sicily and the Netherlands. It proved difficult to look after them properly if they fell on hard times and became sick, since they were seldom able to speak German and very much adhered to the traditional ways of life of their native countries. In order to redress this state of affairs Charles VI decided to establish a hospital for people from these countries. In a personal letter of 25 August 1718 to the Secretary of State Marquis de Rialp, the Emperor established various sources of funding for the establishment and upkeep of this 'Spanish Hospital'. After its completion the hospital offered 90 beds for patients.

After the death of Charles VI, Empress Maria Theresia extended the building in 1741 by adding an additional level on top of the existing building. Subsequently, sick soldiers (and later also civilians) of any nationality were cared for at the hospital. In 1785, the orphanage on Rennweg (in what is now the 3rd district of Vienna) was also moved to the Spanish Hospital and remained there until the early 20th century.

On 21 January 1913 the building of the Spanish Hospital changed ownership at the cost of 1,846,000 Crowns (Kronen) to become a priests' seminary, which is what it remains to this day.

The Facilities of the ESI

After the ESI had moved to its present location it expanded its accommodation further on 1 January 2004 by renting additional space within the Priests' Seminary. After some remodelling the institute now had a large lecture room (the Boltzmann Lecture Room) in addition to its former, smaller Schrödinger Lecture Room.

The Boltzmann lecture room

The institute currently includes 14 visitors' offices of varying sizes with a total of 54 desks. There is also a large common room that can serve as an overflow area for visitors during particularly busy periods.

The common room

The attractive corridors of the institute with their huge blackboards offer additional space for discussion and interaction.

The corridors with their blackboards

The institute is equipped with WLAN. For reasons of space and budget, the institute does not have its own library but its visitors have access to the nearby university mathematics and physics libraries.

Mission and activities

From the beginning the institute's mission was to advance research in mathematics and physics through fruitful interactions between leading scientists from these disciplines. With its scientific activities and international contacts the institute also aimed to support research at the surrounding universities and to stimulate science in Austria and beyond.

When the institute was founded in 1993 it also had a second mission: through its geographical location at the centre of Europe it aimed to stimulate intellectual exchange between scientists from Central and Eastern Europe and the Western world. With the subsequent changes in post-Communist Europe the latter mission became less important. However, the role of the ESI as a scientific meeting place for these regions remains as strong as ever.

The institute's scientific activities are centred around four to six larger thematic programmes per year on the basis of applications submitted two years in advance and evaluated by an International Scientific Advisory Committee (http://www.esi.ac.at/call/call.html). In addition workshops, conferences and summer schools are organised at shorter notice, as well as visits of individual scientists who collaborate with members of the local scientific community.

In order to further increase the impact of the institute's activities on the research, graduate and post-doc programmes of the nearby universities, in 2000 the ESI started to offer several Senior Research Fellowships (http://www.esi.ac.at/activities/SRF.html) with the aim of attracting top quality scientists to Vienna for longer (and repeated) periods.

The most important subsequent development was the creation of the Junior Research Fellows Programme (http://www.esi.ac.at/activities/JRF.html) in 2004. The purpose of this programme (which also receives its funding from the Austrian Ministry of Science and Research) is to enable post-docs and PhD students to participate in

the activities of the institute, to strengthen their contacts with the Austrian and international research communities and to work with individual visitors as well as Austrian scientists.

The presence of the junior research fellows at the institute has had a very positive impact on its scientific atmosphere through their interaction with the regular thematic programmes and the senior research fellows. The Junior Research Fellows Programme is part of the institute's long term policy of vertical integration of research and scientific education.To date, the institute has organized about 80 thematic programmes and about 4000 scientists have visited the institute (among them the majority of leading researchers in mathematics and mathematical physics). The ESI preprint server offers over 2000 preprints, the majority of them directly related to research originating from scientific activities at the institute (http://www.esi.ac.at/preprints/ESI-Preprints.html). Most of these preprints have since appeared in leading international scientific journals.

The scientific directors of the institute are editors of the *ESI Lectures in Mathematics and Physics*, published by the European Mathematical Society. To date, four volumes have appeared in this series and further volumes are in preparation. The institute also publishes a biannual newsletter, the ESI NEWS, which can be downloaded from http://www.esi.ac.at/about/ESI-News.html.

For further information please contact:
ESI, Boltzmanngasse 9, A-1090 Vienna, Austria
Telephone: +43-1-4277-28282, Fax: +43-1-4277-28299
Email: secr@esi.ac.at
Website: http://www.esi.ac.at/.

Isabella Miedl (Head of Administration),
Klaus Schmidt (President),
Joachim Schwermer, Jakob Yngvason (Scientific Directors)

THE OSTROWSKI PRIZE 2009

Call for proposals

The aim of the Ostrowski Foundation is to promote the science of mathematics by periodically awarding an international prize for the best performances in the field of pure mathematics and of the theoretical foundations of numerical mathematics. As a rule, the prize is awarded every two years to the scientist, or group of scientists, who, during the preceding five years, has achieved the highest scientific accomplishments in these fields. It is awarded independently of politics, race, religion, domicile, nationality or age. The prize in 2007 amounted to 100,000 Swiss francs.

The Foundation awards at the same time a scholarship for a talented young mathematician, whose name is to be suggested by the current prizewinners. The scholarship will enable the winner to spend a year for further education (as a postdoctoral fellow) at a university of his or her own choice.

The previous prizewinners are, in chronological order: L. de Branges, J. Bourgain, M. Ratner and M. Laczkovich, A. Wiles, Y. Nesterenko and G. Pisier, A. Beilinson and H. Hofer, H. Iwaniec, P. Sarnak and R. Taylor, P. Seymour, B.Green and T.Tao, O. Schramm.

The jury invites proposals for candidates for the Ostrowski Prize 2009. The proposals including a short justification should be sent to David.Masser@unibas.ch before 1st February 2009.

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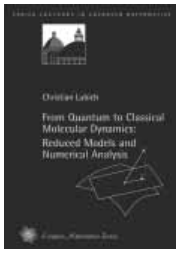


Christian Lubich (University of Tübingen, Germany)
From Quantum to Classical Molecular Dynamics: Reduced Models and Numerical Analysis (Zurich Lectures in Advanced Mathematics)

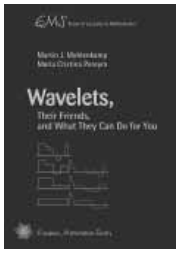
ISBN 978-3-03719-067-8. 2008. 153 pages. Softcover. 17.0 x 24.0 cm. 32.00 Euro

Quantum dynamics of molecules poses a variety of computational challenges that are presently at the forefront of research efforts in numerical analysis in a number of application areas: high-dimensional partial differential equations, multiple scales, highly oscillatory solutions, and geometric structures such as symplecticity and reversibility that are favourably preserved in discretizations. This text addresses such problems in quantum mechanics from the viewpoint of numerical analysis, illustrating them to a large extent on intermediate models between the Schrödinger equation of full many-body quantum dynamics and the Newtonian equations of classical molecular dynamics. The fruitful interplay between quantum dynamics and numerical analysis is emphasized.

Paul Seidel (Massachusetts Institute of Technology, Cambridge, USA)
Fukaya Categories and Picard–Lefschetz Theory (Zurich Lectures in Advanced Mathematics)

ISBN 978-3-03719-063-0. 2008. 336 pages. Softcover.17 cm x 24 cm. Euro 46.00

The central objects in the book are Lagrangian submanifolds and their invariants, such as Floer homology and its multiplicative structures, which together constitute the Fukaya category. The relevant aspects of pseudo-holomorphic curve theory are covered in some detail, and there is also a self-contained account of the necessary homological algebra. The last part discusses applications to Lefschetz fibrations, and contains many previously unpublished results. The book will be of interest to graduate students and researchers in symplectic geometry and mirror symmetry.



Martin J. Mohlenkamp (Ohio University, Athens, USA), María Cristina Pereyra (University of New Mexico, Albuquerque, USA)
Wavelets, Their Friends, and What They Can Do for You (EMS Series of Lectures in Mathematics)

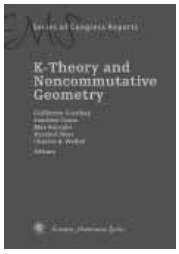
ISBN 978-3-03719-018-0. 2008. 119 pages. Softcover. 17.0 cm x 24.0 cm. Euro 24.00

So what is all the fuss about wavelets? You can find out by reading these notes. They will introduce you to the central concepts surrounding wavelets and their applications. By focusing on the essential ideas and arguments, they enable you to get to the heart of the matter as quickly as possible. They then point you to the appropriate places in the literature for detailed proofs and real applications, so you can continue your study. They begin with the notion of time-frequency analysis, present the multiresolution analysis and basic wavelet construction, introduce you to the many friends, relatives and mutations of wavelets, and finally give a selection of applications. They are suitable for beginning graduate students and above.

Trends in Representation Theory of Algebras and Related Topics (EMS Series of Congress Reports)
Andrzej Skowroński (Nicolaus Copernicus University, Toruń, Poland), Editor

ISBN 978-3-03719-062-3. 2008. 722 pages. Hardcover. 17.0 x 24.0 cm. 98.00 Euro

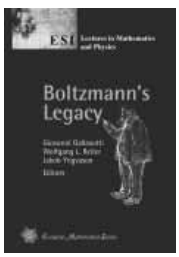
This book is concerned with recent trends in the representation theory of algebras and its exciting interaction with geometry, topology, commutative algebra, Lie algebras, quantum groups, homological algebra, invariant theory, combinatorics, model theory and theoretical physics. The collection of articles, written by leading researchers in the field, is conceived as a sort of handbook providing easy access to the present state of knowledge and stimulating further development. The topics under discussion include diagram algebras, Brauer algebras, cellular algebras, quasi-hereditary algebras, Hall algebras, Hecke algebras, symplectic reflection algebras, Cherednik algebras, Kashiwara crystals, Fock spaces, preprojective algebras, cluster algebras, rank varieties, varieties of algebras and modules, moduli of representations of quivers, semi-invariants of quivers, Cohen–Macaulay modules, singularities, coherent sheaves, derived categories, spectral representation theory, Coxeter polynomials, Auslander–Reiten theory, Calabi–Yau triangulated categories, Poincaré duality spaces, selfinjective algebras, periodic algebras, stable module categories, Hochschild cohomologies, deformations of algebras, Galois coverings of algebras, tilting theory, algebras of small homological dimensions, representation types of algebras, model theory. The articles contain a large number of open problems and give new perspectives for research in the field.



K-Theory and Noncommutative Geometry (EMS Series of Congress Reports)
Guillermo Cortiñas (Universidad de Buenos Aires, Argentina), Joachim Cuntz (University of Münster, Germany), Max Karoubi (Université Paris 7, France), Ryszard Nest (University of Copenhagen, Denmark), Charles A. Weibel (Rutgers University, USA), Editors

ISBN 978-3-03719-060-9. 2008. 454 pages. Hardcover. 17.0 x 24.0 cm. 88.00 Euro

Since its inception 50 years ago, K-theory has been a tool for understanding a wide-ranging family of mathematical structures and their invariants: topological spaces, rings, algebraic varieties and operator algebras are the dominant examples. The invariants range from characteristic classes in cohomology, determinants of matrices, Chow groups of varieties, as well as traces and indices of elliptic operators. Thus K-theory is notable for its connections with other branches of mathematics.
To study noncommutative geometric problems one considers invariants of the relevant noncommutative algebras. These invariants include algebraic and topological K-theory, and also cyclic homology, discovered independently by Alain Connes and Boris Tsygan, which can be regarded both as a noncommutative version of de Rham cohomology and as an additive version of K-theory. There are primary and secondary Chern characters which pass from K-theory to cyclic homology. These characters are relevant both to noncommutative and commutative problems, and have applications ranging from index theorems to the detection of singularities of commutative algebraic varieties. The contributions to this volume represent this range of connections between K-theory, noncommmutative geometry, and other branches of mathematics.



Boltzmann's Legacy (ESI Lectures in Mathematics and Physics)
Giovanni Gallavotti (Università di Roma "La Sapienza", Italy), Wolfgang L. Reiter (University of Vienna, Austria), Jakob Yngvason (University of Vienna, Austria), Editors

ISBN 978-3-03719-057-9. 2008. 284 pages. Softcover. 17 x 24 cm. 58.00 Euro

Ludwig Eduard Boltzmann (1844–1906) was an Austrian physicist famous for his founding contributions in the fields of statistical mechanics and statistical thermodynamics. He was one of the most important advocates for atomic theory when that scientific model was still highly controversial. To commemorate the 100th anniversary of his death in Duino, the International Symposium "Boltzmann's Legacy" was held at the Erwin Schrödinger International Institute for Mathematical Physics in June 2006. This text covers a wide spectrum of topics ranging from equilibrium statistical and nonequilibrium statistical physics, ergodic theory and chaos to basic questions of biology and historical accounts of Boltzmann's work. Besides the lectures presented at the symposium the volume also contains contributions specially written for this occasion. The articles give a broad overview of Boltzmann's legacy to the sciences from the standpoint of some of present day's leading scholars in the field. The book addresses students and researchers in mathematics, physics and the history of science.

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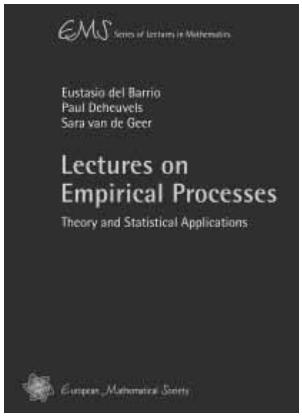
Book Review

Winfried Stute



E. del Barrio, P. Deheuvels and S. van de Geer
Lectures on Empirical Processes

264 pages, paperback.
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These notes are based on lectures given by the three authors at a seminar in Laredo (Spain) in September 2004. The idea was to discuss the state of art of empirical process theory and of the many applications in statistics. As such the three chapters present the personal view and interest of each author.

E. del Barrio's contribution deals with "Empirical and Quantile Processes in the Asymptotic Theory of Goodness-of-fit Tests". In its six sections he presents a detailed account of the asymptotic aspects. The main motivations are various questions in goodness-of-fit testing χ^2–, Cramér-von Mises, Kolmogorov-Smirnov, Anderson-Darling, Durbin). In each case the asymptotic distribution may be obtained from a functional central limit theorem for the empirical process and its counterpart, the quantile process. If Hilbert space methods are available, a proper principal component analysis gives further insight into the power of the resulting test. In other cases, asymptotic studies require the convergence of the empirical (quantile) process in weighted sup-metrics. In principle, two different techniques are studied in detail. One methodology requires Hungarian approximations through Brownian Bridges. The other technique carefully studies the processes under consideration at the boundary of the support (of the distribution) since typically weight functions in denominators decrease to zero thus blowing up the difference between the empirical and the true distribution there. For a proper analysis sharp (uniform) exponential bounds are needed. More or less, this is what del Barrio's contribution is about. In the quantile case, section six pays particular attention to the analysis of the Wasserstein metric. As with the other authors, most results deal with univariate independent identically distributed data. In summary, this chapter provides an insightful contribution to asymptotic aspects of standard empirical processes on the real line. Interested readers may find the list of references useful to get deeper insight of this technically involved topic.

In chapter 2 of these seminar notes, P. Deuheuvels focuses more on the almost sure behaviour of empirical and quantile processes. As Donsker's invariance principle has been a landmark result for the distributional convergence of these processes, the functional law of the iterated logarithm (LIL) due to Finkelstein describes the class of functions that may serve as approximations for the paths of the (uniform) empirical process, as $n \to \infty$. In the earlier sections Deheuvels carefully studies these classes of functions. To show the functional LIL, some exponential bounds for sums of independent random variables are needed. Sometimes they are obtained from connecting empirical processes with the Poisson process; in other cases bounds related with normal tails are appropriate. While the Finkelstein LIL describes the a.s. limit set of the ordinary empirical process, the local empirical process reflects its behaviour in a neighbourhood of a given point. Such results have some applications in nonparametric density estimation. Naturally the type of limit behaviour depends on the size of the given bandwidth. This chapter combines, at a high technical level, elements of measure theory, topology, probability (bounds) and statistical applications.

In S. van de Geer's chapter on "Oracle Inequalitites and Regularization"', the author starts from a problem in curve estimation (density and/or regression estimation). There, to avoid too much roughness, a penalty term is introduced and added to an integral with respect to the empirical distribution function. The resulting sum is then minimized (and maximized) over a suitably chosen class of functions (integrands). This approach is formalized in a section on "M-estimators" followed by a detailed discussion of the various risks involved. In particular, some normal location model is investigated with rigour. The chapter concludes with a discussion of various penalties and bounds for the resulting risks.

In summary, with more than 20 years since the publication of the monograph by Shorack and Wellner on empirical processes, these seminar notes present another well written approach to this area. Most topics deal with basic probabilistic aspects of empirical processes rather than statistical applications or data analysis. The sometimes sophisticated technical tools are discussed in detail. The booklet also contains many references (and a few exercises), which may be helpful to get a more detailed overview of the area.

Winfried Stute [Winfried.Stute@math.uni-giessen.de] studied mathematics and economics at the University of Bochum (Germany) and obtained a PhD in mathematics in 1975. He completed his habilitation at the University of Munich in 1980. From 1981–1983 he was an associate professor in Siegen. Since 1983 he has been a full professor in probability and statistics at the University of Giessen. His research interests are stochastic processes and their applications to statistics.

Personal column

Please send information on mathematical awards and deaths to the editor.

Awards

Lucien Birgé and **Sunder Sethuraman** have obtained the prizes to the best articles published in the *Annales Institut Henri Poincaré (B) Probabilités et Statistiques*, by their articles "Lucien Birgé, Model selection via testing: an alternative to (penalized) maximum likelihood estimators" (Ann. Inst. H. Poincaré Probab. Statist., vol 42 (2006), p. 273–325), and "Sunder Sethuraman, On diffusivity of a tagged particle in asymmetric zero-range dynamics" (Ann. Inst. H. Poincaré Probab. Statist. Volume 43 (2007), p. 215–232).

Yvan Martel et Frank Merle and **Anne de Bouard et Arnaud Debussche** have obtained the prizes to the best articles published in the *Annales Institut Henri Poincaré (C) Analyse non linéaire*, by their articles "Yvan Martel, Frank Merle, Multi solitary waves for nonlinear Schrödinger equations" (Ann. Inst. H. Poincaré Anal. Non Linéaire 23 (2006), no. 6, p. 849–864), and "Anne de Bouard, Arnaud Debussche, Random modulation of solitons for the stochastic Korteweg-de Vries equation" (Ann. Inst. H. Poincaré Anal. Non Linéaire 24 (2007), no. 2, p. 251–278).

Simon Donaldson (Imperial College, London) has obtained the 2008 Nemmers Prize for his work in four-dimensional topology, symplectic geometry and gauge theory.

Pablo Mira (Universidad Politécnica de Cartagena, Spain) has obtained the 2007 Premio José Luis Rubio de Francia, awarded by the Real Sociedad Matemática Española to Spanish young researchers.

Marie-José Pestel has obtained the 2008 Prix d'Alembert for all his action, notably in the French CIJM (Comité International des Jeux Mathématiques).

The prize Anatole Decerf has been awarded to **Robert Ferréol** for his site on the remarkable curves.

The Shaw Laureates 2008 in Mathematical Sciences are Prof. **Ludwig Faddeev** (Director of Euler International Mathematical Institute, Steklov Institute of Mathematics, St. Petersburg, Russia) and Prof. **Vladimir Arnold** (Chief Scientist of Steklov Mathematical Institute, Moscow, Russia) for their widespread and influential contributions to Mathematical Physics.

The André Lichnerowicz prize in Poisson geometry for the year 2008 was awarded to **Henrique Bursztyn** (IMPA, Rio de Janeiro, Brasil) and **Marius Crainic** (University of Utrecht, Holland).

Stephen Hawking has received the 2008 Prize Fonseca from the University and the City hall of Santiago de Compostela, because of his work on black-holes and divulgation of science.

The 2008 Brouwer Medal laureate, awarded by the Dutch Mathematical Society, goes to **Phillip A. Griffiths** by his work on algebraic, complex-analytic, and differential geometry.

David Preiss (University of Warwick) has received the 2008 Pólya Prize (awarded by the London Math. Soc.) in recognition of his outstanding contributions to analysis and geometric measure theory.

Nicholas Higham (University of Manchester) has received the 2008 Fröhlich Prize (awarded by the London Math. Soc.) in recognition of his leading contributions to numerical linear algebra and numerical stability analysis.

Kevin Buzzard (Imperial College, London) has received the 2008 Senior Berwick Prize for the paper "Eigenvarieties", published in volumen 320 of the LMS Lecture Note Series, L-Functions and Galois Representations, 2007.

Timothy Browning (University of Bristol), **Tamás Hausel** (University of Oxford), **Martin Hairer** (University of Warwick) and **Nina Snaith** (University of Bristol) have received the 2008 Whitehead Prizes (awarded by t he London Mathematical Society).

Józef Siciak (Kraków) was awarded the Polish Prime Minister Prize for scientific achievements

Marian Mrozek (Kraków) was awarded the special Polish Science Minister Prize "for outstanding results in science"

Deaths

We regret to announce the deaths of:

Dan Butnariu (Israel, 4 July 2008)
Henri Cartan (France, 13 August 2008)
Pauline Coolen-Schrijer (UK, 23 April 2008)
Esfir Jos-Gersh Goldengershel (Israel, 2007)
George Greaves (UK, 24 August 2008)
Detlef Gromoll (Germany and USA, 31 May 2008)
Graham Higman, FRS (UK, 8 April 2008)
Andrzej Hulanicki (Poland, 23 March 2008)
Kyoshi Ito (Japan, 10 November 2008)
Peter Lesky (Germany, February 2008)
Edward Lorenz (USA, 16 April 2008)
Horst Niemeyer (Germany, 31 October 2007)
Jose Sousa Ramos (Portugal, 1 January 2007)
Stanley Richardson (UK, 12 March 2008)
Oded Schramm (Israel and USA, 1 September 2008)
Rafał Sztencel (Poland, 26 January 2008)
Krzysztof P. Wojciechowski (Poland and USA, 28 June 2008)

Forthcoming conferences

compiled by Mădălina Păcurar (Cluj-Napoca, Romania)

Please e-mail announcements of European conferences, workshops and mathematical meetings of interest to EMS members, to one of the addresses madalina.pacurar@econ.ubbcluj.ro or madalina_ pacurar@yahoo.com. Announcements should be written in a style similar to those here, and sent as Microsoft Word files or as text files (but not as TeX input files).

December 2008

1: Paris-London Analysis Seminar, Paris, France
Information: lerner@math.jussieu.fr;
http://people.math.jussieu.fr/~lerner/index.plans.html

1–5: Homology of algebra: structures and applications, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

1–5: Workshop on Stability and Instability in Mechanical Systems: Applications and Numerical Tools, CRM, Barcelona, Spain
Information: imub@imub.ub.es; http://www.imub.ub.es/wsims08/

8–12: Latent variables and mixture models, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

10–12: Workshop on Triangulated Categories, Swansea University, United Kingdom
Information: g.garkusha@swansea.ac.uk;
http://www-maths.swan.ac.uk/staff/gg/Workshop/

15–16: Rolling Waves in Leuven 2008, K.U. Leuven, Belgium
Information: http://www2.cs.kuleuven.be/~raf/ade2008

15–19: Meeting on mathematical statistics, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

15–22: First Cuban Congress on Symmetries in Geometry and Physics, Universidad de La Habana, Cuba
Information: Elizabeth.Gasparim@ed.ac.uk, bval@matcom.uh.cu;
http://www.maths.ed.ac.uk/~egaspari/cuba/

16–18: 8th IMA International Conference on Mathematics in Signal Processing, Cirencester, UK
Information: pam.bye@ima.org.uk;
http://www.ima.org.uk/Conferences/signal_processing/signal_processing08.html

17–19: International Conference on Numerical Analysis and Optimization (JANO 9), Mohammedia, Morocco
Information: jano9_fstm@yahoo.fr; http://www.fstm.ac.ma/jano9/

17–19: 1st Hispano-Moroccan Days on Applied Mathematics and Statistics, Tetouan, Morocco
Information: congreso.hmams@urjc.es; http://www.urjc.es/hmams/

January 2009

8–March 27: i-MATH Winter School: DocCourse Combinatorics and Geometry 2009. Discrete and Computatuional Geometry, CRM, Barcelona, Spain
Information: http://www.crm.es/DOCCOURSE

12–16: Algebraic Geometry and Complex Geometry, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

19–23: Resonances in Mathematical Physics, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

21–25: International Conference on Uniform Distribution, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

26–30: Quantum Gravity meets Non Commutative Geometry, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

26–30: Winter School on Quantum Chaos, Talence, France
Information: qchaos2009org@math.u-bordeaux1.fr;
http://www.math.u-bordeaux1.fr/qchaos2009/

28–February 1: Holomorphic partial differential equations, small divisors and summability, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

February 2009

2–6: Advanced Course on Mathematical Biology: Modelling and Differential Equations, CRM, Barcelona, Spain
Information: crm@crm.cat; www.crm.cat/ACMODELING

3–7: 30th Linz Seminar on Fuzzy Set Theory (Linz 2009), Linz, Austria
Information: linz2009@flll.jku.at;
http://www.flll.jku.at/research/linz2009/index.html

5–8: European Student Conference in Mathematics (EUROMATH2009), Nicosia, Cyprus
Information: cms@cms.org.cy; www.euromath.org, www.cms.org.cy

9–13: Conference on Mathematical Biology: Modelling and Differential Equations, CRM, Barcelona, Spain
Information: crm@crm.cat; www.crm.cat/CMODELING

9–13: 80th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM 2009), Gdansk, Poland
Information: gamm2009@gamm2009.pl;
http://www.gamm2009.pl./

11–13: 6th International Conference on Mathematical Modelling (MATHMOD 2009), Viena, Austria
Information: http://www.mathmod.at/

15–21: 5th Meeting for Young Mathematicians in Sedano "Grothendieck Duality, Valuations, Resolution of Singularities and Tropical Geometry" (YMIS 09), Sedano, Spain
Information: http://www.singacom.uva.es/sedano/

2–March 6: Thematic month – Scientific computing and Partial Differential Equations on nonlinear partial differential equations, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

March 2009

4–8: 4th World Conference on 21st Century Mathematics, Lahore, Pakistan
Information: wc2009@sms.edu.pk; http://wc2009.sms.edu.pk/

10–14: ALEA meeting, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

9–11: International Technology, Education and Development Conference (INTED2009), Valencia, Spain
Information: inted2009@iated.org; http://www.iated.org/inted2009

9–13: Harmonic Analysis and PDE: Fluid Mechanics and Kato's Problem, CRM, Barcelona, Spain
Information: http://www.crm.cat/harmonicpde/

15–20: ALGORITMY 2009 – Conference on Scientific Computing, High Tatra Mountains, Podbanske, Slovakia
Information: algoritm@math.sk; http://www.math.sk/alg2009

18–20: IAENG International Conference on Operations Research (ICOR'09), Hong Kong
Information: imecs@iaeng.org;
http://www.iaeng.org/IMECS2009/ICOR2009.html

23–27: Numeration – Mathematics and Computer Science, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

23–27: T=∞, Evolution Equations and Dynamical Systems (Conference on the occasion of the 60th birthday of Alain Haraux), Hammamet, Tunisia
Information: ma.jendoubi@fsb.rnu.tn;
http://www.math.univ-metz.fr/~harauxconference/

25–28: Taiwan-France joint conference on nonlinear partial differential equations , CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

April 2009

7–11: Graph Decomposition, Theory, logics and algorithms, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

14–18: Young Researchers in Set Theory Workshop 2009, CRM, Barcelona, Spain
Information: http://www.crm.cat/wkset_theory/

28–May 2: Recent progress in operator and function theory, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

May 2009

1–June 20: INdAM Intensive Period on Geometric Properties of Nonlinear Local and Nonlocal Problems, Milan and Pavia, Italy
Information: ugopietro.gianazza@unipv.it;
http://www.imati.cnr.it/gianazza/bimestre

4–8: Multilinear Harmonic Analysis and Weights, CRM, Barcelona, Spain
Information: http://www.crm.cat/multilinearharmonic/

7–9: Algebra and Probability in Many-Valued Logics, Darmstadt, Germany
Information: apmvl@mathematik.tu-darmstadt.de;
http://www.mathematik.tu-darmstadt.de/fbereiche/logik/events/apmvl/

9–17: 51th Workshop on Variational Analysis and Applications (In memory of Ennio De Giorgi), Erice, Italy
Information: maugeri@dmi.unict.it; http://www.ccsem.infn.it/

10–15: Leopoldina-Symposium in Algebraic and Arithmetic Algebraic Geometry, Monte-Verita, Ascona, Switzerland
Information: Clemens.Fuchs@math.ethz.ch;
http://www.math.ethz.ch/leo09/

11–15: Workshop and Advanced Course on Deterministic and Stochastic Modeling in Computational Neuroscience and Other Biological Topics, CRM, Barcelona, Spain
Information: http://www.crm.cat/wkmodeling/

23–26: International Conference on Interdisciplinary Mathematical and Statistical Techniques (IMST 2009), Plzen, Czech Republic
Information: pgirg@kma.zcu.cz;
http://home.zcu.cz/pgirg/IMST2009/

25–29: 6th European Conference on Elliptic and Parabolic Problems, Gaeta, Italy
Information: gaeta@math.uzh.ch;
http://www.math.uzh.ch/gaeta2009

26–30: High Dimensional Probability, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

27–June 1: Infinite-Dimensional Analysis and Topology, Yaremche, Ivano-Frankivsk, Ukraine
Information: idat@pu.if.ua; http://www.idat.frankivsk.org

31– June 6: Spring School on Analysis: Function Spaces, Inequalities and Interpolation, Paseky nad Jizerou, Czech Republic
Information: pasejune@karlin.mff.cuni.cz; http://www.karlin.mff.cuni.cz/katedry/kma/ss/jun09/

June 2009

1–5: School on Combinatorics, Automata and Number Theory (CANT'09), Liege, Belgium
Information: M.Rigo@ulg.ac.be;
http://www.cant.ulg.ac.be/cant2009/

1–5: Geometry and Topology 2009, Münster, Germany
Information: sfb478mi@math.uni-muenster.de;
http://www.math.ku.dk/~erik/muenster/

2–6: Thompson's groups: new developments and interfaces, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

3–12: Four Advanced Courses on Quasiconformal Mappings, PDE and Geometric measure Theory, CRM, Barcelona, Spain
Information: http://www.crm.cat/acmappings/

8–12: International Conference AutoMathA: from Mathematics to Applications, Liege, Belgium
Information: M.Rigo@ulg.ac.be;
http://www.cant.ulg.ac.be/automatha/

9–12: MAFELAP 2009 – 13th Conference on the Mathematics of Finite Elements and Applications, Brunel University, England
Information: Carolyn.sellers@brunel.ac.uk;
http://people.brunel.ac.uk/~icsrsss/bicom/mafelap2009

9–13: Geometric Applications of Microlocal Analysis, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

11–13: Representation Theory in Mathematics and in Physics, Strasbourg, France
Information: http://www-irma.u-strasbg.fr/article717.html

14–20: Stochastic Analysis and Random Dynamical Systems, Lviv, Ukraine
Information: sard@imath.kiev.ua;
http://www.imath.kiev.ua/~sard/

14–20: Geometric Group Theory, Bedlewo, Poland
Information: topics09@math.uni.wroc.pl;
http://www.math.uni.wroc.pl/ggt/

14–27: ESI workshop on large cardinals and descriptive set theory, Vienna, Austria
Information: esi2009@logic.univie.ac.at;
http://www.logic.univie.ac.at/conferences/2009_esi/

15–18: 5th International Conference on Dynamical Systems and Applications, Constantza, Romania
Information: cgherghina@gmail.com, cristinatoncu@canals.ro;
http://www.univ-ovidius.ro/faculties/civil_eng/conferinta%20iunie%202009/Home.html

15–18: 3th International Conference on Mathematics and Statistics, Athens, Greece
Information: atiner@atiner.gr;
http://www.atiner.gr/docs/Mathematics.htm

15–19: Waves 2009, Pau, France
Information: helene.barucq@inria.fr, julien.diaz@inria.fr;
https://waves-2009.bordeaux.inria.fr/

16–22: 6h International Workshop on Optimal Codes and Related Topics (OC 2009), Varna, Bulgaria
Information: oc2009@math.bas.bg;
http://www.moi.math.bas.bg/oc2009/oc2009.html

23–27: Hermitian symmetric spaces, Jordan algebras and related problems, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

28–July 2: 20th International Workshop on Combinatorial Algorithms (IWOCA 2009), Hradec nad Moravici, Czech Republic
Information: iwoca09@iwoca.org;
http://www.iwoca.org/iwoca09

30–July 4: Geometry of Complex Manifolds, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

July 2009

1–3: The 2009 International Conference of Applied and Engineering Mathematics, London, UK
Information: WCE@iaeng.org;
http://www.iaeng.org/WCE2009/ICAEM2009.html

5–8: Algebra and Analysis around the Stone-Cech Compactification, Cambridge, UK
Information: garth@maths.leeds.ac.uk, stferri@uniandes.edu.co;
http://matematicas.uniandes.edu.co/~stferri/donaconference.html

6–10: 26th Journées arithmétiques, Saint-Etienne, France
Information: ja2009@univ-st-etienne.fr;
http://ja2009.univ-st-etienne.fr

6–11: Conference on Algebraic Topology (CAT'09), Warsaw, Poland
Information: cat09@mimuw.edu.pl;
http://www.mimuw.edu.pl/~cat09/

13–18: 7th International ISAAC Congress, London, UK
Information: info@isaac2009.org;
http://www.isaac2009.org

14–17: 24th Summer Conference on Topology and Its Applications, Brno, Czech Republic
Information: slapal@fme.vutbr.cz, Eva.Tomaskova@law.muni.cz;
http://www.umat.feec.vutbr.cz/~kovar/webs/sumtopo

14–24: Banach Algebras 2009, Bedlewo, Poland
Information: asoltys@amu.edu.pl; http://www.siue.edu/MATH/BA2009/

15–18: Mathematics of Program Construction, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr;
http://www.cirm.univ-mrs.fr

20–24: 21st International Conference on Formal Power Series and
Algebraic Combinatorics, RISC Linz, Schlosz Hagenberg, Austria
Information: ppaule@risc.uni-linz.ac.at;
http://www.risc.jku.at/about/conferences/fpsac2009/

27–31: Stochastic Processes and their Applications, Berlin, Germany
Information: "kongresse@tu-servicegmbh.de;
http://www.math.tu-berlin/SPA2009

August 2009

3–8: 16th International Congress of Mathematical Physics, Prague, Czech Republic
Information: icmp09@ujf.cas.cz; http://www.icmp09.com/

13–17: 7th International Algebraic Conference in Ukraine, Kharkov, Ukraine
Information: iaconu2009@univer.kharkov.ua; http://iaconu2009.univer.kharkov.ua

30–September 4: Algebraic Groups and Invariant Theory, Monte Verita, Ascona, Switzerland
Information: baur@math.ethz.ch, donna.testerman@epfl.ch; http://www.math.ethz.ch/~baur/AGIT/

September 2009

1–5: Representation of surface groups, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

8–12: Chinese-French meeting in probability and analysis, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

7–9: 13th IMA Conference on the Mathematics of Surfaces, York, UK
Information: ralph@cs.cf.ac.uk; http://ralph.cs.cf.ac.uk/MOSXIIIcall.html

10–12: Quantum Topology and Chern-Simons theory, Strasbourg, France
Information: http://www-irma.u-strasbg.fr/article744.html

15–19: Geometry and Integrability in Mathematical Physics, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

22–26: 10th International Workshop in Set Theory, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

29–October 3: Commutative algebra and its interactions with algebraic geometry , CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

October 2009

6–10: Partial differential equations and differential Galois theory, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

12–16: Algebra, Geometry and Mathematical Physics, Bedlewo, Poland
Information: tralle@matman.uwm.edu.pl; http://www.agmf.astralgo.eu/bdl09/

13–17: Hecke algebras, groups and geometry, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

20–24: Symbolic computation days, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

November 2009

3–7: Harmonic analysis, operator algebras and representations, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

3–7: Discrete models of biological networks: from structure to dynamics, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

10–14: The 6th Euro-Maghreb Workshop on Semigroup Theory, Evolution Equations and Applications, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

17–21: Geometry and topology in low dimension (dedicated to the 60th birthday of Oleg Viro), CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

24–28: Approximation, Geometric Modelling and Applications, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

December 2009

1–5: Homology of algebra: structures and applications, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

8–12: Latent variables and mixture models, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

15–19: Meeting on mathematical statistics, CIRM Luminy, Marseille, France
Information: colloque@cirm.univ-mrs.fr; http://www.cirm.univ-mrs.fr

July 2010

4–7: 7th Conference on Lattice Path Combinatorics and Applications, Siena, Italy

Recent Books

edited by Ivan Netuka and Vladimír Souček (Prague)

Books submitted for review should be sent to: Ivan Netuka, MÚUK, Sokolovská, 83, 186 75 Praha 8, Czech Republic.

***A. Adem, J. Leida, Y. Ruan: Orbifolds and Stringy Topology**, Cambridge Tracts in Mathematics 171, Cambridge University Press, Cambridge, 2007, 149 pp., GBP 35, ISBN 978-0-521-87004-7*

This book offers an introduction to the theory of orbifolds from a modern perspective, combining techniques from geometry, algebraic topology and algebraic geometry. One of the main motivations, and a major source of examples, is string theory. The subject is first developed following the classical approach analogous to manifold theory. Then the description branches and it includes a useful description of orbifolds by means of groupoids, as well as many examples in the context of algebraic geometry. Classical invariants (e.g. the de Rham cohomology and bundle theory) are developed for orbifolds and a careful study of orbifold morphisms as well as orbifold K-theory and its twistings is provided. The heart of the book is in the penultimate chapter, which contains a detailed description of the Chen-Ruan cohomology, which introduces a new cup product for orbifolds and has had significant impact over the past few years. The final chapter includes explicit computations for certain interesting examples. (pso)

***I. Agricola, T. Friedrich: Elementary Geometry**, Student Mathematical Library, vol. 43, American Mathematical Society, Providence, 2008, 243 pp., USD 39, ISBN 978-0-8218-4347-5*

This book is a translation of the German original "Elementargeometrie" published by F. Vieweg and Sohn Verlag in 2005. It is intended as a compendium of the curriculum of elementary geometry for university students. Chapters 1-2 are devoted to an exhaustive study of planar elementary geometry. Many classical theorems are demonstrated including the Ceva theorem, the Menelaus theorem and various properties of triangles, circles and conic sections. Chapter 3 describes the group of Euclidean transformations and its subgroups including discrete ones. Chapter 4 deals with hyperbolic geometry (mainly in the Poincaré model) and in chapter 5 basics of spherical geometry are developed. The main techniques of the book are based on analytical computations in the Euclidean plane, which is introduced as the two dimensional real affine plane with a positive definite quadratic form. Also its identification with the complex line is exploited. Unfortunately, we do not find in the book projective proofs of Euclidean results that are projective in their essence. The book is nicely written, with numerous figures, and the material in the book is organised systematically. It can be widely used by university students and teachers. (zš)

***C. Bär, N. Ginoux, F. Pfäffle: Wave Equations on Lorentzian Manifolds and Quantization**, ESI Lectures in Mathematics and Physics, European Mathematical Society, Zürich, 2007, 194 pp., EUR 38, ISBN 978-3-03719-037-1*

This book is devoted to global solutions of the wave equation on Lorentzian manifolds and to a quantization of fields in general relativity. Fields with values in Hermitean or Riemannian finite rank vector bundles are allowed. Whereas the theory of local solutions to the wave equation is quite well developed, a detailed global approach is almost impossible to find in contemporary literature. The book gives a detailed introduction to the subject summarizing and unifying particular results. After recalling basic notions on distributions on manifolds and Lorentzian geometry, local solutions are constructed using the Riesz distribution and specific methods for obtaining convergence of the so-called formal solution are derived. Using local results, global existence and uniqueness are stated and proved in the case of globally hyperbolic manifolds. The notion of a globally hyperbolic manifold turned out to be the right replacement of the notion of a complete manifold, which is quite unsuitable in the Lorentzian geometry. Related geometric notions (e.g. causal future, causal past, past compact set, causally compatible set and Cauchy hypersurfaces) are defined and illustrated in several nice figures.

At the beginning of the last chapter (devoted to quantization) the theory of C^*-algebras and *CCR*-representations are developed in detail. Analytic results on global solutions to the wave equation are then used to obtain field quantization functors. In the appendix, necessary notions from categories, functional analysis, differential geometry and further needed topics are collected. The book is written very carefully and its contents is self-contained. It is recommended not only to mathematicians working in the area of Lorentzian geometry or global analysis but also to physicists working in general relativity or more generally to those who want to get familiar with (hyperbolic) partial differential equations on manifolds. (skr)

***R. Becker: Ordered Banach Spaces**, Travaux en cours, vol. 68, Hermann, Paris, 2008, 132 pp., EUR 43, ISBN 978-27056-6721-4*

Even though there are many excellent monographs on Banach spaces, the topic of ordered Banach spaces is not very often included. And even if it is, the authors usually deal only with the more particular case of Banach lattices. The aim of this book is to fill (at least partially) this gap and to provide an up-to-date study of the structure of convex cones contained in Banach spaces and some of the related operators. The book originates from three different sources. The first is conical measures (introduced by G. Choquet and used for developing integral representation theory). The second is the well-established theory of Banach lattices and the third is the Krivine theorem on finite representability of finite dimensional ℓ^p spaces in Banach lattices. By blending them together, the author obtains an original and instructive contribution to classical functional analysis.

The book starts by presenting various forms of the Hahn-Banach theorem and proving theorems of M. G. Krein, V. L. Klee and T. Ando on cones in Banach spaces. The second chapter is devoted to a presentation of B. Maurey's theorem on factorization of operators through L^p spaces. An important ingredient here and later on is the Rosenthal lemma. To study convex cones, chapter 3 introduces conical measures and their basic properties. The next part contains the first main results of the book on p-summing operators and their factorization. The author then proceeds with an investigation of representability of finite ℓ^p spaces in normal cones of Banach spaces. He also shows a relationship between type and cotype of a Banach space with the index introduced in the previous chapter. The author then studies positive operators starting in $C(K)$ spaces and he continues the investigation of p-summing operators on convex cones. The Pietsch inequality and

a composition theorem are proved. The last chapter describes the situation of tensor products and positive maps. Five appendices and several open problems complete the book making the presentation rather self-contained. (jsp)

***A. Beligiannis. I. Reiten: Homological and Homotopical Aspects of Torsion Theories**, Memoirs of the American Mathematical Society, no. 883, American Mathematical Society, Providence, 2007, 207 pp., USD 72, ISBN 978-0-8218-3996-6*

Torsion pairs (originally called 'torsion theories') entered module theory in the 60s through the works of Dickson and Gabriel, and were later developed into a powerful tool, e.g. in the monographs of Stenström and Golan. In the 80s, analogues of torsion pairs, called t-structures, were used in the seminal work of Beilinson, Bernstein and Deligne on triangulated categories. At about the same time, tilting theory emerged providing important examples of torsion pairs both in module categories and, later, in bounded derived categories of modules. Yet another source of torsion pairs, this time in stable module categories, came from (co)tilting theory via covariantly and contravariantly finite subcategories, notably in the works of Auslander and Reiten. Moreover, torsion pairs in stable categories were later shown to be closely related to complete cotorsion pairs in the original Abelian categories, and the latter to closed model structures in the sense of Quillen (e.g. in the works of Hovey). Thus it has become clear that torsion pairs tie together a number of important areas of contemporary algebra, topology and geometry.

The Beligiannis-Reiten memoir not only provides a comprehensive treatment of these ties but also finds remarkable generalisations, clarifications and extensions of the results mentioned above. The point is that the authors work in the general setting of pretriangulated categories, which includes both the Abelian and the triangulated setting as special cases. The core of the memoir consists of proving general correspondence theorems (some of which were mentioned above). Moreover, the authors use torsion pairs to develop universal cohomology theories generalising the Tate-Vogel (co)homology theory. There are also a number of concrete applications presented, notably to Gorenstein and Cohen-Macaulay categories (generalizing the classical Gorenstein and Cohen-Macaulay rings). The memoir covers an important area of contemporary pure mathematics; it is particularly recommended to anyone interested in modern representation theory, homological algebra or algebraic topology. (jtrl)

***N. Bergeron, L. Clozel: Spectre automorphe des variétés hyperboliques et applications topologiques**, Astérisque, no. 303, Société Mathématique de France, Paris, 2005, 218 pp., EUR 46, ISBN 2-85629-186-4*

This book consists of two parts. The first part gives a general introduction to the modern theory of automorphic forms with applications to spectral questions. In particular, it deals with the spectrum of differential forms on congruence hyperbolic manifolds. It contains, for example, the Selberg type theorem on the first eigenvalue of the Laplace operator acting on differential forms, using representation theoretic methods and techniques of proof. The second part of the book has a more differential geometric flavour. The main motivation of this chapter comes from Arthur conjectures, which imply strong restrictions on the spectrum of arithmetic manifolds and conjectural properties of the geometry of hyperbolic manifolds (proved in a weak form in some particular cases). (pso)

***V. I. Bogachev: Measure Theory**, Springer, Berlin, 2007, 1105 pp., EUR 119.95, ISBN 978-3-540-34513-8*

This is a remarkably comprehensive treatise on modern, as well as classical, measure theory and integration. Volume 1 covers constructions and extensions of measures, the (abstract) Lebesgue integral, L^p-spaces, signed measures, product measures (including infinite products), change of variables and connections between the integral and derivative (covering theorems, the maximal function, functions of bounded variation and absolutely continuous functions). Of course the Radon-Nikodym theorem, convolution and basic facts on the Fourier transform are included. Also, less traditional topics are discussed: uniform integrability, strong convergence of measures and a concise introduction to the Henstock-Kurzweil integral. The core material of volume 1 (500 pages in total) is divided into five chapters and the exposition is presented on about 170 pages.

What makes both volumes exceptional, interesting and extremely valuable are the sections "Supplement and exercises" attached to each chapter. These sections provide important additional material. Let us mention just a few subjects: set-theoretic problems in measure theory, invariant extensions of Lebesgue measure, Whitney's decomposition, Steiner's symmetrization, Hausdorff measures, the Brunn-Minkowski inequality, mixed volumes, weak compactness in L^1, Hellinger's integral, additive set functions, density of point sets, differentiation of measures, BMO, the area and coarea formulas, surface measures and the Calderon-Zygmund decomposition. Some of the exercises are marked as problems accessible for individual work of students while others extend the basic exposition and include plenty of material with hints and references. The concluding part "Bibliographical and Historical Comments" offers a rich, detailed and competent picture of the development and the present state of measure and integration theory.

Volume 2 is organised analogously with five chapters, each accompanied by "Supplement and exercises". The selection of material reflects the research orientation of the author and is written for analysts as well as for probabilists. The arrangement is not necessarily designed for linear reading; individual chapters are high quality detailed surveys on important parts of modern measure theory: Borel, Baire and Souslin sets, topological measure theory, weak convergence of measures, transformation of measures and isomorphisms and conditional measures and conditional expectations. There is again a wealth of material, which cannot be described here in detail. However, what should be mentioned is the collection of 2038 references also representing large contributions from the Russian mathematical school. This is an excellent and impressive monograph, which I can strongly recommended to researchers in analysis and probability, to university teachers as well as to students. I am convinced that this two volume treatise cannot be missing from university libraries and the shelves of mathematicians interested in measure and integration. (in)

***C. Bonnafé: Sur les caractères des groupes réductifs finis a centre non connexe: applications aux groupes spéciaux linéaires et unitaires**, Astérisque, no. 306, Société Mathématique de France, Paris, 2006, 165 pp., EUR 36, ISBN 978-2-85629-190-0*

The main topic treated in this book is a study of the properties of finite reductive groups with disconnected centre. Let G be a connected reductive group over a finite field F_q of characteristic p with Frobenius map F. The Lustig conjecture relates

almost characters of the finite reductive group G^F to characteristic functions of character sheaves of G (up to a scalar). If the corresponding scalars can be computed, the conjecture makes it possible to compute irreducible characters of G^F. The Lustig conjecture was proved by T. Shoji for the case when the group G has a connected centre and by J.-L. Waldspurger for Sp_{2n} and O_n (with p and q big enough). In the book, a circle of related problems (a parametrization of irreducible characters, a parametrization of character sheaves and computations of the character table) are treated for the case when the centre of G is not connected. It contains a review of results obtained by several authors as well as new results. In particular, the (generalized) Lusztig conjecture is proved here for the special linear group and for the special unitary group in the case that p is arbitrary and q is large enough. (vs)

A. Bressan, B. Piccoli: Introduction to the Mathematical Theory of Control*, AIMS Series on Applied Mathematics, vol. 2, American Institute of Mathematical Sciences, Springfield, 2007, 312 pp., GBP 39.50, ISBN 978-1-60133-002-4*

This book is devoted to the mathematical theory of control. It provides a self-contained introduction to the topic and it also includes some topics of current research. The main aim of the book is a study of the following control system $x'(t) = f(t,x(t),u(t))$, where $u(t)$ belongs to U, t belongs to some time interval $(0,T)$, x in R^n is a controlled unknown quantity and u is a control from the set of admissible controls U, which is a subset of R^m. Basic properties of the control system are described in chapter 3. Considering, in addition to the equation described above, a cost functional depending on the terminal value $x(T)$ and/or on the whole trajectory x, the existence of an optimal control is studied in chapter 5. Chapters 6–8 are devoted to a discussion of necessary and sufficient conditions for optimal control. In chapter 4, asymptotic stabilization of the system by stabilizing feedback is studied. The topic is further developed in chapter 9, where a new tool of patchy feedbacks (which might be discontinuous) is introduced. Chapter 10 deals with impulsive control systems, also depending on the derivative of the control u.

A necessary background can be found in the appendix and in chapter 2, where basics of the theory of ordinary differential equations are explained with special focus to issues arising from the theory of optimal control. The book is well organised. Simplified problems are presented first, if possible, in order to explain main ideas. Proofs of theorems are nicely structured and divided clearly into steps. The book also contains many figures and examples helping to understand the subject. Each chapter contains several homework problems. The book can serve students of science and engineering as an introduction to the theory of nonlinear control and as an overview of basic techniques and results in the field. It can be used as the basis for a course on control theory at a beginning graduate level. (pkap)

J. Bryant, C. Sangwin: How Round is Your Circle?*, Princeton University Press, Princeton, 2008, 306 pp., USD 29.95, ISBN 978-0-691-13118-4*

The subtitle of the book is "Where Engineering and Mathematics meets"; indeed, one of the authors is an engineer and the other is a mathematician. The book illustrates how physical models can be created from mathematical ones. To be more precise, the book is devoted to various relations between geometry and mechanics. Various topics, presented in 13 chapters, include construction of linkages producing exact and approximate movements along straight lines and other curves, balancing bodies and dissecting and recomposing planar figures. The topics treated in the book are usually first briefly explained from the (correct) geometrical point of view and then applied to physical constructions. The book is very nicely printed and contains many nice figures and photographs of physical models, as well as an extensive bibliography. It can be recommended as a formal or recreational lecture both for mathematicians and engineers. (zš)

J.B. Conrey, D. W. Farmer, F. Mezzadri, N. C. Snaith, Eds.: Ranks of Elliptic Curves and Random Matrix Theory*, London Mathematical Society Lecture Note Series 341, Cambridge University Press, Cambridge, 2007, 361 pp., GBP 40, ISBN 978-0-521-69964-8*

Random Matrix Theory (RMT) was created by physicists in a study of statistical properties of energy levels of atomic nuclei. The book contains a series of 22 lectures on relations of RMT to problems in number theory and it clearly shows the amazing richness of the subject. Many papers are related to lectures given at a workshop on the topic organised at the Isaac Newton Institute in 2004. An important feature of the book is that it contains a number of excellent survey papers, including the paper by C. Delaunay (probabilistic group theory), D.W. Farmer (families of L-functions), A. Gamburd (symmetric functions and RMT), E. Kowalski (families of elliptic curves and random matrices), F. Rodrigues-Villegas (central values of L-functions), A. Silverberg (ranks of elliptic curves), P. Swinnerton-Dyer (2-descent on elliptic curves), D. Ulmer (functions fields and random matrices) and M.P. Young (analytic number theory and ranks of elliptic curves). Due to these expository lectures, the book may well be of help to newcomers to the field. (vs)

C. De Lellis: Rectifiable Sets, Densities and Tangent Measures*, Zürich Lectures in Advanced Mathematics, European Mathematical Society, Zürich, 2008, 124 pp., EUR 26, ISBN 978-3-03719-044-9*

This interesting book is based on the author's course given at the University of Zürich. It is addressed to people who are interested in geometric measure theory. The main aim of the book is to provide a self-contained proof of the celebrated Preiss theorem, which in particular characterizes k-dimensional rectifiable sets in an n-dimensional Euclidean space using existence of k-dimensional densities. The Preiss theorem (proved in 1987) is the culmination of the long deep research started by Besicovich in 1938. In its full generality, it gives a rectifiability criterion for measures in terms of upper and lower densities. The author of the book presents a simpler proof of its special case dealing with the density of measures. In this way, he succeeded in presenting a proof accessible for people who are not experts in the field. However, most of deep ideas that are used in the Preiss proof (in particular the method of tangent measures) are needed in this simpler proof and are carefully explained. The first four chapters contain an introduction to rectifiable sets and measures in Euclidean spaces, including basic properties of tangent measures and the most elementary rectifiability criterions. The fifth chapter contains the subtler Marstrand-Mattila rectifiability criterion. In the sixth chapter,

the Preiss strategy is explained and its ingredients are proved in the following three chapters. The last chapter presents several open problems related to the topic. (lz)

***P. Deligne, B. Malgrange, J.-P. Ramis: Singularités irrégulières. Correspondance et documents**, Documents Mathématiques, vol. 5, Société Mathématique de France, Paris, 2007, 188 pp., EUR 47, ISBN 978-2-85629-241-9*
The book contains a few introductory texts of the authors on an irregular version of Hodge theory, the formal reduction of differential equations with irregular singularities and Gevrey filtration on the Picard-Vessiot group of irregular differential equations. The general theme behind these expositions comprises topics like the theory of linear differential equations with irregular singularities, asymptotics of their solutions, Stokes sheaves and Galois theory of differential fields. However, the core of the book is based on reprints of correspondence among the authors (with a few exceptions) on the topics mentioned above in the period 1976-1991 (with a few exceptions). In this way, an interested reader can gain a direct insight into the evolution of the subject, culminating in applications like the geometric Langlands program. (pso)

***E. S. Edgington, P. Onghena: Randomization Tests, fourth edition + CD-Rom**, Statistics: A Series of Textbooks and Monographs, Chapman & Hall/CRC, Boca Raton, 2007, 345 pp., USD 79.95, ISBN 978-1-58488-589-4*
This is the fourth edition of the book "*Randomization Tests*" containing a large number of innovative applications of randomization tests in experimental design, significance testing, computing facilities and other fields. The book focuses more on design than on test statistics. This volume can serve as a practical source book for researchers but, at the same time, it puts emphasis on randomization tests rationale. In comparing with the third edition, this volume gives a more didactical approach in the exposition and it contains many new examples making the book more accessible as a textbook for students in applied statistics. The book contains 15 chapters on topics including statistical tests that do not require random sampling, randomized experiments, between-subject and factorial designs, repeated-measures and randomized, block design and multivariate design, trend tests, tests of quantitative laws, tests of direction and magnitude of effect. (lkl)

***D. A. Ellwood, P. S. Ozsváth, A. I. Stipsicz, Z. Szabó, Eds.: Floer Homology, Gauge Theory, and Low-Dimensional Topology**, Clay Mathematics Proceedings, vol. 5, American Mathematical Society, Providence, 2006, 297 pp., USD 64, ISBN 978-0-8218-3845-7*
Mathematical gauge theories investigate solution spaces of partial differential equations defined with the help of a principal bundle connection. These partial differential equations are generalizing (nowadays classical) equations introduced by physicists Yang and Mills in the realm of the strong interaction or, mathematically speaking, in the realm of principal SU(3)-bundles over four dimensional manifolds. After fundamental works by Simon Donaldson, Nathan Seiberg and Edward Witten, the gauge theory approach is extensively used in investigations of the (low dimensional) topology of manifolds. There is a strong relationship of these theories to symplectic geometry. The Floer construction is throwing light on this relationship; it can be applied either to define symplectic invariants of Lagrangian submanifolds or to define certain invariants of 3-manifolds. The Heegaard Floer homology is derived from an application of the Lagrangian Floer homology and it is conjecturally equivalent to the Seiberg-Witten theory. However, it is much more combinatorial and often more suitable for calculations.

These striking interplays between the low dimensional topology and symplectic geometry are the main subject of this book, which is freely based on lecture courses given at the Clay Mathematics Institute Summer School in Budapest, Hungary, in 2004. Preparatory and introductory parts contained in these proceedings are written in an intelligible way, often with proofs. Also, many examples and figures are included in the book. In this way it can serve for researchers active in the subject and related fields as well as for graduate students. Specific chapters of the book are devoted to the Heegaard Floer homology and knot theory, Floer homologies, contact structures, symplectic 4-manifold and Seiberg-Witten invariants. The authors are the following experts in the mentioned research field: P. Oszváth, Z. Szabó H. Goda, J. Etnyre, A. Stipsicz, P. Lisca, T. Ekholm, R. Fintushel, R. Stern, J. Park, Tian-Jun Li, D. Auroux and I. Smith. (skr)

***J. Feng, T. G. Kurtz: Large Deviations for Stochastic Processes**, Mathematical Surveys and Monographs, vol. 131, American Mathematical Society, Providence, 2006, 410 pp., USD 99, ISBN 978-0-8218-4145-7*
This book is focused on recent results on large deviation for a general class of Markov processes obtained mostly by the authors. It is not intended for beginners and inexperienced readers and a very good mathematical background and a preliminary knowledge of Markov processes and stochastic analysis is an advantage when reading the book. The volume itself is divided into five parts. The book starts with an introduction and overview with many motivating examples and it ends with an extensive appendix containing useful results on operators, semigroups and mass transport theory. The core of the book is in the remaining three sections. Large deviations in general are treated in section 1. The exponential tightness and necessary and sufficient conditions for it are given in an analogous way as for classical tightness of measures. The rate function is introduced and the problem of identifying the rate function is studied. Section 2 gives an overview of the classical semigroup approach to large deviations of Markov processes and an alternative approach using viscosity solutions. The proofs of large deviation results need verification of a comparison principle. Since it is typically the most difficult step, a chapter in section 3 is devoted to this problem. In the rest of section 3, the comparison principle is discussed for different stochastic processes, in particular for nearly deterministic processes with almost negligible perturbation, for stochastic processes in a random environment, for occupation measures of Markov processes and, finally, for solutions of stochastic equations in infinite dimensions. Large deviations have many applications in probability and statistics, hence the book may be recommended to researchers in the field of stochastic processes and their applications or to specialists in statistics of stochastic processes. (dhl)

***C. Gilain, Ed.: Œuvres complètes de Jean Le Rond d'Alembert. Textes de mathématiques pures 1745–1752**, CNRS Editions, Paris, 2007, 436 pp., EUR 60, ISBN 978-2-271-06013-3*
This book contains d'Alembert's mathematical texts on pure mathematics written between 1740 and 1752, when he was one of

the most important members of the Academy of Sciences in Paris. The book is the fourth volume of the first series of the critical edition of d'Alembert's collected papers prepared by a group of mathematicians, historians of sciences and philosophers (directed by Christian Gilain, a specialist in the history of mathematical analysis and a professor at Université Pierre et Marie Curie, Paris). The book starts with a comprehensive introduction, where d'Alembert's mathematical ideas, works and results are presented and their role in the development of mathematics is analysed. The next part contains three texts with the title "Recherches sur le calcul intégral" (1745, 1746, 1747) containing d'Alembert's fundamental contributions to integral calculus (e.g. integration of algebraic functions of a real variable, integration of rational and irrational functions, the Riccati equation and its solution, the d'Alembert equation and its singular solutions, rectification of ellipse and hyperbola, methods for solution of some systems of differential equations) together with many notes and remarks. The paper "Observation sur quelques mémoires imprimés dans le volume de l'Academie 1749" (1752) contains d'Alembert's theory of complex numbers and his contributions to the fundamental theorem of algebra, which were inspired by Euler's works. The fifth text "Sur les logarithmes des quantités négatives" (1752) shows d'Alembert's concept of the logarithm of negative, and complex, numbers. The sixth of d'Alembert's published articles "Additions aux recherches sur le calcul intégral" (1752) contains some corrections and an extension of his text on integral calculus from 1747. At the end of the book, there are three appendices containing some proofs of the fundamental theorem of algebra inspired by d'Alembert's works, a large list of references, indexes and a list of illustrations. The book can be recommended to a wide audience; it is suitable for mathematicians, historians of mathematics and science, students and teachers. (mbec)

R. Glowinski, J.-P. Zolésio, Eds.: Free and Moving Boundaries: Analysis. Simulation and Control*, Lecture Notes in Pure and Applied Mathematics, vol. 252, Chapman & Hall/CRC, Boca Raton, 2007, 454 pp., USD 152.96, ISBN 978-1-58488-606-8*

This book contains 24 selected papers presented at the conference "Free and moving boundary analysis, simulation and control" held in Houston, Texas, in 2004. It includes a discussion of various concepts of how to treat moving domains and moving boundary conditions in systems described by partial differential equations (e.g. the concept of fictitious domains introduced by R. Glowinski, the concept of arbitrary Euler-Lagrange representations and a level set technique for moving geometry). Many papers in the volume also discuss various applications to other fields (algebraic problems in biomathematics, dynamical control of geometry, problems arising from continuum mechanics, stabilization of structures, three-dimensional electromagnetism, inverse problems and numerical simulation of suspensions and liquids). (vs)

G. Harutyunyan, B.-W. Schulze: Elliptic Mixed, Transmission and Singular Crack Problems*, Tracts in Mathematics 4, European Mathematical Society, Zürich, 2007, 765 pp., EUR 112, ISBN 978-3-03719-040-1*

The object of this book is to study elliptic boundary value problems with data, which may have singularities (e.g. mixed boundary value problems, boundary value problems with transmission property and singular crack problems, a prominent example being the Zaremba problem for the Laplace equation with mixed Dirichlet and Neumann boundary conditions). The authors' aim is to study such problems based on the general calculus of operators on a manifold with edges or conical singularities and boundary. General theory then allows the construction of parametrix for considered problems and the proof of the regularity of the solutions. In the last chapter, an applied approach with operator algebras and symbolic structures on manifolds with singularities is discussed, together with motivations and branches of research over the past years and new challenges and open problems for the future. The mathematicians and physicists interested in elliptic differential equations with singularities will definitely appreciate the unified approach presented in the book. The authors also address the text to advanced students and specialists working in the field of analysis on manifolds with geometric singularities, applications of index theory and spectral theory, operator algebras with symbolic structures, quantization and asymptotic analysis. (pkap)

B. Hassett: Introduction to Algebraic Geometry*, Cambridge University Press, Cambridge, 2007, 252 pp., GBP 19.99, ISBN 978-0-521-69141-3*

The exposition of the subject of algebraic geometry in this book does not pass through sheaf theory, cohomology, derived functors, categories or abstract commutative algebras but it is rather focused on specific examples, together with a part of the basic formalism that is most useful for computations. In particular, Gröbner bases are introduced quite early and for almost every technique there is both an algorithmic and a computational approach. All core techniques of algebraic geometry are developed systematically from scratch, with necessary commutative algebra integrated to geometry. Classical topics (like resultants and elimination theory) are discussed in parallel with affine varieties, morphisms and rational maps. Important examples of projective varieties (like Grassmannians, Veronese and Segre varieties) are emphasised, along with the matrix and exterior algebras needed to write down their defining equations. (pso)

K. H. Hofmann, S. A. Morris: The Lie Theory of Connected Pro-Lie Groups*, Tracts in Mathematics, vol. 2, European Mathematical Society, Zürich, 2007, 678 pp., EUR 88, ISBN 978-3-03719-032-6*

This comprehensive monograph is devoted to a systematic treatment of pro-Lie groups. The notion of a pro-Lie group is a generalization of compact groups as well as of locally compact connected topological groups with a property that an arbitrary product of pro-Lie groups is again a pro-Lie group. The monograph is devoted to a systematic treatment of pro-Lie groups based on a theory of pro-Lie algebras, which is very much similar to the structure theory of finite dimensional Lie algebras. The book is very carefully organised. It begins with 60 pages of an overview of the contents of the book describing the structure of the theory. A good understanding of projective limits is a necessary prerequisite for the book, although a careful description of it can be found in chapter 1. Pro-Lie groups are introduced in chapter 3. A structure of commutative pro-Lie groups and their relations to weakly complete (infinite dimensional) topological vector spaces are discussed in chapter 5. As in the classical theory, a key point of the theory is a structure theory for pro-Lie algebras, introduced in chapter 7. The full structure theory is then treated in chapters 8–13. The book ends with a catalogue of examples. The book is very well written and it offers a first systematic treatment of the subject in the literature. (vs)

***Y. Ilyashenko, S. Yakovenko: Lectures on Analytic Differential Equations**, Graduate Studies in Mathematics, vol. 86, American Mathematical Society, Providence, 2008, 625 pp., USD 79, ISBN 978-0-8218-3667-5*

This book is devoted to the analytic theory of ordinary differential equations with complex time. Methods for the investigation of local and global properties of solutions are deeply examined so that the current state of typical problems like the 16th Hilbert problem (the number of limit cycles of polynomial planar vector fields) and the Riemann-Hilbert problem (i.e. the 21st Hilbert problem on the existence of a linear system with prescribed monodromy group and position of all singularities) can be presented. The first two chapters are devoted to an analysis of singular points of holomorphic vector fields by holomorphic normal forms. A local analysis of singularities is based on the notion of algebraic and analytic solvability. Chapter 3 deals with the local and global theory of linear systems. This chapter also contains positive and negative results on the solvability of the Riemann-Hilbert problem. Chapter 4 is concerned with analytic classification of resonant singularities. The main working tool here is an almost complex structure and quasiconformal maps. In the last chapter, the global theory of polynomial differential equations on the real and complex plane is investigated. Tools for the study of limit cycles (the 16th Hilbert problem) near poly-cycles or those which bifurcate from non-isolated periodic orbits (Abelian integrals) are presented. It is also shown how generic properties of complex foliations differ from real ones.

The book is carefully written and important notions are motivated and explained in detail. All sections end with exercises and problems often lying at the frontier of current research. A good knowledge of various parts of analysis (e.g. complex analysis in several variables) and topology is required. The book is aimed at senior graduate students in differential equations. Professionals can also find here an initiation into the present-day level of research and interesting applications of algebraic geometry to differential equations. (jmil)

***S. B. Iyengar, G. J. Leuschke, A. Leykin, C. Miller, E. Miller, A. K. Singh, U. Walther: Twenty-Four Hours of Local Cohomology**, Graduate Studies in Mathematics, vol. 87, American Mathematical Society, Providence, 2007, 282 pp., USD 55, ISBN 978-0-8218-4126-6*

This book contains 24 lectures by a group of authors on the topic of local cohomology. The notion of local cohomology was originally introduced by A. Grothendieck in the realm of algebraic geometry. Nowadays, the subject has a lot of relations to various other fields of mathematics. The book contains a revised set of lectures notes on the theme of local cohomology presented at the summer school organised at Snowbird, Utah, in 2005. Quite a few first lectures in the series cover the basic prerequisites needed later from geometry, sheaf theory and homological algebra (the Krull dimension of a ring, the dimension of an algebraic set and the dimension of a module; sheaves and ~ech cohomology; complexes, resolutions and derived functors, and projective dimension; gradings, filtrations and Gröbner bases; and the Koszul complex and depth). It makes it possible to introduce the local cohomology functors and its first properties (depth and cohomological dimension). A further two lectures discuss properties of Cohen-Macaulay and Gorenstein rings. Further lectures treat relations to commutative algebra, algebraic geometry, topology and combinatorics. A few lectures also cover computational aspects (algorithms related to Gröbner bases, Weyl algebras and D-modules). (vs)

***V. J. Katz, Ed.: The Mathematics of Egypt, Mesopotamia, China, India, and Islam. A Sourcebook**, Princeton University Press, Princeton, 2007, 685 pp., USD 75, ISBN 978-0-691-11485-9*

This is the first book collecting the English translations of the historical mathematical texts from the five ancient and medieval non-Western mathematical cultures. It is the biggest sourcebook containing the newest fruit of historical research and that is why the book can replace older sources for the history of mathematics. The book is divided into five sections: Egypt (written by A. Imhausen), Mesopotamia (by E. Robson), China (by J. W. Dauben), India (by K. Plofker) and Islam (by J. L. Berggen). Each chapter starts with a detailed introduction that gives an overview of each culture, historical and social contexts, events and heritages, discovery of writing, origin of mathematics, numerical systems, etc. Then a deeper analysis of mathematical sources is presented. The authors of each part are renowned experts in their fields; they have carefully selected key mathematical texts, they provide new translations and in many cases they give new interpretations, commentaries and notes. They explain the mathematical skills and knowledge of the ancient and medieval non-Western mathematicians and they analyse the role of mathematics in these civilizations and its impact on their developments. The book can be recommended to students, teachers, historians and mathematicians as well as anyone who wants to understand the depth and power of ancient mathematics and who wants to learn about mathematical ideas and their use in the daily life of non-Western cultures. (mbec)

***J. Kohlas, P.-A. Monney: Statistical Information. Assumption-Based Statistical Inference**, Sigma Series in Stochastics, vol. 3, Heldermann, Lemgo, 2008, 170 pp., EUR 32, ISBN 978-3-88538-303-1*

This monograph is based on ideas by A. Dempster (1967) and G. Shafer (1976). They developed probabilistic argumentation systems combining logic and probability with a unified theory of inference under uncertainty. It has numerous applications in various fields (artificial intelligence, diagnostics and reliability, among others). The book applies this new theory to statistical inference. In particular, a new principle, called by the authors assumption-based inference in statistics reasoning, is introduced and worked out. Both the Bayesian approach and the Fisher fiducial probabilities are seen as special cases of a more general theory. The authors show the possibility of a new approach to discrete probability models, continuous probability models and linear models. Basic principles are introduced and explained in part concerning simple discrete probability models. A number of illustrative examples help in understanding the theory. The book is intended to open a new view on statistical inference. (mahus)

***R. Y. Liu, R. Serfling, D. L. Souvaine, Eds.: Data Depth – Robust Multivariate Analysis, Computational Geometry and Applications**, DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, vol. 72, American Mathematical Society, Providence, 2006, 246 pp., USD 89, ISBN 978-0-8218-3596-8*

Fifteen papers presented at the workshop Data Depth: Robust Multivariate Analysis, Computational Geometry and Applica-

tions (held in May 2003 at the Rutgers University) are collected in this book. The recent development of data depth and its applications are presented by leading researchers in the field. Contributions may be divided into three main groups. Statistical theory and applications of data depth comprise the first part of the book. Among the main topics the reader will find are a general study of depth functions, tests based on data depth, development of zonoid, simplicial and spherical depth, classification and discrimination based on the depth function, regression depth and depth for functional data. The second section of presentations covers computational problems related to data depth. The main problem is to find fast algorithms for computing the depth, a process which is typically very slow, in particular in higher dimensions. The last section of contributions is devoted to geometric aspects of statistical data depth. The book can be recommended to researchers or students interested in multivariate statistical analysis and its applications. (dhl)

J.-P. Luminet: The Wraparound Universe*, A.K. Peters, Wellesley, 2008, 316 pp., USD 39, ISBN 978-1-56881-309-7*

This interesting book is the English translation of the first French edition published in 2001 by Jean-Pierre Luminet, an astrophysicist at the Paris-Meudon Observatory in France. The main aim of the book is to describe a particular approach to cosmology. The author discusses the topology of the universe, which is not a simple theme for popularisation. To understand the main topics, there is a requirement for a deeper knowledge of mathematics (e.g. non-Euclidean geometry, the classification of surfaces, the classification of three-dimensional spaces and symmetries), physics (the theory of relativity, the curvature of the universe and cosmic crystallography), astrophysics (astronomical distances, cosmic repulsions, etc.) and the history of cosmological ideas and philosophical concepts of the cosmos and spaces.

The central notion is the theory of "the wraparound universe". The author discusses a model of wrapped universes, their experimental ramifications, problems of their sophisticated observations and their consequences (e.g. size of space, fraction of distant galaxies, folds in the universe, expansion and the infinite, the rate of expansion and the age of the universe). The author also tries to explain the most important parts of general relativity, big bang models and cosmic topology. The book is very well written and nicely illustrated; the author uses a simple graphical representation to solve and explain complex problems. The author combines his understanding of history, scientific knowledge and expository skill to produce the book, which can be recommended to all readers interested in mathematical and astronomical ideas and cosmology, as well as the topology of the universe. (mbec)

M. J. Mohlenkamp, M.C. Pereyra: Wavelets, Their Friends, and What They Can Do for You*, Lectures in Mathematics, European Mathematical Society, Zürich, 2008, 109 pp., EUR 24, ISBN 978-3-03719-018-0*

The goal of these lecture notes is to introduce the reader to the central concepts related to wavelets and their applications as quickly as possible. By focusing on essential ideas and arguments, the authors indicate appropriate places in the literature for detailed proofs and real applications. The book is organised as follows. A preliminary chapter containing some of the required concepts and definitions is included for reference. In chapter 2, time-frequency analysis is reviewed. The authors start with Fourier series and the Fourier transform. The windowed Fourier transform, the Gabor basis and local trigonometric bases are discussed. Finally the authors gain localization at the scales with the wavelet transform. In chapter 3, the notion of multiresolution analysis (MRA) is introduced. The Haar wavelets and MRA is carefully described. This example contains most of the important ideas behind MRA. Daubechies compactly supported wavelets are described briefly and pointers to the literature are given.

In chapter 4, the authors discuss variants of the classical orthogonal wavelets and MRA. The MRA associated to biorthogonal and multiwavelets are also carefully described. The authors also explain how to construct wavelets in two dimensions by tensor products. The wavelets confined to an interval or a domain in the space are very briefly mentioned. The authors also discuss wavelet packets and some relatives and mutations of wavelets that have been constructed to tackle more specialized problems. Finally the prolate spheroidal wave functions are studied. In chapter 5, a few applications are described without attempting to be systematic or comprehensive. The choice of sample applications is dictated by the authors' experiences in this area. A description is made in some detail of how to calculate derivatives using biorthogonal wavelets, and how one can construct wavelets with more fancy differential properties. The authors also describe how wavelets can characterize a variety of function spaces and how well adapted wavelets are able to identify very fine local regularity properties of functions. Finally the authors very briefly describe how wavelets could be used for the study of differential equations. The authors expect the reader to have been exposed to some real and complex analysis, calculus and linear algebra and some concepts of orthonormal bases, orthogonal projections and orthogonal complements on Hilbert space. The book is intended for beginning graduate students and beyond. (knaj)

P. J. Nahin: Digital Dice. Computational Solutions to Practical Probability Problems*, Princeton University Press, Princeton, 2008, 263 pp., USD 27.95, ISBN 978-0-691-12698-2*

Books containing interesting problems from probability theory and/or mathematical statistics are very popular among teachers and students. This kind of recreational mathematics offers supplementary material for use in classes. The formulation of problems gives an opportunity of discussing how to construct models in real life. Solutions often lead to seemingly paradoxical results. Sometimes calculations are based on theorems from quite different branches of mathematics, which makes it possible to present the beauty of mathematical thinking. Collections of such problems have been published for many years. Contemporary books containing such material include those by G. J. Székely (Akadémiai Kiadó, Budapest, 1986), P. J. Nahin (Princeton Univ. Press, 2000), H. Tijms (Cambridge Univ. Press, 2004) and also my book (J. Anděl, Wiley, New York, 2001).

In this book the author includes problems that come from some aspect of everyday real life. However, even simply formulated problems may be too hard to be solved analytically. On the other hand, numerical answers can be reached using simulations. This is the main difference between this book and the others. The author first presents a MATLAB code and the results of simulations and only then an analytic solution is given (or outlined) – if it is known. The book is divided into three parts. The first part contains the formulation of the problems with some historical remarks, the second part describes the MATLAB solutions

to the problems and the third part is composed of nine appendices. In the appendices, we find some theoretical complements to presented problems. Of course, some additional references to problems presented in the book can be given. For example, an interesting motivation to the material on page 22 can be found in the book by J. Swift (The Math. Teacher, 76, 268–269,1983). I have two critical remarks. In all computations, where a random number generator is used, I strongly recommend fixing the seed at the beginning of calculations. Only in this way can everybody repeat the whole process with the same results. Unfortunately, the author does not use this approach. Secondly, the author presents remarks as a special subsection at the end of each section. I find this annoying; it would be much better to print them as footnotes. In conclusion, though, I believe that this book will find many readers and that the problems presented here will refresh introductory courses in probability theory. (ja)

***A. V. Pajitnov: Circle-valued Morse Theory**, de Gruyter Studies in Mathematics, vol. 32, Walter de Gruyter, Berlin, 2006, 454 pp., EUR 98, ISBN 978-3-11-015807-6*

Reformulated in modern terms, the geometric essence of Morse theory is as follows. For a smooth function f on a closed manifold having only non-degenerate critical points (a Morse function), there is a chain complex MCC (Morse chain complex) freely generated by the set of critical points of f, such that the homology of MCC is isomorphic to the homology of the underlying manifold and the boundary operator in this complex is related to the geometry of the gradient flow of f. Motivated by a problem in hydrodynamics, S. P. Novikov initiated a study of circle-valued Morse functions in the early 80s. The aim of the book is to give a systematic treatment of the geometric foundations of Morse-Novikov theory. Various applications of this approach to problems in differential topology include the Arnold Conjecture in the theory of Lagrangian intersections, fibrations of manifolds over the circle, dynamical zeta functions and the theory of knots and links in the three sphere. (pso)

***A. Papadopoulos, Ed.: Handbook of Teichmüller Theory, vol. I**, IRMA Lectures in Mathematics and Physics, vol. 11, European Mathematical Society, Zürich, 2007, 793 pp., EUR 98, ISBN 978-3-03719-029-6*

This book is the first volume of a comprehensive treatment of Teichmüller theory and its many different facets. There are 14 papers by different authors, divided into four parts. The first part is devoted to the metric and analytic theory (the Weil-Petersson metric, a harmonic map interpretation of a compactification of the Teichmüller space, the Teichmüller metric, Thurston's asymmetric metric, decorated hyperbolic structure, Hölder distributions, the Grothendieck dessins and Teichmüller disks). Group theory aspects are studied in the second part (mapping class groups and their subgroups, deformations of Kleinian groups and a geometry of the complex of curves). Surfaces with singularities and discrete Riemann surfaces form the topic of the third part. Beautiful relations to quantum physics are discussed in the last part of the book (including quantization theories of the Teichmüller space, lamination spaces, a modular functor from quantized Teichmüller theory and a quantization of the moduli space of irreducible flat PSL(2,R) connections on a punctured surface). The first volume of the handbook already shows an extraordinarily broad spectrum of important and interesting topics related to Teichmüller theory. (vs)

***E. Park: Complex Topological K-Theory**, Cambridge Studies in Advanced Mathematics 111, Cambridge University Press, Cambridge, 2008, 208 pp., GBP 38, ISBN 978-0-521-85634-8*

This book brings a modern exposition of complex topological K-theory. It is designed for beginners in the field of K-theory, primarily for graduate students. The exposition is quite self-contained and the author has reduced the number of prerequisites for reading to a minimum. On the other hand, the text is not very long, consisting of only 208 pages. This was possible because the author has limited the exposition to the most central and classical part of K-theory, namely the above mentioned complex topological K-theory. No other parts of K-theory are included. Nevertheless, the reader can find here hints for reading about other parts of K-theory. Vector bundles are often studied here in terms of idempotents and invertible matrices over Banach algebras of continuous complex-valued functions. We should also remark that the last quarter of the book deals with characteristic classes of vector bundles in the Chern-Weil style. Each chapter is followed by exercises. Generally we can say that the presentation is very nice and the book can be strongly recommended. (jiva)

***V. Pestov: Dynamics of Infinite-dimensional Groups. The Ramsey-Dvoretzky-Milman Phenomenon**, University Lecture Series, vol. 40, American Mathematical Society, Providence, 2006, 192 pp., USD 39, ISBN 0-8218-4137-8*

The main theme of this book is a study of properties of a certain class of infinite-dimensional groups. It is very much an interdisciplinary topic having relations to many parts of mathematics, including representations theory, descriptive set theory, infinite dimensional Lie groups, topological transformation groups, operator algebras, topological and ergodic dynamics and Ramsey theory. An approach presented in the book describes relations among dynamical properties of these groups, asymptotic geometric analysis, Ramsey type theorems in combinatorics and concentration properties. A presentation of a circle of problems relating the mentioned topics is based on a detailed study of representative examples (e.g. the unitary group of a Hilbert space, the group of homeomorphisms of a manifold, the infinite symmetric group, the group of transformations of measure spaces) and it covers many recent results in the field. (vs)

***D. J. Sheskin: Handbook of Parametric and Nonparametric Statistical Procedures, fourth edition**, Chapman & Hall/CRC, Boca Raton, 2007, 736 pp., USD 139.95, ISBN 978-1-58488-814-7*

This book is the fourth extended edition of the handbook designed to provide researchers, teachers and students with a comprehensive reference in the area of parametric and nonparametric statistical methods. The author focuses on hypothesis testing. The structure of the handbook is the following: introduction, 40 tests (with a separate chapter for each test) and appendix containing tables. The third edition has only 32 tests. The fourth one contains eight additional chapters (tests) concerning multivariate statistical methods and some medical statistics. Their titles are: multivariate regression, Hotelling's T^2, multivariate analysis of variance, multivariate analysis of covariance, discriminant function analysis, canonical correlational, logistic regression, and principal components analysis and factor analysis. The chapters (tests) all have the same structure: basic information on the particular problem, illustrative example, formulation of the null and alternative hypotheses, test computation (statistical software package SPSS serves as

the basic software), interpretation of the test results, related tests, additional discussion, additional examples and references. The same structure in each chapter ensures that chapters are self-contained. The handbook can serve as a reference book for classical statistical procedures concerning hypothesis testing. (mahus)

***D. Simson, A. Skowronski: Elements of the Representation Theory of Associative Algebras. 2: Tubes and Concealed Algebras of Euclidean Type**, London Mathematical Society Student Texts 71, Cambridge University Press, Cambridge, 2007, 308 pp., GBP 27.99, ISBN 978-0-521-54420-7*

***D. Simson, A. Skowronski: Elements of the Representation Theory of Associative Algebras. 3: Representation-Infinite Tilted Algebras**, London Mathematical Society Student Texts 72, Cambridge University Press, Cambridge, 2007, 456 pp., GBP 29.99, ISBN 928-0-521-70876-0*

These are the second and third volumes of a long awaited modern treatment of representation theory of finite dimensional algebras, written by some of the leading experts in the area. The first volume dealt with fundamentals of the theory, introducing Auslander–Reiten quivers, tilting theory and classification of representations of finite algebras. The main goal of the second and the third volumes is to study representations of infinite tilted algebras $B = \mathrm{End}\, T_{KQ}$ for a Euclidean diagram Q and an algebraically closed field K and give a complete description of their finite dimensional indecomposable modules, their modules categories mod B and the Auslander-Reiten quivers $\Gamma(\mathrm{mod}\, B)$.

Volume 2 starts with a chapter on tubes and then develops in detail the structure theory for regular components of concealed algebras of Euclidean type. This is then applied to a complete classification of all indecomposable modules over tame hereditary algebras. In the final chapter, a criterion for infinite representation type is proved and then applied to the Bongartz-Happel-Vossieck classification of all concealed algebras of Euclidean type in terms of quivers and relations.

The first part of Volume 3 culminates in the classification of all tilted algebras of Euclidean type due to Ringel. The next two chapters are dedicated to wild hereditary algebras and to a proof of the Drozd tame-wild dichotomy. In the final chapter, a number of recent results pertaining to the topic are listed without proof; as the authors point out, the extent of the volumes did not allow for presentation of all the contemporary tools (in particular covering techniques and derived categories). Each chapter of both volumes ends with a number of exercises; moreover, there are many examples worked out in detail throughout the text. The volumes are indispensable both for researchers and for graduate students interested in modern representation theory. (jtrl)

***H. Triebel: Function Spaces and Wavelets on Domains**, Tracts in Mathematics, vol. 7, European Mathematical Society, Zürich, 2008, 256 pp., EUR 58, ISBN 978-3-03719-019-7*

This book develops a theory of wavelet bases and frames for function spaces on various types of domains (such as Euclidean n-spaces) and on related n-manifolds. Basic notation and classical results are repeated in order to make the text self-contained. The book is organised as follows. Chapter 1 deals with the usual spaces on R^n, periodic spaces on R^n and on the n-torus T^n, and their wavelet expansions under natural restrictions for the parameters involved. Spaces on arbitrary domains are discussed in chapter 2. The heart of the exposition is found in chapters 3 and 4, where the author develops the theory of function spaces on so-called thick domains (including wavelet expansions and extensions to corresponding spaces on R^n). In chapter 5 this is completed with spaces on smooth manifolds and smooth domains. In the final chapter, the author discusses desirable properties of wavelet expansions in function spaces (introducing the notation of Riesz wavelet bases and frames). This chapter also deals with some related topics, in particular with spaces on cellular domains. The book is addressed to two types of reader: researchers in the theory of function spaces who are interested in wavelets as new effective building blocks for functions, and scientists who wish to use wavelet bases in classical function spaces for various applications. Adapted to the second type of reader, the preface contains a guide to where one will find basic definitions and key assertions. (knaj)

***M. M. Woolfson: Everyday Probability and Statistics. Health, Elections, Gambling and War**, Imperial College Press, London, 2008, 223 pp., GBP 35, ISBN 978-1-84816-031-6*

Information disseminated by newspapers, radio, television and so on brings a lot of data that we can use as support for our decisions. Since the decisions are made in an environment where uncertainty plays an important role, a scientific approach is also based on probability theory. It is easy to misinterpret given data, which leads to the well-known phrase "lies, damned lies and statistics" (L. H. Courtney). As for me, I prefer another phrase: "It is easy to lie with statistics. It is hard to tell truth without statistics" (A. Dunkels). And the author in the introduction correctly writes: "In the 21st century a cultured man should understand something about statistics otherwise he will be led by the nose by those who know how to manipulate statistics for their own ends".

The book is a very elementary introduction to probabilistic and statistical thinking. The basic ideas are demonstrated on simple examples from everyday life, e.g. how to bet on a horse. There are also non-intuitive problems like the birthday problem and the problem about switching. As a more practical topic we find an application of probability theory to medicine. The elements of statistics presented in the book concern calculations of the mean and variance and normal and Poisson distributions. The book also contains parts devoted to predicting voting preferences, a sampling technique, some statistical tests and building probabilistic models. The author does not assume that the reader is familiar with mathematics. Because of that, an explanation on how to handle expressions like $(2^2)^3$ is quite long and, similarly, a description of the definition of the number e is also very detailed. Some places in the book deserve critical remarks. The expectation of the normal distribution is called the mean and denoted by the same symbol as the arithmetical mean – this is confusing (p. 117). I cannot agree with the formulation "Assuming that the lifetimes have a normal distribution…" (p. 120). The lifetimes are nonnegative and so they cannot have a normal distribution. It would be better to say that a normal distribution can be a good approximation to the unknown and perhaps very complicated true distribution of the lifetimes. The book can be recommended to students who are not specialists in mathematics. (ja)

***N. Young, Y. Choi, Eds.: Surveys in Contemporary Mathematics**, London Mathematical Society Lecture Note Series 347, Cambridge University Press, Cambridge, 2007, 361 pp., GBP 40, ISBN 978-0-521-70564-6*

This book has a special character. A continuation of the outstanding quality and tradition of Russian mathematical schools at home in new conditions is not at all automatic. The book offers the second volume of papers written by young mathematicians in Russia on their recent achievements. The first volume concentrated on geometry and number theory, while the second volume contains contributions in the field of algebraic geometry, topology and combinatorics. The papers form revised and expanded versions of research articles generally having the character of survey papers. The topics vary a lot; the papers are written by A. E. Guterman (matrices over semi-rings), I. V. Kazachkov (algebraic geometry over Lie algebras), A. V. Malyutin (the Markov destabilization of braids), D. V. Osipov (higher-dimensional local fields and higher adelic theory), T. E. Panov (equivariant topology of torus actions), A.M. Raigorodskii (the Borsuk partition problem), A. B. Skopenkov (embedding and knotting of manifolds) and V. V. Ten (Maxvellian and Boltzmann distributions). (vs)

***K. Zhu: Operator Theory in Function Spaces, second edition**, Mathematical Surveys and Monographs, vol. 138, American Mathematical Society, Providence, 2007, 348 pp., USD 89, ISBN 978-0-8218-3965-2*

This book deals with three types of operators on Bergman and Hardy spaces on the open unit disk in the complex plane: Töplitz operators, Hankel operators and composition operators. The main emphasis is on the size of these operators, or more precisely whether they are bounded, compact or belong to Schatten classes. The book starts with a presentation of types of operators on Banach and Hilbert spaces that are studied later along with their basic properties. Then the author proves the classical interpolation theorems and Hölder type inequalities on L_p spaces. After introducing Bergman, Bloch and Besov spaces, the author presents results on the Berezin transform. The next sections are devoted to a study of Töplitz and Hankel operators on Bergman spaces. The presentation proceeds with Hankel operators on Hardy and BMO spaces. The last chapter is devoted to composition operators. The second edition is considerably improved and enriched with recent results. Also, several new proofs are included. The book contains exercises of varying degrees of difficulty and an extensive bibliography. (jsp)

Errata

In No. 67 of the EMS Newsletter, two reviews were printed with incorrect headings. The editors of the column apologise to the readers for this unfortunate error. Both reviews are reprinted below in their correct form.

***J. Tilouine, H. Carayol, M. Harris, M.-F. Vignéras, Eds.: Formes automorphes (II): Le cas du groupe GSp(4)**, Astérisque 302, Société Mathématique de France Paris, 2005, 436 pp., EUR 86, ISBN 2-85629-184-8*

This is the second volume of the proceedings of the Automorphic Semester held at Centre Emile Borel in Paris in 2000. It contains five important articles on various arithmetic aspects of automorphic forms on $GSp(4)$: G. Laumon extends his earlier results on cohomology of Siegel 3-folds to the case of non-trivial coefficient systems; R. Weissauer constructs ℓ-adic Galois representations attached to discrete series automorphic forms $GSp(4)$ and establishes some of their properties; E. Urban discusses the local behaviour of these representations at ℓ A. Genestier and J. Tilouine prove a modularity lifting theorem for 4-dimensional symplectic Galois representations; D. Whitehouse proves a weighted twisted fundamental lemma necessary for establishing a functorial transfer of packets from $GSp(4)$ to $GL(4)$. The book will be of interest to researchers and graduate students interested in arithmetic applications of automorphic forms. (jnek)

***W. D. Wallis: Introduction to Combinatorial Designs, second edition**, Discrete Mathematics and Its Applications, Chapman & Hall/CRC, Boca Raton, 2007, 311 pp., USD 80.96, ISBN 978-1-58488-838-3*

The style of this book is very friendly to the reader and the book is obviously well equipped to serve its main purpose, i.e. the exposition of the main kinds of combinatorial designs to undergraduates. As one can expect, the topics include balanced incomplete block designs, their development by means of difference sets, latin squares, one-factorization, tournaments, Steiner triple systems and their large sets, Hadamard matrices and Room squares. There is a section on the Bruck-Ryser-Chowla theorem (in fact, there are two different proofs). Interactions with other parts of mathematics are limited. Of course, one needs to develop the basic notions of affine and projective geometries (there is a section on ovals) and one needs to be able to work with matrices and quadratic residues. Besides matrices, all other necessary notions are explained in the book. That is usually done at the first point where the notion is needed, which makes it possible for the student to get quickly to the objects he or she is interested in. The book is equipped with exercises, there are quite a few historical remarks and almost no claims are stated without proof. Information about unsolved problems is limited, which perhaps makes the book a little less exciting than it could be. (adr)

List of reviewers for 2008.

The editors would like to thank the following for their reviews this year.

J. Anděl, J. Antoch, T. Bárta, L. Barto, M. Bečvářová, A. Drápal, D. Hlubinka, J. Hromadová, M. Hušek, M. Hušková, O. John, P. Kaplický, T. Kepka, L. Klebanov, P. Kolman, J. Kratochvíl, S. Krýsl, P. Kůrka, R. Lávička, J. Lukeš, J. Málek, J. Malý, J. Milota, I. Mrázová, K. Najzar, J. Nekovář, I. Netuka, O. Odvárko, L. Pick, Š. Porubský, D. Pražák, P. Příhoda, M. Rokyta, A. Slavík, P. Somberg, V. Souček, J. Spurný, D. Stanovský, J. Stará, O. Suchý, Z. Šír, D. Šmíd, J. Štěpán, J. Trlifaj, J. Tůma, J. Vanžura, J. Veselý, L. Zajíček, J. Zítko, J. Žemlička.

All of the above are on the staff of the Charles University, Faculty of Mathematics and Physics, Prague, except: J. Vanžura (Mathematical Institute, Czech Academy of Sciences), M. Bečvářová, (Technical University, Prague), Š. Porubský (Institute of Computer Science, Czech Academy of Sciences) and J. Nekovář (University Paris VI, France).

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Jaume Llibre
E-mail: jllibre@mat.uab.cat
Jaume Giné
E-mail: gine@matematica.udl.cat

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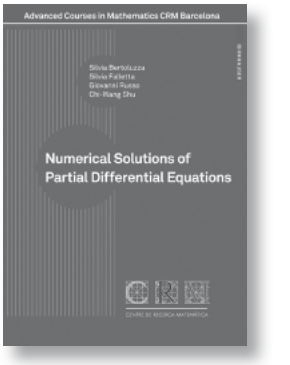

Numerical Solutions of Partial Differential Equations

Silvia Bertoluzza, CNR, Pavia, Italy
Silvia Falletta, Politecnico di Torino, Italy
Giovanni Russo, University of Catania, Italy
Chi-Wang Shu, Brown University, Providence, RI, USA

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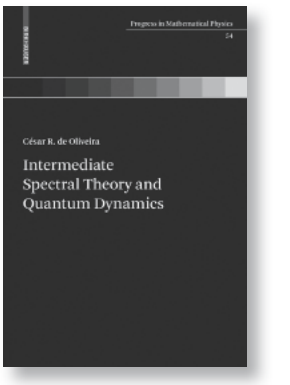

Intermediate Spectral Theory and Quantum Dynamics

César R. de Oliveira, Federal University of São Carlos, Brazil

2009, XIII, 410 p., Hardcover
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The spectral theory of linear operators plays a key role in the mathematical formulation of quantum theory. Furthermore, such a rigorous mathematical foundation leads to a more profound insight into the nature of quantum mechanics. This textbook provides a concise and comprehensible introduction to the spectral theory of (unbounded) self-adjoint operators and its application in quantum dynamics.

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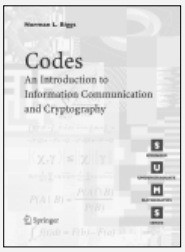

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N. L. Biggs, London School of Economics, UK

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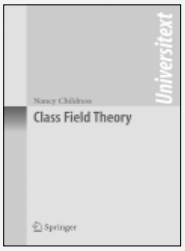

Class Field Theory

N. Childress, Arizona State University, Tempe, AZ, USA

Class field theory brings together the quadratic and higher reciprocity laws of Gauss, Legendre, and others, and vastly generalizes them. This book provides an accessible introduction to class field theory. It takes a traditional approach in that it attempts to present the material using the original techniques of proof, but in a fashion which is cleaner and more streamlined than most other books on this topic. It could be used for a graduate course on algebraic number theory, as well as for students who are interested in self-study. The book has been class-tested, and the author has included lots of challenging exercises throughout the text.

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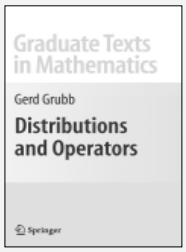

Distributions and Operators

G. Grubb, University of Copenhagen, Denmark

This book gives an introduction to distribution theory, based on the work of Schwartz and of many other people. Additionally, the aim is to show how the theory is combined with the study of operators in Hilbert space by methods of functional analysis, with applications to ordinary and partial differential equations. In some of the latter chapters, the author illustrates how distribution theory is used to define pseudodifferential operators and how they are applied in the discussion of solvability of PDE, with or without boundary conditions. Each chapter has been enhanced with many exercises and examples, and a bibliography of relevant books and papers is collected at the end.

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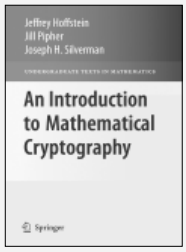

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J. Hoffstein, **J. Pipher**, **J. Silverman**, Brown University, Providence, RI, USA

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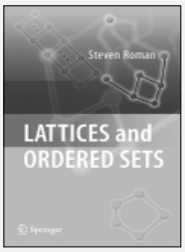

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S. Roman, Irvine, CA, USA

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N. Ghoussoub, University of British Columbia, Vancouver, BC, Canada

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