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Notices

of the American Mathematical Society

December 2009 Volume 56, Number 11

Adrien-Marie Legendre and Joseph Fourier (see page 1455)

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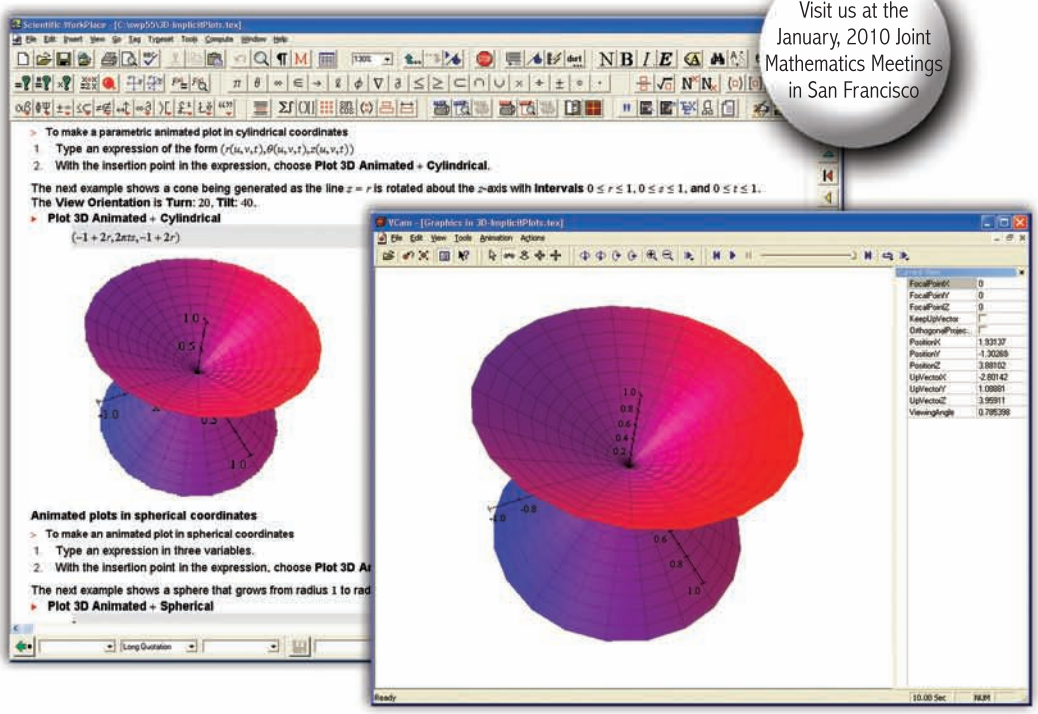

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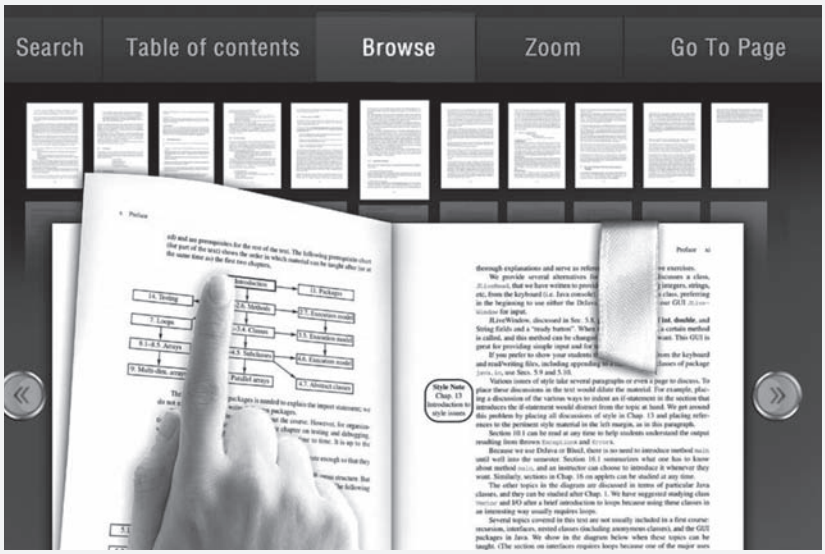

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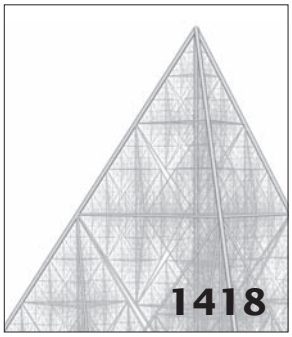

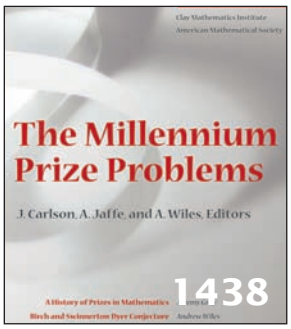

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Letter from the Editor

Anniversaries

With this issue, the *Notices* completes fifteen years of publishing in its current format. For perhaps as many as half our readers, this is the only format they've ever known: features, communications, and commentary "…providing a lively and informative magazine, which contains news about mathematics and mathematicians as well as information about the Society and the profession." Or so reported and recommended the 1993 Committee to Review Member Publications, or CRMP, a recommendation the AMS Council adopted in August of that year. Older readers probably still refer to the current format as the "new" *Notices*, although the CRMP's term of art was "enhanced *Notices* of the American Mathematical Society", or "eNAMS". Even in 1993, this could have been a sly reference to an electronically delivered "e-NAMS" (the Society's online services were known as e-math at the time). Or perhaps not: the same CRMP report referred to an "improved Bulletin of the American Mathematical Society", or "iBAMS"; surely they weren't making a clairvoyant hint about a journal for touchscreen cellphones.

Actually the report is hardly prescient. Virtually none of the ideas for eNAMS contents that the CRMP attached to their report made it into the new *Notices*. And nowhere in the report is there discussion of the graphics which have become emblematic of *Notices* articles. But by the time the first enhanced issue of the *Notices* appeared, in January 1995, most of the present format had fallen into place. In fact the features appearing in that issue are not so different from those appearing in this one, including a memorial article and an expository mathematical article. And there was a "Letter from the Editor", where Hugo Rossi announced "The *Notices* shall continue to publish information about the profession and the mathematics community along with articles of general interest. But we shall also begin to regularly publish informal, discursive articles about mathematical research: new developments, trends, assessment, history; the analog for these articles is that of the discussion in the tearoom preceding the colloquium lecture (not the lecture!)."

I believe Hugo's vision has been realized, but it wasn't easy. Lots of effort went into convincing mathematicians who had the insight to write such articles to actually do so, and much editorial effort went into revising and editing submissions into the ultimately published articles. In the end, something has emerged as the paradigmatic *Notices* article. However difficult the qualities of that may be to articulate precisely, readers know what it means when they read one, and authors know what it means when they write one. Fortunately, there are many authors willing to make the attempt.

This was not always the case. Hugo's "Letter from the Editor" notes the difficulty mathematicians have in writing informally and the challenge in getting them to try. I've been a member of the *Notices* Editorial Board (NEBO) since it began in 1994, and I know the effort my predecessors as editor had to put into soliciting articles. Indeed, there was sometimes an impression in the mathematical community that one had to be invited to write for the *Notices*. That was never the case—the *Notices* has always welcomed submissions from readers—and as editor I have come to rely on such submissions. Luckily, good ones have been sufficiently abundant, with many excellent ones on topics I never anticipated. And to be fair, the *Notices* Editorial Board, including myself, as well as officers of the Society, have continued to solicit articles when something of interest arises.

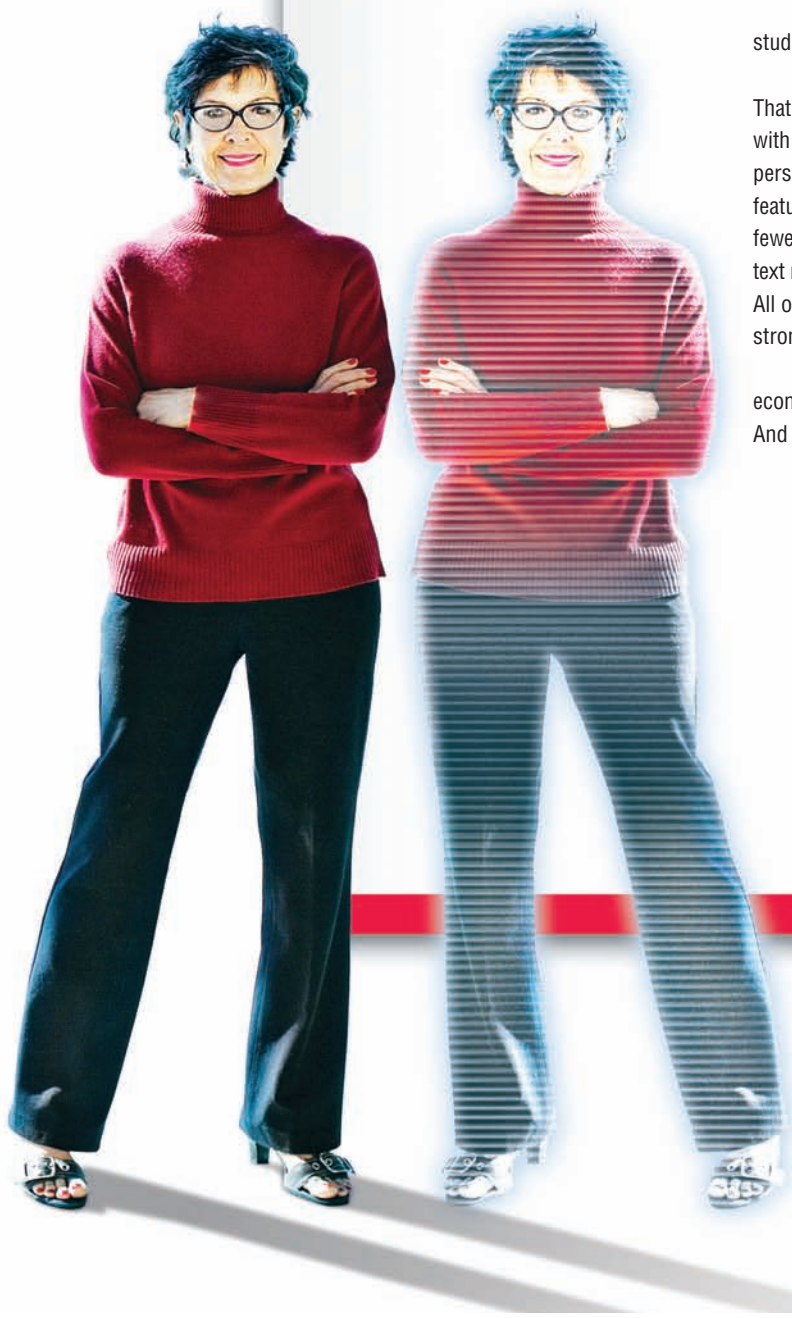
With this issue, I complete my second, and final, term as editor of the *Notices*. This means I've been editor for 40 percent of the issues since the current format was adopted, a sobering statistic I never noticed until preparing this letter. That it was a pleasure goes without saying; so does forgoing any assessment.

Beginning with the January 2010 issue, Steven Krantz will be *Notices* editor (see the article by Elaine Kehoe in this issue). Among all his other achievements, Steve served on the 1994 inaugural NEBO, and he rejoined NEBO when my terms began. As he tells Elaine, some interesting new changes are coming up.

There is also some important continuity to be noted. The excellent AMS Production and Graphics Departments and Production Assistant Muriel Toupin will continue to maintain the quality and values the *Notices* is famous for. Managing Editor Sandra Frost and Deputy Editor/Senior Writer Allyn Jackson will continue to bring to the *Notices*, as they have since 1995, the professional skills and judgment that make the *Notices*, well, the *Notices*. To them, and to the rest of the staff, I am deeply grateful.

—Andy Magid

“ME, MYSELF & WEBASSIGN.”



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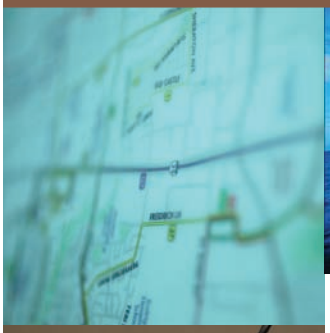

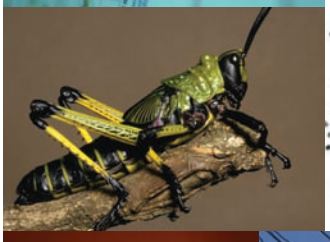
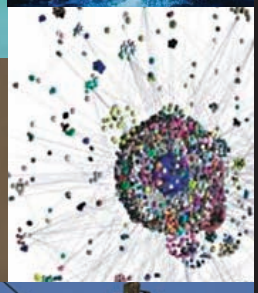
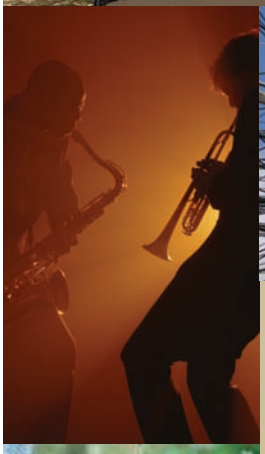
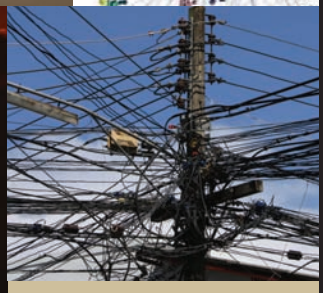


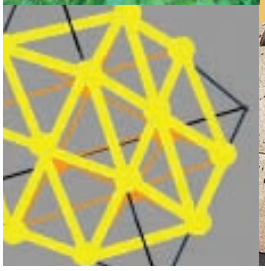


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Remembering John Stallings

Danny Calegari and Benson Farb, coordinating editors

Introduction/Authors' Note

This document collects reminiscences of John Stallings by some of us who knew him. The contributions have been minimally edited and are supplemented by Stallings's own "Items from my unknown autobiography". Photo credits are given where known.

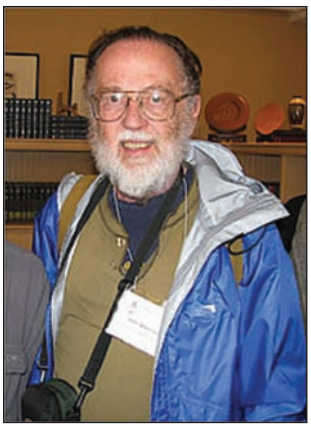

Photo credit: Enrico Le Donne, 2006.

John Robert Stallings Jr.

Danny Calegari

John Robert Stallings Jr. was born in Morrilton (which John pronounced "Marrrlton", rolling the r's), Arkansas, on the 22nd of July 1935, and died at his home in Berkeley, California, on the 24th of November 2008. He achieved early fame as a postdoc with his alternative proof of the Poincaré Conjecture in high dimensions (obtained only days after Smale's breakthrough) using an original method known as engulfing. John then switched his attention to 3-manifold topology and geometric group theory, and transformed both. He brought combinatorial methods from group theory to 3-manifold theory, which at the time was preoccupied with the point-set methods of Bing and Wilder — giving new and cleaner proofs of Papakyriakopoulos's fundamental discoveries, characterizing fibered 3-manifolds by using the fundamental group, and introducing important new methods (e.g., plumbing) in knot theory. Conversely, he brought geometry and topology back to group theory, reinvigorating a field that had forgotten the perspective of Dehn and Nielsen, and laid the groundwork for the later radical innovations of Thurston and Gromov: characterizing groups with infinitely many ends (an achievement for which he was recognized with the Cole Prize in 1965), constructing an example of a finitely presented group with infinite-dimensional H_3 (an example which became the cornerstone of Bestvina-Brady's discrete Morse theory), and clarifying the work of Serre on trees, especially as it applied to Haken 3-manifolds. In 1983 he wrote a brief paper, "Topology of finite graphs", which, besides giving astonishingly short and illuminating proofs of notoriously opaque algebraic theorems, anticipated to some extent the theory of automatic groups and structures developed by Cannon, Thurston, Epstein et al. Later work was more sporadic but included such important notions as triangles of groups and angles between subgroups and continued to be guided by the interaction between (especially 3-dimensional) topology and group theory.

John is remembered as much for his anti-establishment attitudes and distinctive personality as for his mathematics (and sometimes for the interaction between the two, such as in his famous paper "How not to prove the Poincaré Conjecture"); some of this is captured in the reminiscences below. He was always a champion of the originality and brilliance of teenagers and young people, keeping in touch with many young correspondents even in his seventies and taking great delight in the music and antics of modern enfants terrible such as Eminem. Both aspects of his personality are revealed in the following excerpt from his introduction to a talk at Barry Mazur's birthday conference in 1998:

> There are some lessons to be learned from this story. One that appeals to me is that Barry broke the rules; he didn't have a Bachelor's degree, he didn't stay quietly in Princeton for three years. Even Douady broke the unspoken rule that one is supposed to wear clothes under the gown. All those rules, BA diploma, residence in Princeton, wearing shoes, being nice to chairmen and

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deans, being a team player—basically I hate those rules, even though I give in and adjust to them. It makes me feel good to see a rule-breaker succeed!

And, teenagers are creative and amazing. Barry's theorem could be compared to Opus One of some great composer. For instance, Gustav Mahler, at the age of 17, wrote a long poem, and set it to music by the age of 19. This cantata, "Das klagende Lied", is rarely performed in its original form, because Mahler "improved" it later on. I recently heard the original work in Berkeley, played by the Berkeley Symphony Orchestra under Kent Nagano, with a large chorus, six vocal soloists, two of which were from the San Francisco Girls Choir, and an offstage band from Hayward State University that played in a different key and time-signature. It had its adolescent moments, but it is truly a great work of art. Just as Barry's sphere theorem was.

Those of us who are antiestablishmentarians at heart or who met him later in his life probably remember John more for his laconic wit, his predilection for Thai food or for beer and pizza after seminars (at La Val's or Jupiter), his fondness for reading "Zits" in the morning paper (usually in Brewed Awakenings), his impossible turn of speed around about the fourth mile of a hike to Point Reyes, his long gossipy monologues while driving out to a seminar at Stanford, his provocations and his unconventional behavior (tearing up a *Bulletin* article on "Making proofs without modus ponens" with mock rage; speculating on the likelihood that Alex Gottlieb would fall off the balcony outside 1015 Evans) than for his mathematical insights, which were rare in his later years but seemed rarer still because of his modesty and high standards. The truth is, we have internalized his mathematics so that it seems less like a reflection of John and more like a fact of nature. He felt more like a fellow graduate student than one of the exalted faculty. For generations of graduate students at Princeton, Berkeley, and elsewhere, Stallings was larger than life. It is hard to believe that he is gone.

Benson Farb

John Stallings was a one-of-a-kind mathematician. Perhaps this is due to the fact that he came out of a small town in Arkansas. He loved to play up his roots, often portraying himself as a kind of naive country bumpkin. Of course, he ended up getting a Ph.D. from Princeton. His thesis gave a new topological proof of an old important theorem of Grushko in combinatorial group theory. This was the first indication of how Stallings would transform combinatorial group theory by introducing powerful topological methods.

Stallings definitely followed his own path in mathematics. He was known for his great originality; he most often came up with completely original ideas rather than following up on the ideas of others. His work often inspired a great flurry of activity by other mathematicians, who would develop Stallings's methods. There are important cases, though, including his Ph.D. thesis, where Stallings reunderstood someone else's theorem in a completely new way, which would open the door to new developments on an old topic.

Stallings made fundamental contributions to a number of different areas of mathematics, from combinatorial and geometric group theory to knot theory to the theory of 3-dimensional manifolds. Indeed, he was one of the main forces responsible for tying these areas together.

Stallings's ideas were usually remarkably simple but remarkably deep. They seemed to grow out of his incessant doodling. He doodled all the time, especially when he attended talks. One example of a simple but powerful idea is Stallings's beautiful paper "Topology of finite graphs". How many people could write a deep paper with that title? In this paper Stallings took our understanding of free groups to a new level, along the way making older, difficult theorems look almost obvious.

Stallings was greatly respected as a mathematician. One acknowledgment came in the form of his being awarded the Cole Prize for his now famous theorem on ends of groups: a group splits as an amalgamated product over a finite group if and only if it has at least two ends. Here is a paradigmatic example of how fine algebraic structure can be determined by coarse, large-scale information. No wonder this theorem is a cornerstone of geometric group theory.

Everyone loved Stallings. He was always generous with his time and with his ideas. He treated students with the same respect he did colleagues, indeed with more respect. Stallings had a dislike of authority and made a point of playing by his own rules. He often made fun of authority, but not in a mean way. He made fun of himself all the time. Actually, I can't think of anything or any person (including himself) that Stallings took seriously.

Stallings was widely known not just for his genius but for his sense of humor. As one example, he wrote an entire paper in the universal language Interlingua. One of his famous papers on one of the most famous mathematical problems, "How not to prove the Poincaré Conjecture", begins: "I have committed—the sin of falsely proving Poincaré's Conjecture. But that was in another country; and

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Photo credit: Princeton Mathematics Department, 1958.

Princeton, 1958. Left to right: H. Trotter, Chih-Han Sah, L. Neuwirth, R. Fox, C. Papakyriakopoulos, and J. Stallings.

besides, until now no one has known about it."[1]

Stallings was incredibly generous with his time. He would sit and listen to my mathematical arguments for hours, even though he was working on different things at the time. He would always push for simplicity. While I am a student of Thurston, I am proud that Stallings considered me his "bastard (mathematical) son". I have fond memories of Stallings's seminar, followed by beer at La Val's or dinner at an Indian restaurant, where Stallings would order extra spicy food and proceed to turn bright red and sweat profusely as he ate it.

When I first got to Berkeley I knew no one. I felt alone. It was difficult. Stallings befriended me and showed me great kindness. He treated me, as he did everyone, as an equal and as a mathematical equal, which was truly undeserved. We became close friends, keeping in touch until his death. Stallings was always there when I needed him, whether it be for giving me a ride at an inconvenient time or for comforting me in a time of crisis. I will miss him.

Peter Shalen

John Stallings probably had a bigger influence on my early career than any other mathematician. During my first year in graduate school, studying some of his papers on engulfing gave me my first hint of the rich combinatorial ideas that can come up in the topology of manifolds. In the summer of 1969, after my second year of graduate school, I went to the Georgia topology conference and met Edward M. Brown, from Dartmouth, who told me about Stallings's celebrated paper on the fibration theorem. When I got home I spent several months studying this paper, which packs an extraordinary amount of mathematics into four pages.

In order to understand this paper I had to look at several other sources, including Stallings's beautiful paper on the loop theorem. By the time I was done I had a sense of what 3-manifold theory was about and how closely connected to group theory it was, and I felt that this was my area of research, even though I had not yet made contributions of my own.

At the Georgia conference I also met Mauricio Guttierez, who told me about Stallings's paper on homology and lower central series. I spent a number of years thinking about applying this to 3-manifold theory before using it for the first time in my AMS *Memoir* with Jaco. I still keep finding new applications; every few months I look back at the paper and learn something new.

A little later in my graduate career, Stallings's famous paper on ends of groups appeared. By that time I was in a position to appreciate the importance of the results in the context of the mathematics that was then known, although I don't think anyone at the time realized how broad the impact of the paper on the mathematics of the future would be.

When I finally met John while I was a postdoc at Columbia, I made a mega gaffe, which as you can imagine was disconcerting after all the years I had spent admiring him from afar. I won't give details here, since this is about John and not about me, but I do want to mention John's reaction when I apologized for my gaffe on meeting him for the second time. He just smiled and nodded as if to say, well, the world is full of all kinds of nuts who say all kinds of goofy things. I think he went through life with a kind of amused tolerance for the whole benighted human race.

John was shy and had few really close friends. I never succeeded in getting close to him personally and always had to settle for admiring him from a certain distance. We never had a conversation that lasted for more than a few minutes. I think he was especially shy about talking mathematics. When I brought up connections between his work and mine, he certainly said kind things about my work but never seemed eager to pursue the discussion.

Still, his low-key humor always came through even in a brief chat. The last time I saw him was at a conference, possibly at the University of Arkansas, his alma mater. I saw him when I was on the way back from lunch and started walking with him to try to strike up a conversation. He was walking pretty fast and explained that he was trying to get a beer before the afternoon talks. I don't remember who was talking that afternoon, which is probably just as well.

Hyam Rubinstein

I arrived in Berkeley in the fall of 1970, having never been outside Australia before. It was a

[1] *This is a parody of T. S. Eliot's excerpt from Marlowe's* The Jew of Malta*: "Thou hast committed/Fornication: but that was in another country,/And besides, the wench is dead."*

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Hyam Rubinstein is professor of mathematics at the University of Melbourne. His email address is rubin@unimelb.edu.au.

fantastic experience being a graduate student there, and I was especially fortunate to have John Stallings as my supervisor.

John had been away in 1971 on leave, and when he returned, I quickly approached him to suggest a thesis problem. I had read a number of his marvelous papers on PL topology, on 3-manifolds, and his recently published book on groups with infinitely many ends. John had a unique writing style—like a great athlete or musical performer, he made mathematics look effortless and graceful. His paper "How not to prove the Poincaré Conjecture" contains some wonderful observations on the traps of research—how one can get so enthusiastic about an idea that self-criticism and skepticism disappear and mistakes can be overlooked. It is still rather mysterious, with the solution of the Poincaré Conjecture by Perelman, that Stallings's algebraic characterization of this by splitting homomorphisms is now established. This is an issue still well worth pursuing.

I felt rather shy around John, but he was a very kind, encouraging supervisor. He suggested a very nice thesis problem arising from Laudenbach's recent paper in the *Annals of Mathematics*, "Sur les 2-spheres d'une variete de dimension 3", and suggested to me that I investigate whether the result could be extended to 2-sided projective planes in nonorientable 3-manifolds. Stallings was a pioneer in the synthesis of ideas between group theory and 3-dimensional topology. In his work on ends, he had proved a deep splitting theorem for groups which can be seen as a version of the sphere and projective plane theorems of Whitehead and Epstein. Laudenbach's result can be interpreted as uniqueness for splitting a 3-manifold fundamental group into a free product. An analogous result for Epstein's projective plane theorem would then be similar to uniqueness for Stallings splittings as an amalgamated free product over a finite group.

Stallings was very encouraging with my rather slow progress on this and was very pleased when I was able to finally come up with a good idea to solve the problem. At that stage he did not have many students, as he had been away, so I had no difficulty in getting to see him whenever I needed to.

I returned to Australia immediately after my Ph.D. Several years later, I invited John out for a visit of several weeks. This was very enjoyable—as well as talking about mathematics, a highlight was a trip to a semiarid area of western Victoria called the Little Desert National Park. Ironically, due to an unusual amount of rain, we were limited to touring the outskirts of the park, as otherwise vehicles were getting bogged! John turned out to have a great knowledge of flowers and had a magnifying glass to observe the beautiful tiny native orchids in the area. I had no idea of their existence, and this was a small instance to me of John's wide range of interests and knowledge.

Over the years I have regularly visited Berkeley, and I always looked forward to dropping in to say hello to John. He will be greatly missed by everyone who knew him.

Mahan Mj

John's style (mathematical or otherwise) was understated and deceptively simple. There was little or no show of power or machinery, and things seemed to be almost childishly simple at times. The first time I had an opportunity to see this in action was in my second week of graduate school at a weekly geometric group theory seminar he ran. He asked the speaker some silly-sounding question on the product of a 2-sphere and a circle, and the speaker said something. John didn't seem too happy about it. "Is this guy really John Stallings?" I asked myself. During the weekend I was thinking about the talk and decided to run through a part of the argument which seemed obvious but not quite clear. It was only then that things started falling in place and John's question made full sense. I felt rather stupid, and the question I had asked myself was answered. Most of the audience—and, I daresay, the speaker too—had overlooked a simple point.

Photo credit: Unknown, 2002.

The next thing I remember about John was doing a reading course with him on the Swiss notes on hyperbolic groups. Repeat performance. I was explaining an argument, and at a certain point he stopped me with "Why?" I tried to hand-wave it away, but I had known John for a while now, and while speaking, I realized there was a gap. Took me all weekend to plug it satisfactorily.

Some people never learn. I was presenting the first result I thought I had proven to John privately. At a certain point he again seemed to find something dubious and made some disconcerting noises. I raced on, and he indulgently allowed me to pass. A month later when I was writing things up, I got stuck. It took a small new idea to plug the gap this time. I went to him and told him about it. He said, "Yeah, I thought something like that would be true."

As John was so easygoing, many of us hung out with him. There were Paul Brown, Bill Grosso, and Noel Brady—his own students—and there were

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Photo credit: Stephen Miller, 2004.

Stallings at Brewed Awakenings, one of his favorite haunts.

his "illegitimate children"—Michah Sageev, Benson Farb, me—who, though not his Ph.D. students, nevertheless worked in near-enough areas and were part of the group. Graduate school is hard for many, being a transition from mathematical adolescence to mathematical adulthood. One does not yet have the confidence of the adults, but one has lost the innocence of mathematical childhood in the form of undergraduate study. One is excited one moment and thinking that there is no stupider mortal the next. Being around John was soothing and put things in perspective. He was to me a philosopher and a guide, true, but most of all a friend.

Anandaswarup Gadde

I first met John Stallings in early 1967, when he visited the Tata Institute of Fundamental Research to give a lecture course on polyhedral topology and I was asked to write up his lecture notes. I was a third-year research student at that time, mainly interested in algebraic topology and differential topology, learned through some unpublished notes of Samuel Eilenberg and John Milnor. I knew about John's work on the Poincaré Conjecture and that some papers of William Browder were inspired by John's work. In preparation for his visit, I worked through some papers of J. W. Alexander, J. H. C. Whitehead, E. C. Zeeman's notes from I.H.E.S, and some papers of John on engulfing. For two months I was in constant contact with John discussing his lectures, showing my notes, helping with shopping and a sightseeing trip to Lonawala. He was unassuming, and note taking turned out to be easy except for a couple of appendices, where my reading of Whitehead helped. Most of the time he gave me his own notes, and all I had to do was number the lemmas and add symbols on the stencils. It turned out to be somewhat messy, and some of the elegance of his presentation was lost in misprints. Surprisingly, at the end he offered joint authorship, which I politely declined. He also gave a seminar, which seemed very nice, until a point when he said, "By waving hands twice, we have the result," and this was probably my introduction to combinatorial group theory.... There was some correspondence soon about his lecture notes, his leaving Princeton for Berkeley, and I continued to read his papers. They always seemed very elegant, with neat ideas and easy to read, with unpleasant technical difficulties tucked away in a half page somewhere. Slowly I found that not only were his theorems useful but their generalizations too, and when these did not work, one could often go back to his techniques.

Just before Stallings left Bombay, I asked whether he could suggest some problems for my thesis. I think that I wanted to prove some embedding theorems, following his ideas in the lecture notes, about an alternate argument in the proof of *s*-cobordism theorem avoiding the Whitney trick. But all he said was that somebody named Papakyriakopoulos did some great work. I had never studied anything in 3-dimensional topology before, and after he left, I started reading "On Dehn's lemma and asphericity of knots", the first paper on 3-manifolds which I read. To round it off, I read a few more papers and got stuck in 3-manifolds for a long time. Meanwhile, possibly around the end of 1967, he sent a preprint of "Groups with infinitely many ends", which is probably my main introduction to topological group theory. Though my fascination with higher-dimensional topology continued, I found myself returning to Stallings's papers and ideas. I do not remember any papers of mine not influenced by Stallings, except possibly one on cut points which built on the impressive work of Brian Bowditch. But even here, one of Stallings's students, Bill Grosso, seemed to have many of the basic ideas but not proofs.

Meeting such a first-rate mind at an early part of my career has influenced me, and he kept an affectionate interest in me throughout my career. My acquaintance with Stallings, and miswriting his notes, seems to have made me a member of the Stallings community, and I always felt welcomed by his students and friends.

Koji Fujiwara

I met John for the first time in March 1993 at a conference in Scotland. He happened to be next door in the dorm we all inhabited on campus. I did not know him, but we became friends. I went to Berkeley in September 1993 as a postdoc in

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differential geometry. The theme at MSRI that year was differential geometry. I attended his course and seminar at the department and met many people. For example, Sela was giving a series of talks on his work to solve a system of equations on free groups, and Perelman was in the audience. In one year and a half, when I went back to Japan, I was a topologist/geometric group theorist.

In Japan he is known for his contribution to the solution of the Poincaré Conjecture in higher dimensions, and I know he was obsessed by the three-dimensional Poincaré Conjecture his whole life. But to me, he is a hero in geometric group theory who is comparable to Dehn.

Stephen Miller

My Berkeley classmates and I felt saved by our surprise discovery of the relaxed Southerner in the Hawaiian shirt. We kept taking his classes and seminars, and found him to be such a wonderful interface for learning mathematics and what it is like to be a mathematician. John had a very loyal following among students, mainly due to the respect he gave them and his easy accessibility. He was both a front door to the subject and a window into what happens behind the scenes in a big place like Berkeley. I definitely owe him much for his insights on navigating the profession.

I am most grateful to John for our correspondence after I finished Berkeley and began graduate school at Princeton. I didn't write him immediately, but once I did, we were pen pals for the next five years or so. He remotely served as a de facto advisor of what to do during my first year. Once, after he mentioned an interesting talk on zeta functions of groups that I found intriguing, he promptly sent me TeXed lecture notes of it! I am constantly finding things he told me valuable and certainly will continue to realize further nuggets of wisdom he told me.

John was fortunate to have recognized the opportunity the VERIP program gave him to retire early in 1994 at age fifty-eight. He was still extremely active as a graduate advisor after this, yet enjoyed the freedom this gave him. He was an extremely humble man who seemed to notice everything. I once heard him speak in a large auditorium at the University of Utah, when someone asked him to put a formula higher up on the board. He said: "OK, I can put it way up there where the little feet are." And our eyes all drifted up near the ceiling, where, in fact, the chalkboard had faint paint markings of a dozen or so baby footsteps! He had such a wonderful sense of humor this way. I remember once visiting him at Berkeley with my mother and brother and getting into a conversation about bad drivers. He obtained victory by telling us he had recently passed a slow driver who was hunched over, consuming soup.

Despite John's modesty, he was not shy about sharing his ideas and promoting the subjects he was interested in and for which he was a subject builder. His 1960s papers on the 3-dimensional Poincaré Conjecture are both brilliant and hilarious at the same time, as were the many emails he sent to his pen pals across the world. He was also quite broad mathematically: the last time I saw him was at a conference we both attended at AIM on sphere packing and Poisson summation techniques. I went up to Berkeley for the day, met him at Brewed Awakenings, had lunch, and then rode back down to Palo Alto with him. He was very happy to show me how he could unlock his car by walking near it using a proximity lock in his wallet. As we crossed the San Mateo bridge, this great senior personality in mathematics announced to me that it was time to have some music. He cranked up Bon Jovi's "It's My Life". And it was: he really seemed to love his life and gave a tremendous amount to people around him, especially my generation of students. About ten years ago he said if something happened to him, you'd have to write him at `stall@math.heaven.edu` <`stall@heaven.edu`>. Remembering that quip is a nice way to remember him at a sad time like this.

Archives of the Mathematisches Forschungsinstitut Oberwolfach. © George Bergman. With permission.

Stallings at Berkeley: top, 1968; bottom, 1984.

Barry Mazur

On John Stallings's University of California homepage there are two photos of him,[1] one where he is clasping a sheaf of papers among a group of mathematicians, a picture taken during his graduate student days at Princeton; and the other a much more recent one. John asks us on his webpage to compare them.

The older Stallings in a grand white beard is engrossed in something off-camera; his interest in whatever it is sparks a questioning look. There is movement in that still photo, with the hint of a smile coming on. The younger Stallings has the

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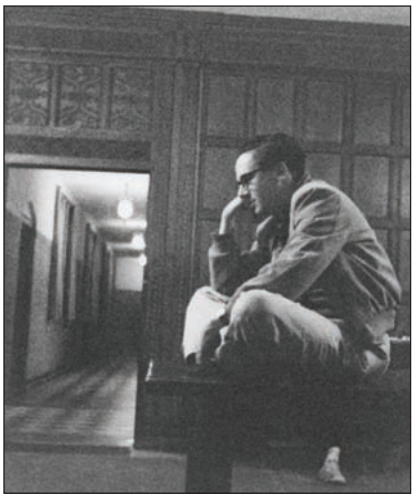
[1] *See photographs on pages 1410 and 1412 of this article.*

more composed smile I remember vividly from our graduate student days: both diffident and at ease.

I remember when we were graduate students at Princeton many occasions when John would stride into a room, intoning something or other with a kind of playful irony in his resonant Arkansas accent. Once, after thinking that he had solved something but finding a hole in his argument, he sang out these lines of Keats:

> And Joy, whose hand is ever at his lips
> Bidding adieu.

His response accomplished, in my eyes, the magical trick of converting the common experience of finding a hole in one's proof—a sure but minor downer, one would think—into a joyous testimonial of the ephemerality of joy. And this was typical, I think, of the grounded, self-ironic, and always amused way he walked through the world (with his successes or his setbacks, with his foibles and his gifts).



Photograph © Jay Goldman, 2000.

Contemplation in the old Fine Hall.

Stallings was the center of a group of graduate students (Jim Stasheff, Han Sah, and I were part of that group) hellbent on piercing the mysteries of a subject that goes nowadays under the not very glorious name of point set topology, but at the time I would often call it pure topology, where the adjective *pure* had for me, I'm now amazed to say, a moral force: all other versions of topology were, I thought, in some sense adulterated—adumbrated by crutches such as *polyhedral* or *smooth* or—heaven forbid—*complex analytic* or *algebraic* structures that would alloy—would sully—the topological essence of the spaces being studied.

I can't imagine that my companions in this group had the same puritanical view as I did, but we all shared the drive to understand what we considered to be the primal objects of topology (notably the real line, the closed interval, the circle, the disk, etc.) and to protect them from the various encroaching monsters and chimeras such as solenoids, Cantorian concoctions, impacted sine curves, and that deep sea serpent, the long line. This latter creature John would always deferentially refer to as "the long long line", alliteratively drawing out the music of those slow syllables in honor of the immensity of the referent. There was something strident in our engagement in this pursuit: we would fall over ourselves dreaming up more and more arcane criteria that distinguished, say, the classical unit interval from one of these behemoths, and when we failed we, joyously, would stomp and proclaim, "We don't even know *the unit interval*!"

But John was at home with, and comprehended, the creations of geometry that struck our fancy in a clearer, more vivid, and more original way than any of us did, whether it was an exhibit from the *cabinet of counterexample wonders* that I described above or one of the even more wonderful constructions of Alexander, Antoine, or Bing. It was an extraordinary experience to watch John talk so slowly and visualize things so fast.

Of course, in the more official world of studies, we were taking in the standard fare of graduate studies in topology, with heavy doses of spectral sequences, H-spaces, and other equipment of the epoch. And surely our professors would have looked askance—or maybe even 180 degrees away— had they known how much time we spent cataloging the ways we "didn't even know the unit interval." But I don't recall that the landscape of my graduate student life was studded, outside of courses, with very many professors. We were largely shaping our own interests—a good thing, after all, for there are ways of becoming educated that are worse than that. It was mainly fellow graduate students—John Stallings and others—along with various visitors to the university and the Institute for Advanced Study that set the tone of graduate studies for me and, vitally important, made it a joy.

John Stallings—Items from My Unknown Autobiography

In order to make my autobiography entirely truthful, I have heard things from other people that I do not remember in the same way. I would love to get suggestions from people telling me what happened in the past that are deeply meaningful. Two examples:

First, there is the baby bottle with the whiskey. As I recall it, one time in the early 1960s, I wandered down Nassau Street in Princeton and found a store that was selling baby bottles with nipples attached. I bought one. Then I took it to Fine Hall for the math tea time. What I seem to recall is that I put some hot chocolate in the bottle and then sat around and sucked on it. But what I have heard from others is that I put whiskey in the bottle and then sucked on it. I seem to recall that it was difficult to suck the hot chocolate, and so it could have happened that I rinsed it out and filled it up with whiskey. I always had a bottle of whiskey in my office in Princeton, and when a speaker came to give a topology seminar, I would try to get the speaker drunk. After all, a drunk speaker is usually more fun than a sober one. Also, there is a problem with seminars, which I call A.S.S. (attention surfeit syndrome), in which a person sits quietly even

when completely bored. This is a serious problem with education in general, and especially in serious seminars and colloquia, where some chairman or other thinks people should shut up and sit still. If the audience drinks too much, they will snore and distract the speaker; but when the speaker is drunk, it all works out pretty well, usually.

Second, there is the "Class Cancelled!" story. Early in my career, when I was starting to teach at Princeton, I got to give some seminar talks on my work on PL manifolds, involving the Engulfing Theorem and high-dimensional Poincaré Conjecture. I did not do a good job of this; there were many details, such as general position, which I did not really know how to do; the typical proof was just by hand-waving. I do recall "great" topologists in the audience, such as Milnor. And I think I called it off eventually, finally getting the proofs of some details in my Tata notes of 1967 or so. But I have heard a slightly different story, which is that I was actually assigned a graduate topology class to teach; I started out by trying to prove some basic lemmas and getting stuck. So, the next meeting of the class, I got stuck at about the same point. In the third meeting of the class, I still couldn't get the details right, and so I looked seriously at the audience and said "Class Cancelled!"—Could that have really happened? I have always believed that young faculty members in the Princeton math department only were allowed to teach those undergraduate classes that were filled with children of rich alumni, and only after many years of this was one allowed to teach a graduate course. But maybe I had the opportunity and flunked it.

Is it allowed nowadays at Princeton to suck on a baby bottle in the common room at tea time? Do seminar organizers try to get the speakers drunk nowadays? Can a teacher get disgusted with a class and cancel it? What else can we do now to get the chairman and the dean embarrassed and irritated and angry???

The Quest for Universal Spaces in Dimension Theory

Stephen Leon Lipscomb

For metric spaces, the quest for universal spaces in dimension theory spanned more than a century of mathematical research. The history breaks naturally into two periods—the *classical* (separable metric) and the *modern* (not necessarily separable metric).

To unify these two periods, we shall motivate the construction of the space J_A that did for the modern period what the unit interval I did for the classical period. The approach is chronological and dates from 1883 to 2009.

Classical Period

Cantor's 1883 Construction

The 1970s introduction of the space J_A was partly motivated by a construction of a topological copy of unit interval I. Indeed, the mapping $C \to I$ from Cantor's set C, known as *classical adjacent-endpoint identification*, yields, as a quotient space, a topological copy of the unit interval. (It is most likely that it was Cantor who introduced classical adjacent-endpoint identification—see Cantor [1883] and [1884], the English translation of Cantor [1884] in Edgar [1993], or Lipscomb [2009, pages 7 and 8].)

Recall that Cantor's set C is the limit set obtained by starting with the unit interval I, removing the middle-third open segment $(1/3, 2/3)$, and then recursively removing the "middle thirds" of the remaining segments ad infinitum. Moreover, notice that the first "middle third" $(1/3, 2/3)$ has *endpoints*

$$1/3 = \tfrac{0}{3^1} + \tfrac{2}{3^2} + \tfrac{2}{3^3} + \cdots \equiv 0222\cdots \equiv 0\overline{2},$$

$$2/3 = \tfrac{2}{3^1} + \tfrac{0}{3^2} + \tfrac{0}{3^3} + \cdots \equiv 2000\cdots \equiv 2\overline{0}.$$

It is also true that the endpoints of *all* "removed segments" correspond one-one with sequences in $\{0, 2\}$ that have the form

$$a_1 \cdots a_t u v v v \cdots = a_1 \cdots a_t u\overline{v} \quad (u \neq v).$$

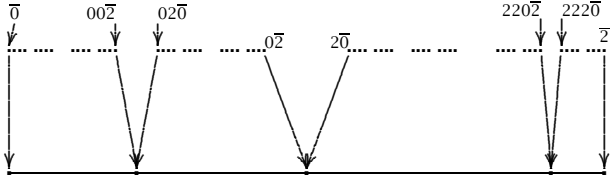
This one-one correspondence extends to a bijection between all sequences in $\{0, 2\}$ and all points in C according to "$x \in C$ if and only if

$$x = \sum_{i=1}^{\infty} \frac{a_i}{3^i} \text{ for some } a_1 a_2 \cdots \in N(\{0, 2\}),$$

where $N(\{0, 2\})$ is an instance of a *Baire space*". (For any nonempty discrete space A, the countably infinite topological product $N(A) = A \times A \times \cdots$ is called a Baire space.)

The one-one correspondence $C \to N(\{0, 2\})$ given above is a homeomorphism; in the context of viewing C as an attractor of an iterated function system, the inverse mapping $N(\{0, 2\}) \to C$ is the *address map* and $N(\{0, 2\})$ the *code space*.

So using the sequential representations (addresses) of the endpoints in Cantor's set C, we may illustrate classical identification of adjacent endpoints $C \to I$ in the following graphic.



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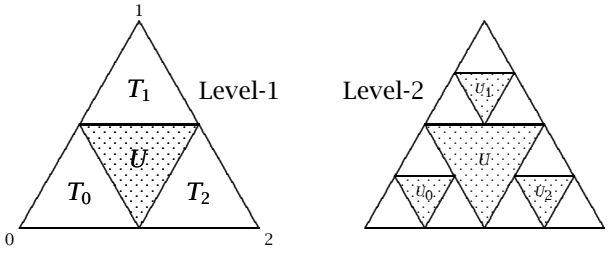
For our purposes, the key facts concerning C are detailed in the following theorem. For a proof that C is a universal space see Kuratowski [1966, page 285].

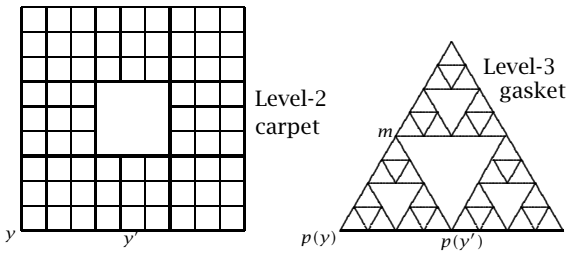
Theorem 1 (Dimension zero)**.** *Cantor's set C is a fractal that is also universal for the class of zero-dimensional separable metric spaces.*[1]

Classical Imbedding Theorems

The symbiotic beginnings (circa 1900) of topology and dimension theory were documented by Tony Crilly [1999]. In 1915, two years after L. E. J. Brouwer [1913] constructed his precise and topologically invariant definition of dimension, Wacław Sierpiński [1915] introduced his classical fractal Sierpiński's *triangle* (or *gasket*). He conveyed his inductive construction in two illustrations; a partial rendition is given below. (Note that like Cantor's construction of his set C above, Sierpiński recursively cut holes in a manifold with boundary.)



And in the following year, 1916, Sierpiński [1916] introduced his *carpet*, a limit set obtained by starting with a square, dividing it into nine congruent subsquares, removing the middle subsquare, and then, on each of the remaining eight subsquares, repeating this process ad infinitum.



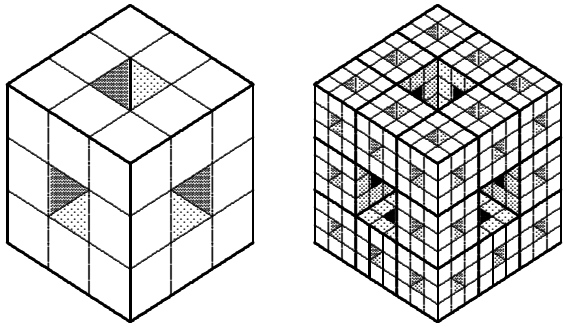
Sierpiński's carpet is another example of a classical fractal that is also a *universal* space.

Theorem 2 (Planar and dimension one)**.** *Sierpiński's carpet is a fractal that is also universal for the class of one-dimensional compact subspaces of the plane.*

In passing, we note that Sierpiński's carpet and triangle are quite distinct; e.g., no subspace of his triangle is homeomorphic to any plane figure that has five or more line segments meeting at a common point (Peitgen, Jürgens, and Saupe [1992, page 30]).

By 1926 Menger extended Sierpiński's construction of the carpet by recursively cutting holes in the unit cube I^3. Menger's construction is commonly known as Menger's *sponge*. Like the carpet, the sponge turned out to be a fractal that is also a universal space (Peitgen, Jürgens, and Saupe [1992, page 108], Menger [1926], and the illustration below).

Theorem 3 (Dimension one)**.** *The fractal introduced by Menger* (*Menger's sponge*) *is universal for the class of one-dimensional compact metric spaces.*



Menger also formulated a statement for the classical n-dimensional case: any compact metric space of dimension less than or equal to n is homeomorphic to a subspace of I^{2n+1}—the topological product of $2n+1$ copies of the unit interval I. And then Menger's student G. Nöbeling [1931] proved the Classical Theorem.

Theorem 4 (Classical Theorem 1931)**.** *The set of points in I^{2n+1}, at most n of whose coordinates are rational, is universal for the class of n-dimensional separable metric spaces.*

For $n = 0$ the Classical Theorem yields another dimension-zero universal space.

Theorem 5 (Dimension zero)**.** *The subspace of irrational points in the unit interval is universal for the class of zero-dimensional separable metric spaces.*

It also follows from the Classical Theorem that the class of finite-dimensional separable-metric spaces may be viewed as the class of subsets of finite-dimensional Euclidean spaces. And viewing each I^{2n+1} as a subspace of the countably infinite product I^∞, Nöbeling's classical 1931 theorem dovetails nicely with Urysohn's universal space theorem (Urysohn [1925]).

[1] *For a given class $\mathbb{C}$ of topological spaces, $U \in \mathbb{C}$ is universal for $\mathbb{C}$ if each member of $\mathbb{C}$ is homeomorphic to a subspace of U. All spaces in this article are metrizable.*

Theorem 6 (Urysohn 1925)**.** *The countably infinite product I^∞ is universal for the class of separable metric spaces.*

Dimension Theory (1940s–1960s)

Following its emergence during the early 1900s, topological dimension theory evolved into an elegant body of mathematics within the context of separable (weight $\leq \aleph_0$) metric spaces. By the 1940s, when this now classical theory was well established, an extension to more general spaces seemed improbable (Hurewicz and Wallman 1941). Nevertheless, by the mid-1960s a surprisingly new and natural theory for general (weight $\geq \aleph_0$) metric spaces was rapidly maturing.

The extension of the classical theory was initiated by Stone [1948], who recognized a symbiosis between open coverings and metric spaces. This symbiosis was further developed (in the context of general topology) by Bing [1951], Nagata [1950], and Smirnov [1951] in their metrization theorems. And on that foundation, Katětov [1952] and Morita [1954] created a significant and elegant dimension theory for general metric spaces (see Nagata [1967]).

Modern Period

Star Spaces

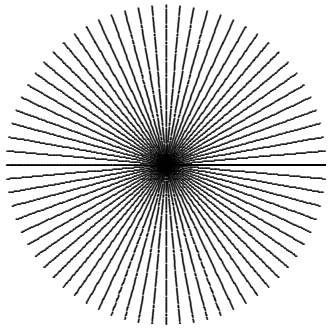
As detailed in the previous sections, the unit interval as a base space dominated universal space theorems in dimension theory up through 1931 when a subspace of I^{2n+1} was shown to be universal for the class of n-dimensional separable-metric spaces.

For n-dimensional weight $|A| \geq \aleph_0$ metric spaces, the unit interval continued to be central through the 1960s when it was used to construct the star space $S(A)$, which is known in the literature as a *hedgehog* with $|A|$ *prickles*, each prickle being a copy of the unit interval.

More precisely, a (Kowalsky) *star space* is a metric space $S(A) = (\bigcup_a I_a, d_S)$ where the set $\bigcup_a I_a$ is the *star-shaped set* obtained by identifying the zeros of a disjoint union of $|A| \geq \aleph_0$ unit intervals I_a (the ath arm), and the metric d_S is given by

$$d_S(x,y) = \begin{cases} |x-y| & x \text{ and } y \text{ in same arm,} \\ |x+y| & x \text{ and } y \text{ in distinct arms.} \end{cases}$$

A star space with a finite number 72 of prickles (or arms) is illustrated above right.



Historically, the one-dimensional star spaces appeared as the base space in the countably infinite product space $S(A)^\infty$, which is *infinite* dimensional.

Theorem 7 (Kowalsky 1957)**.** *A topological space X is metrizable if and only if it can be imbedded in a countable product $P = S(A)^\infty$ of star spaces for some infinite set A.*

Theorem 8 (Nagata 1963)**.** *A metric space X has (covering) dimension $\leq n$, if and only if it can be imbedded in the subset K_n of a countable product $P = S(A)^\infty$ of star spaces for some infinite set A, where K_n is the set of points in P at most n of whose nonvanishing coordinates are rational.*

By 1966, Nagata [1967], contrasting his universal spaces (subspaces of *infinite-dimensional* spaces) with the classical universal spaces (subspaces of *finite-dimensional* Euclidean cubes), stated:

> Comparing the general imbedding theorem with the classical one for separable metric spaces, we notice that $P(A)$ has infinite dimension while every n-dimensional separable metric space is imbedded in the $(2n+1)$-dimensional Euclidean cube I^{2n+1}. This leads us to the following problem: Improve the general imbedding theorem finding another universal n-dimensional space instead of $P(A)$.

Nagata's statement drew attention to the fact that Nöbeling's [1931] Classical Imbedding Theorem rests on the *one-dimensional* unit interval I as the *base space* in "I^{2n+1}". In other words, to construct the desired general imbedding theorem (analogous to Nöbeling's), one needs a *one-dimensional weight $\alpha \geq \aleph_0$ metric space X* whose kth product X^k, for some finite k, contains a weight $\alpha \geq \aleph_0$ universal space.

1971, Adjacent Endpoints in $N(A)$

So prior to the 1970s, it was Nagata's research and quotation above that served as motivation for seeking an analogue of the unit interval.

Also prior to the 1970s, there were *four* well-known results that indicated how to construct such an analogue:

(a) Cantor's construction $C \to I$ of I

(b) C is a topological copy of $N(\{0,2\})$

(c) $N(A)$ is a generalization of $N(\{0,2\})$

(d) Morita's Theorem (see below where "dim" denotes *the covering dimension*).

Theorem 9 (Morita 1955)**.** *Let X be a metric space. Then $\dim X \le n$ if and only if there exists a subspace S of $N(A)$ for suitable A and a closed continuous surjection $f : S \to X$ such that each fiber $f^{-1}(x)$ contains at most $n+1$ points.*

For an example of how Morita's Theorem relates to statements (a), (b), and (c), let $A = \{0,2\}$, $S = N(A)$, and $f : N(A) \to I$ classical adjacent-endpoint identification. Then since all fibers $f^{-1}(x)$ of f have size less than or equal to two, the dimension of the unit interval I is less than or equal to one.

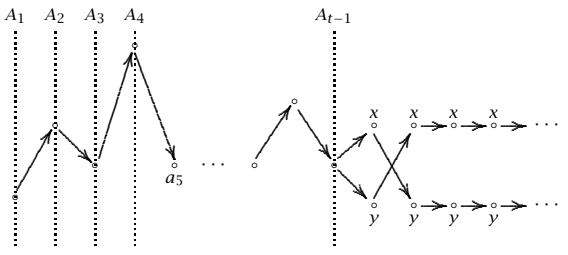
Moreover, straightforward arguments using Morita's Theorem yield the fact that $N(A)$ itself is a universal space.

Theorem 10 (Dimension zero)**.** *For each infinite set A, the Baire Space $N(A)$ is universal for the class of zero-dimensional weight $|A|$ metric spaces.*

So comparing Theorem 10 with Theorem 1, we see that the role of Baire spaces $N(A)$ in the modern period parallels the role of Cantor's set in the classical period. From this observation and (a), (b), and (c) it seemed natural to this author to introduce *modern adjacent-endpoint identification*.

The extension was accomplished as follows: A point $a = a_1 a_2 \cdots$ in $N(A)$ is an *endpoint of* $N(A)$ if there exists an index k such that $a_k = a_{k+1} = \cdots$. Distinct endpoints $a \ne b$ are *adjacent endpoints* when there exists $x \ne y$ in A such that $a = a_1 a_2 \cdots a_{t-1} x y y y \cdots$ and $b = a_1 a_2 \cdots a_{t-1} y x x x \cdots$.

The concept of *adjacent endpoints in* $N(A)$ is graphically illustrated below where each $A_i = A$.



1971, $J(A)$ Quotient Space[2]

With adjacent endpoints in $N(A)$ well defined, the next obvious step was to define J_A as the *identify adjacent endpoints in* $N(A)$ quotient space. So the natural mapping $p : N(A) \to J_A$ for the modern period is an extension of the natural mapping $C \to I$ of the classical period.

Moreover, key topological properties of $C \to I$ extend to $N(A) \to J_A$: both mappings are closed and continuous surjections with fibers of size less than or equal to two, and in both cases Morita's Theorem applies, showing that both I and J_A are one-dimensional.

As a bonus, by defining a point $x \in J_A$ as *rational* whenever $p^{-1}(x)$ has size two, we see that J_A partitions into *rationals* and *irrationals* as counterparts to those in the unit interval. In fact, in the J_2 case there is a homeomorphism $J_2 \to I$ that maps the J_2-rationals onto the rational reals contained in the open interval $(0,1)$.

1970s, J_A Universal Space Theorems

By 1975 the space J_A played a role in the modern period that paralleled the role played by the unit interval I in the classical period (see Lipscomb [1975]).

Theorem 11 (Modern Theorem 1975)**.** *Let A be an infinite set and let $n \ge 0$. Then the set of points in J_A^{n+1} at most n of whose coordinates are rational is universal for the class of n-dimensional weight $|A|$ metric spaces.*

The index "$n+1$" in the Modern Theorem is the best possible because Borsuk [1975], using homology, proved that the 2-sphere S^2 cannot be imbedded in the product of two one-dimensional spaces.

For $n = 0$, Theorem 11 yields the following result, which should be compared to Theorem 5.

Theorem 12 (Dimension zero)**.** *Let A be an infinite set. Then the subspace of irrational points in J_A is universal for the class of zero-dimensional weight $|A|$ metric spaces.*

And for the analogue of Urysohn's [1925] classical universal space theorem (Theorem 6 above), we provide its modern counterpart.

Theorem 13 (Lipscomb 1976)**.** *Let A be an infinite set. Then the countably infinite product J_A^∞ is universal for the class of weight $|A|$ metric spaces.*

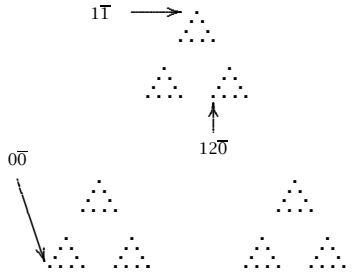
[2] *Because J_A was conceived as a generalization of the unit interval I, it seemed natural to select a notation that serves as a mnemonic of the extension—select the letter that follows the letter I, namely the letter J.*

1975–1990s, J_{n+1} and Fractals

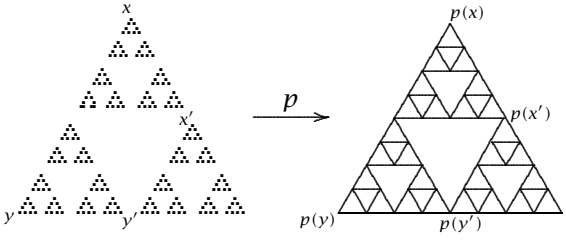
The term *fractal* was coined by Mandelbrot [1975] in the same year that the J_A universal space theorem (Theorem 11) was introduced (Lipscomb 1975).

Nevertheless, prior to 1975 pictures of $J_A = J_{n+1}$ for finite sets A of size $n+1 = 3$ and $n+1 = 4$ were obtained; i.e., graphical illustrations of approximations to J_3 and J_4 were obtained by simply thinking about the quotient mapping $N(A) \to J_A$.

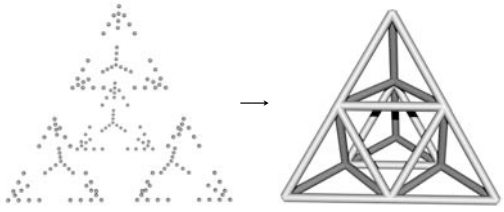
Indeed, for $A = \{0,1,2\}$ each finite list $a_1, \ldots, a_k \in A$ and doubleton subset D of A define a Cantor subspace $\{a_1\} \times \{a_2\} \times \cdots \times \{a_k\} \times D \times D \times \cdots$ of $N(A)$. In the graphic below, lists "a_1, a_2" of length two faithfully index the nine small triangles $T(a_1, a_2)$ whose three "edges"—each a linear arrangement of four dots—are faithfully indexed by the doubleton sets D. So, e.g., the list "1,1" indexes the small triangle T_{11} at the top, while the left side, right side, and bottom edges of T_{11} correspond to $\{1\} \times \{1\} \times D \times D \times \cdots$, where D is $\{0,1\}$, $\{1,2\}$, and $\{0,2\}$, respectively.



With due diligence, using the fact that each such edge (Cantor subset) maps onto a copy of the unit interval, one finds that J_3 is indeed a topological copy of Sierpiński's triangle.

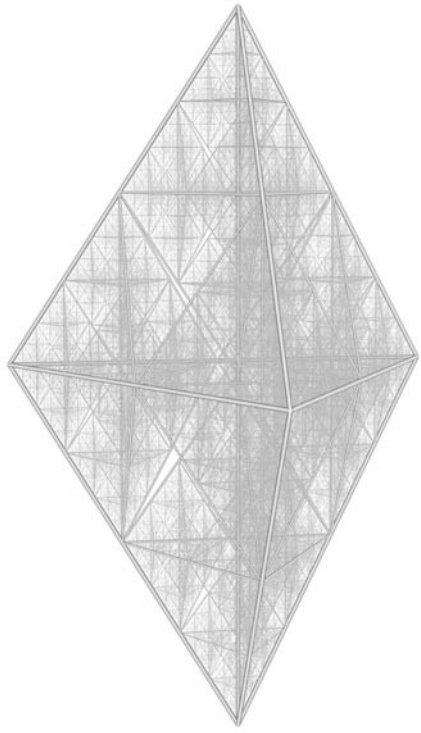


For the Baire space $N(\{0,1,2,3\})$, as illustrated below, one may similarly deduce that J_4 is a topological copy of the *Sierpiński cheese* (the 3-space analogue of Sierpiński's triangle).



By the mid-1990s the mathematics of viewing fractals as attractors of *finite* iterated function systems (IFSs) became rather well known—the ideas were introduced in 1981 (Hutchinson 1981) and then popularized in the late 1980s and early 1990s following the publication of Barnsley's 1988 text.

Against this backdrop, it is not surprising that it was during the 1990s that J_{n+1} emerged as the attractor ω^n, called the "*n-web*", of an IFS $\mathcal{F}_n$ whose $n+1$ members are contractions by one-half toward the $n+1$ vertices of an n-simplex.



Chris Dupilka's Level-6 representation of J_5.

For example, as illustrated in the previous section, J_3 and J_4 are, respectively, copies of fractals known as the 2-web (Sierpiński's triangle) and the 3-web (Sierpiński's cheese).

Turning to J_5, we also seek a picture—we desire to move the 4-web ω^4 from 4-space into 3-space. Any such isotopy should also preserve fractal dimension. The solution was obtained when Perry and Lipscomb [2003] constructed an isotopy that moves ω^4 from 4-space into 3-space with its fractal dimension preserved. (See Dupilka's graphic of the 4-web $\omega^4 =_t J_5$ above.)

The existence or nonexistence of such isotopies for ω^5 in 5-space, ω^6 in 6-space, and ω^7 in 7-space are open problems.

2002, J_3 and Separable Metric Spaces

A quick review of the classical period shows that no universal space was derived from Sierpiński's triangle J_3.

This oversight changed in 2002. By modifying the decomposition approach used to prove the Modern Theorem, Ivanšić and Milutinović [2002] introduced the following theorem.

Theorem 14 (Ivanšić and Milutinović 2002)**.** *The set of points in J_3^{n+1} at most n of whose coordinates are rational is universal for the class of n-dimensional separable metric spaces.*

1990s–2008, J_A as a Generalized Fractal

It turned out, as far as this author knows, that J_A for an infinite A may be counted among the first examples of a *generalized fractal*—an attractor of an *infinite* iterated function system.

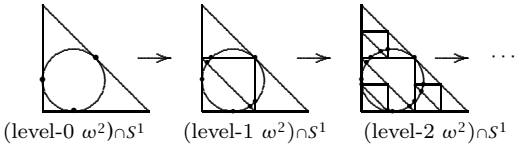
The seeds of such a claim were planted in the early 1990s: For infinite A, Lipscomb and Perry [1992], and independently Milutinović [1992], produced imbeddings of J_A into Hilbert's $l^2(A)$ space. Each imbedding involved an *infinite* IFS. In 1992, however, the IFS theory was limited to IFSs that were *finite*. In 1996, by modifying the topology of J_A, Perry [1996] constructed a subspace ω_c^A of the Tychonoff cube I^A that is *an attractor of an infinite* IFS. Perry also called attention to the open problem of showing that $\omega^A \subset l^2(A)$, a copy of J_A, is the attractor of an infinite IFS (of affine transformations of $l^2(A)$).

The open problem posed by Perry was solved by Miculescu and Mihail [2008]. They provided the mathematical context with an appropriate Hutchinson operator that had ω^A as its fixed point; i.e., ω^A is indeed the attractor of an infinite IFS.

An Application of J_5

A 3-Sphere Meets a 4-Web

Consider the leftmost graphic "(level-0 ω^2) $\cap$ S^1" in the illustration below.



Simply put, the illustration shows how one may use the 2-web ω^2 to approximate a circle, which represents a 1-sphere S^1.

The figure below similarly involves a 3-sphere S^3 and a 4-web ω^4. The 4-web has five vertices consisting of the origin and the four standard orthonormal basis vectors in 4-space. The 3-sphere S^3 is also inside of 4-space and is represented as the solution to $\sum_1^4 (x_i - .25)^2 = .25^2$.

A 3-Sphere meets a 4-web.

In the 4-space case, however, the points of intersection are calculated inside of 4-space, and then faithfully moved into 3-space using the Perry and Lipscomb [2003] isotopy that "moves" the points of intersection into 3-space—the isotopy $H : \omega^4 \times I \to \mathbb{R}^4$ rel ω^3 is a homotopy such that, for $0 \le t \le 1$, each H_t is a homeomorphism that is the identity on $\omega^3 \subset \omega^4$, and each H_t is a linear transformation that preserves fractal dimension. In addition, $H_1 : \omega^4 \to \mathbb{R}^3 \subset \mathbb{R}^4$. In other words, the intersection (Level-7 ω^4) $\cap$ S^3 in 4-space is faithfully moved into 3-space.

Comments

For more information see the author's 2009 (Springer's Monographs in Mathematics series) book *Fractals and Universal Spaces in Dimension Theory*. And for his excellent graphics—the J_5 graphic and the PovRay file that generated the 3-space view of (Level-7 ω^4) $\cap$ S^3, I wish to acknowledge and thank Chris Dupilka.

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Thank you

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A Trio of Institutes

Allyn Jackson

> "[I]nstitutes for advanced study modeled in some measure or another along the lines of the Princeton Institute are [multiplying] and will multiply throughout the western world."
>
> — *J. Robert Oppenheimer, in a December 17, 1959, letter to the French Education Minister, suggesting the French government support the Institut des Hautes Études Scientifiques*

In mathematics, Oppenheimer's prediction has come true: Over the past couple of decades, mathematics institutes have proliferated worldwide. While all share the goal of fostering mathematics research, each has its own unique history and traditions. Europe boasts several major institutes that loom large in international mathematical affairs, from the elegant Institut des Hautes Études Scientifiques, whose activities are mainly organized by its small but outstanding permanent faculty, to the beloved Mathematisches Forschungsinstitut in Oberwolfach, Germany, a bustling conference center with a different event every week. But Europe also has several smaller institutes known for their high-quality mathematical programs and their distinctive characters. Three of them are profiled here: the mathematics department at Aarhus University in Denmark, the Centre de Recerca Matemàtica in Barcelona, and the Centro di Ricerca Matematica Ennio De Giorgi in Pisa.

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Aarhus University

Svend Bundgaard is not a household name among mathematicians. Looking him up in MathSciNet reveals that he published just seven papers in his lifetime. He does not appear at all in the Mathematics Genealogy Project because he had no Ph.D. students—and in fact did not have a Ph.D. himself. And yet Svend Bundgaard had a significant impact on mathematics by establishing Aarhus University in Denmark as an international focal point for mathematics research, with a thriving visitor program and excellent facilities. The traditions he fostered there starting in the 1950s have continued ever since and find their most recent expression in the establishment of two centers within the mathematics department, the Center for the Topology and Quantization of Moduli Spaces (CTQM) and the Thiele Center for Applied Mathematics in Natural Science.

Bundgaard was born in 1912 and received a master's degree in mathematics from the University of Copenhagen. On the faculty at the time were the physicist Niels Bohr and his brother, mathematician Harald Bohr, and the two made Copenhagen a lively center for mathematics and physics. It was there that Bundgaard made contacts with leading mathematicians from around the world. In 1954 he became the first mathematician to be appointed to Aarhus University's division of science, which had been established a few years earlier (the university itself was founded in 1928). There was no mathematics building; a small office was cleared out for him in the anatomy building. But Bundgaard had been hired to launch the mathematics department, and for this he had big plans. From the beginning he envisioned an international dimension for the department, and

when he got funds to hire faculty, he used some of the money to bring in long-term visitors from abroad.

Bundgaard's genius for administration can be seen most clearly in the current mathematics department building, which was completed in 1967. Aarhus mathematicians say that Bundgaard sat in on all the weekly meetings of the architects and builders to make sure that the design features he wanted were carried out. When higher-ups nixed his plan to install sinks in all the offices so that people could wash chalk dust from their hands, Bundgaard had the builders put the sinks in anyway; they are discreetly hidden behind cabinet doors, possibly to avoid being seen by government inspectors. In another instance of bucking authority—and one that could not be so easily hidden—he directed the builders to put guest rooms and apartments on the top floor of the mathematics building, even though the authorization for this construction had been turned down. It was a prescient move: having these lodgings available made it easy for the department to invite many short- and long-term visitors from abroad. A set of apartments was also added to the computer science building when it was constructed. The Aarhus mathematics department today has sixteen guest rooms and six apartments.

The mathematics building is a lively place, bustling with faculty, students, and visitors. "The infrastructure fills all of our needs," states department chair Johann P. Hansen. Apart from some interior renovations to spruce things up—and the sacrifice of a couple of seminar rooms to office space as the department grew—the building remains as it was in Bundgaard's day. Each floor has several small spaces equipped with blackboards, tables, and chairs, where people can gather and chat. The "mathematics canteen" on the first floor attracts students and faculty from within and outside the department. During a two-week CTQM workshop in 2008, fifty mathematicians from all over the world, including a large contingent from Japan, attended talks in one of the building's larger lecture halls, milled around the corridor during coffee breaks, and mixed with students in the canteen for lunch. The proof of the genius that went into the building's design can be seen in the use to which the building is put: many different kinds of activity comfortably coexist.

Bundgaard knew that a high-quality mathematics library was needed to support research in the department, and for this he secured funds from the Carlsberg Foundation, which was created by the Carlsberg beer brewery in part to support scientific research. Today the library has about 100,000 books as well as subscriptions to more than 400 journals. Some of the journals come in exchange for *Mathematica Scandinavica*, which is another initiative of Bundgaard's and which is still produced in the Aarhus department. Because of these long-standing exchange arrangements, the library has some rare journals that one typically does not find in a standard mathematics library. Aarhus mathematics faculty member Johan Dupont recalled that in 1969, when he was a graduate student at Aarhus, he attended a conference in Bucharest and was put up in a fancy hotel room after telling the conference organizers where he was from. Thinking of their journal exchange arrangement with *Mathematica Scandinavica*, "they mistook me for an Aarhus bigwig," Dupont said with a laugh. Three years later, Dupont became a coordinating editor of *Mathematica Scandinavica* and served in that capacity until 1988.

(Photo courtesy of Masaaki Suzuki, Akita University.)

The entrance to the mathematics building at the University of Aarhus.

For those who have become accustomed to libraries outfitted like airport security checkpoints, the Aarhus library evokes amazement. Anyone can walk in, browse around, find books and journals on the shelves, and photocopy materials. It is not a quiet place: the first floor is the math lab, filled with students sitting at tables discussing math problems. The one rule is that books must not be removed from the math building. Inevitably, some material is lost. But according to Hansen, so far it has proved less expensive to replace the missing material than to hire a gatekeeper.

Thanks in large part to Bundgaard, the Aarhus mathematics department has all the facilities needed to function as a small mathematics research institute. What it does not have is the money to support such an enterprise—in fact, the university provides little funding to support research. For this reason, Aarhus mathematicians have long pursued outside funding from the Danish government and other sources in order to host institute-like activities within the mathematics department. One of the best known of these enterprises was MaPhySto, which stands for Mathematical Physics and Stochastics. In its initial incarnation, MaPhySto ran from 1998 until 2003, with a five-year grant

(Photo courtesy of Masaaki Suzuki, Akita University.)

This portrait of Svend Bundgaard is one of several interesting paintings in the Aarhus mathematics building.

of about 50 million kroner (around US$6 million at the current exchange rate) from the Danish National Research Foundation. The founder and scientific director was Ole E. Barndorff-Nielsen, a member of the Aarhus mathematics department and a key figure in building the department's strength in stochastics. When Barndorff-Nielsen retired in 2003, he had to give up the position of director of MaPhySto. Arne Jensen of Aalborg University became his successor, and the structure of MaPhySto changed from being a center located at Aarhus to being a network stretching across several universities in Denmark.

Over its lifetime, MaPhySto spurred interdisciplinary collaborations between areas of mathematical physics—such as quantum mechanics, statistical mechanics, and quantum field theory—and areas of stochastics—such as stochastic analysis, interacting particle systems, stochastic matrices, and free probability. By the time MaPhySto ceased operations, it had drawn hundreds of long- and short-term visitors, held an ongoing seminar series, and organized many conferences and workshops. It also had an active program for postdoctoral researchers and supported many Ph.D. students.

When MaPhySto ended, members of the Aarhus department were ready with a proposal for a new initiative, the Thiele Centre for Applied Mathematics in Natural Science. The center focuses on basic research in stochastics and its interplay with other disciplines of natural science. The main areas of emphasis are stochastic geometry and statistical image analysis, Lévy theory and applied probability, stochastic processes and spatio-temporal modeling, and computational stochastics and bioinformatics. The center has about twenty-five members, including permanent faculty in various departments of the university, as well as postdoctoral researchers and Ph.D. students who are supported through the center's funding from the Danish Natural Science Research Council and the Danish Council for Strategic Research. The center runs a weekly seminar and intensive courses for Ph.D. students, and organizes about four workshops and conferences each year.

The latest addition to the Aarhus department is the Center for the Topology and Quantization of Moduli Spaces (CTQM), which began in 2006 with a grant from the Danish Natural Science Research Council. The center focuses on the investigation of the topology and quantization of moduli spaces associated to two-dimensional surfaces and their mapping class groups. If this sounds rather narrow, CTQM director Jørgen Ellegaard Andersen explained that "it was an interesting move to make it very focused, because it emphasizes very much the kind of things we study, and it gives us a clear profile." At the same time, the area connects to other subjects. "Quantization of moduli spaces includes all of quantum topology, it includes many aspects of gauge theory, and so on," he remarked. "In order to study the topology of moduli spaces, you need to study various other things. The focus we have interacts with many different areas of mathematics."

Part of the reason this area was chosen is that it meshed well with the research interests of various people in the department, including Andersen and Dupont, as well as Ib Madsen, a longtime faculty member who was largely responsible for building the department's strength in topology. Madsen's profile rose in recent years after his 2005 proof, with Michael Weiss, of a conjecture of David Mumford on the stable cohomology of the moduli space of curves. Madsen is no longer at Aarhus; in 2008 he took a position at the University of Copenhagen.

The research focus of CTQM also connects to that of Nikolai Reshetikhin of the University of California at Berkeley, for whom the center secured a Niels Bohr grant from the Danish National Research Foundation. The large-scale Niels Bohr grants provide five years of support for a distinguished visiting professor, along with funding for two additional temporary positions, some postdoctoral researchers, other visitors, conferences, and workshops. In addition to bringing Reshetikhin to Aarhus for a period every year, along with some of his students, the Niels Bohr grant has greatly boosted overall funding for CTQM. The center has over 100 senior visitors a year, hosts between six and eight postdocs, and has a handful of distinguished long-term visitors each year.

In 2009 Andersen received a "center of excellence" grant from the Danish National Research Foundation for a total of 50 million kroner. This grant provides a significant boost to CTQM, securing its funding for the coming five years. The grant will help to further strengthen the ties between CTQM and UC Berkeley and to support new links to the geometry group at the University of Oxford, led by Nigel Hitchin, and to the Institut des Hautes Études Scientifiques in Paris, through the involvement of Maxim Kontsevich. The cooperation with the latter two institutions will include a component for joint predoctoral and postdoctoral appointments. "This is a great opportunity

for us here at CTQM in Aarhus to be able to cooperate with these world-renowned mathematical research institutions in this very manifest way," said Andersen.

Enterprises like CTQM and the Thiele Center have strengthened the international dimension of mathematics research at Aarhus. But such large-scale efforts exact a cost: The funding is always temporary, and there is a constant struggle to make sure new grants are lined up when the old ones run out. They also put additional pressure on the department's resources and infrastructure. Another consideration is how well these centers serve home-grown Danish doctoral students. Dupont, who is a member of CTQM and recognizes the value it brings to the department, nevertheless noted that only a few of the department's doctoral students have the background to really benefit from all of the activities hosted by the center.

The department will face a wave of retirements in the next few years, and having the Thiele Center and CTQM will certainly make Aarhus more attractive to job seekers from other countries who might not otherwise consider making the leap to a small Scandinavian country with a difficult language. And these foreigners will likely be needed. During a recent stint as director of the graduate program, Dupont did a survey of Aarhus Ph.D.s in mathematics over a period of ten years and found that only one-quarter of them ended up with academic jobs in Denmark. "We might get into difficulties if we want to have enough Danish mathematicians," he noted. Although he recognizes the value of cultivating a strong international research environment in the department through ventures like CTQM and the Thiele Center, Dupont cannot help but wish that funding were also available to address more local problems, such as improving the academic career path for young Danish mathematicians. The goal, as Dupont put it, should be to create something with "a long life in mathematics". No doubt Svend Bundgaard would agree.

Centre de Recerca Matemàtica Barcelona

The student unrest that gripped the world during the 1960s led to a university building boom across Europe. In Catalonia, the historic Universitat de Barcelona, founded in 1450, was joined by two modern campuses, the Universitat Politècnica de Catalunya and the Universitat Autònoma de Barcelona, both of which were established in 1968. Located in the suburb of Bellaterra, the sprawling campus of the Autònoma abounds with the boxy concrete buildings characteristic of its era. Though the mathematics building is just as unprepossessing as the rest, in one wing it houses an oasis of elegance called the Centre de Recerca Matemàtica (CRM). The judicious use of space, the refined lighting, and the fluid, undulating corridors could

(Photo courtesy of D. Kotschick, Ludwig-Maximilians-Universität München.)

The entrance to the main lecture room of the CRM Barcelona.

all be the work of a good architectural firm. But when one notices the way the classic motif of the CRM logo is carried throughout the space on the etched glass that adorns the doorways, and when one notices the eclectic, often arresting works of art, one discerns a personality behind the CRM.

That personality is Manuel Castellet, the founder of the CRM and a professor of mathematics at the Autònoma. He started the center in 1984, a time when the mathematical culture in Spain was just starting to recover from the isolation imposed by the dictatorship of Francisco Franco, which lasted from 1936 until Franco's death in 1975. During the Franco era, Spanish universities emphasized personal and political connections rather than excellence and merit, and in this atmosphere mathematical culture languished. This was no less true in Catalonia, a center of resistance against Franco, than in the rest of Spain. "If you look at *Mathematical Reviews* from the end of the 1960s and beginning of the 1970s, there are no papers by Spanish mathematicians," remarked Castellet. "During the 1960s and 1970s at the University of Barcelona, only one Ph.D. in mathematics was given. And this was not much different from the rest of Spain."

At that time, a small number of Spaniards went abroad to get Ph.D.s in mathematics, with the idea of returning to their native land and building mathematics research there. Castellet was one of them. He went to the ETH (Eidgenossische Technische Hochschule) in Zürich, where he received a Ph.D. in 1973 under the direction of Beno Eckmann. About a decade before, Eckmann had founded the Forschungsinstitut für Mathematik (FIM), a research institute in the ETH mathematics department that to this day remains a well-known international center. Castellet stayed on for two years as a postdoc at the FIM, where, he said, the

(Photo courtesy of D. Kotschick, Ludwig-Maximilians-Universität München.)

A corridor in the CRM Barcelona.

atmosphere was "fantastic": it was the meeting point for mathematicians in Zürich and attracted others from all over the world. Upon his return to Spain, Castellet took a position at the newly established Autònoma. He realized that the international contacts he had found so stimulating at the FIM were exactly what Barcelona needed for mathematics to thrive. The FIM became the model on which the CRM was designed—though on a smaller scale. Said Castellet, "We are not as rich as the Swiss."

Catalonia has its own language, distinct from Spanish, and a strong cultural identity, and many Catalans think of themselves as more Catalan than Spanish. The CRM too has had a strongly Catalan character. It was founded within the Institut d'Estudis Catalans (IEC), an organization that promotes research in areas related to Catalan language and culture. The CRM retains its ties to the IEC even though it has since the late 1980s received its core funding from the Catalan government rather than from the IEC. The CRM has emphasized, first of all, service to the local community of mathematicians in Barcelona and, secondly, service to the international community. Although it has been for many years the only international visitor's institute for mathematics in Spain, very few non-Catalan Spaniards participated in its programs. It could be argued that the influence of the CRM has been greater in Europe outside of Spain than in Spain outside of Catalonia (though this has been changing in recent years).

The role of the CRM has been to provide a forum in which mathematicians at the three local universities—the Universitat de Barcelona, the Politècnica, and the Autònoma—could bring in visitors and organize research programs, conferences, and workshops. Unlike in Aarhus, the CRM has no on-site housing for visitors. Instead they are lodged in a set of apartments the CRM rents for that purpose in nearby San Cugat del Vallès, in university housing, or in hotels in the center of Barcelona, which is about thirty-five minutes away by commuter train. The CRM does not have its own library but instead relies on the mathematics library of the Autònoma, which subscribes to about 250 journals and has good access to books through an interlibrary network in Catalonia. The CRM offices are modern and comfortable, and the center has a dedicated staff who know their jobs inside and out and keep the center running smoothly. It has become increasingly crowded in recent years, and there are now plans to build a new wing adjacent to the mathematics building, adding another 900 square meters to the existing 1,200 the center now occupies.

Over the years the CRM has emphasized areas in which there are strong local mathematicians, in particular in Castellet's own area of algebraic topology. The emphasis on the latter area can be seen in the Barcelona Conference on Algebraic Topology, a series of meetings held at the CRM every four years from 1986 to 2002. These conferences attracted some of the top experts in the area and helped put Barcelona on the map as a focal point for research in algebraic topology internationally, while also providing much stimulus for the local mathematicians working in that area. The influence of the conferences was also spread through publication of proceedings in book series of Springer and Birkhäuser (Birkhäuser also publishes a series, "Advanced Courses in Mathematics, CRM Barcelona", which was started in 2002 and comprises some ten volumes). Some mathematicians in Barcelona say that the CRM's focus on a limited range of areas, particularly its focus on algebraic topology, constituted an insufficient attention to breadth. Others argue that the CRM had to carefully husband its scarce funds to focus on areas of strength and excellence. Despite these disparate views, it seems clear that Castellet's careful cultivation of the CRM over the years has helped to develop mathematics in Catalonia. As one of the main players in establishing ERCOM (European Research Centres on Mathematics, a committee of the European Mathematical Society), Castellet has also been active in supporting mathematics institutes across Europe.

It is exactly the cultivation of the CRM into a well-run, well-established institute that has allowed it to capitalize on new opportunities that have appeared in recent years. In 2002 the CRM became a "consortium" between the IEC and the Catalan government. To do so, the center had to sign a contract with the government that specified duties and strategic objectives to be carried out; in return, the CRM received larger and more stable core funding. The contract also brought changes in the way the CRM had been run. Previously, decisions about which research programs to hold at the CRM were made mainly in discussions between local mathematicians and the center. Under the terms of the contract, the CRM began issuing

formal calls for proposals open to mathematicians all over the world and established a clear decision-making process by the CRM's Scientific Advisory Board. As a result, a broader range of areas has been represented at the CRM in recent years: Research programs have included geometric flows, enumerative combinatorics and random structures, Arakelov geometry and Shimura varieties, and control theory. In addition, through a European Union project called NEST (New and Emerging Science and Technologies), the CRM has hosted programs to foster international collaboration and training in three emerging subjects: risk assessment, mathematical neuroscience, and digital content security.

Castellet retired as director in 2007, and, after an international search, his Autònoma colleague Joaquim Bruna was named as successor. When Bruna began as director, everything was in place to run a successful international mathematics institute. "That's terrific," said Bruna. "That's something that has a lot of merit." Today Castellet holds the title of honorary director, by decision of the Board of Governors in recognition of his achievement in founding and building the CRM. Bruna has begun to put his own stamp on how the CRM is run and has set up a team of three codirectors from the other Barcelona universities: Marta Sanz-Solé and Carles Casacuberta of the Universitat de Barcelona and Joan Solà-Morales of the Politècnica. A group of dynamic and experienced academics like this one is not going to agree on everything. But all are committed to preserving the traditions that have made the CRM successful in the past while continuing to expand its international presence and the mathematical areas represented in the center's activities. The CRM has also renewed its Scientific Advisory Board to make it more international and more involved in decisions about the directions the center takes.

The main purpose of the CRM is still to provide a home for activities, such as conferences and year-long research programs, that local mathematics departments cannot easily carry out. At the same time, the center is trying to promote new directions that the universities do not have a way to promote. As Bruna put it, the CRM today is "at somewhat of an inflection point." When it became a consortium center under the Catalan government, the CRM joined the CERCA network of thirty-eight research centers in Catalonia—and the CRM was the only center in the network to have no permanent research staff. The new contract that the CRM negotiated for 2008–2012 stipulates that the center must appoint permanent staff. This means a big change but also a big opportunity, Bruna noted. "We have thought a lot about this, about how to match this with the typology [of the CRM]," he said. "We want to go in this direction, but always with the idea of supporting and complementing what is being done" in the university mathematics departments in Barcelona.

The strategy the direction team is pursuing is to have "semi-permanent" research positions: one or two long-term researchers would be hired each year in areas not currently represented in the local universities. After taking a few years to build up research groups in those areas, these CRM researchers would be expected to move on to permanent positions in academia, or, in exceptional cases, at the CRM itself. The center has now established a few such positions and has a search under way to add a researcher in industrial mathematics. The strategy the CRM has pursued for these positions is similar to that of ICREA, a widely praised program of research positions that was put in place by the mathematical economist Andreu Mas-Colell when he was Minister for Universities and Research of the Government of Catalonia from 2000 to 2003. ICREA was so successful that it has been replicated in other regions in Spain.

Another area of expansion in the CRM in the past couple of years has occurred in its postdoctoral program. Since 2000 the CRM has been a participant in the European Postdoctoral Institute (EPDI), which provides two-year grants for young mathematicians to visit at least two of nine mathematics institutes in Europe for six- to twelve-month stays. The CRM also now funds its own two-year postdoctoral positions. These have been in demand, last year attracting a total of sixty-three applicants for just four slots. Altogether, with funding from various sources, the CRM last year hosted a total of twelve postdocs; the stays were of varying length, partly due to variations in the funding of the positions and partly due to some of the postdocs having found permanent positions before their time at the CRM had ended.

Overall, support for mathematics and science in Spain seems to have a bright future, partly because of insistence by the European Union that its member states invest a certain percentage of their gross national product in research. In 2006 the Spanish government funded Ingenio Mathematica, or i-MATH, a five-year, €7.5 million (approximately US$10 million) project designed to enhance and unify mathematics research across all of Spain. The CRM is one of five nodes participating in i-MATH, and Bruna sits on the project's direction board. The establishment of i-MATH has enhanced the influence of the CRM within Spain. In the last couple of years plans have been under development for the establishment of other mathematics institutes in Spanish universities as well as a national network to connect their activities, and some of these initiatives have gotten off the ground.

In April 2009 the CRM kicked off a celebration of its twenty-fifth anniversary, with the president

(Photo courtesy of D. Kotschick, Ludwig-Maximilians-Universität München.)

The Palazzo Puteano, which houses the Centro de Giorgi, as seen from the steps of the Scuola Normale.

of Catalonia in attendance and a piano concert by Alexander Melnikov (a professional pianist and son of mathematician Mark Melnikov). During its first quarter-century of existence, the CRM was the only mathematics institute of its kind in Spain. Although that singular status is now changing, the CRM will retain its special role as the best established and most experienced center in the country. What is more, the CRM has shown itself to be adaptable and able to respond to new conditions and opportunities. Today the CRM is running at full capacity, with a more intensive menu of activities than ever before. This year the focus is on analysis, and next year on arithmetic geometry. Building on its strong foundation, the ideas and energy of the new directors, and the likelihood of increased government support for research, the CRM is poised to thrive.

Centro Ennio De Giorgi

Ennio De Giorgi, one of the best-known Italian mathematicians of the twentieth century, was a professor at the Scuola Normale Superiore in Pisa. He originally came from Lizzanello, a small village in southern Italy, where the inhabitants today number about 10,000. One day, two deputies from the town government of Lizzanello came to the office of Mariano Giaquinta, a professor at the Scuola and director of the Centro di Ricerca Matematica Ennio De Giorgi, which had been established two years before. "They told me, 'We would like to give a prize named after Professor De Giorgi. What do you think?'," Giaquinta recalled. "I told them, a prize is nice, but it would be much nicer to provide money for young people to have a chance to study. They said, 'That's good, we are willing to do that'." And so the *commune di Lizzanello*—the administrative body governing the village—agreed to provide €25,000 (about US$37,500), each year for twelve years, to fund mathematics research by postdocs. "It is really amazing," said Giaquinta. "Every time I tell people [this story], they say 'That's not possible.' I tell them, it *is* possible. And they say, 'There must be some law that the town cannot spend money that way.' And I tell them no, the town does it." (Unfortunately, happy tales end: In 2008 Lizzanello informed Giaquinta that, due to financial difficulties, the town would be unable to continue to fund the postdocs.)

Lizzanello seems to have been a special case. Giaquinta has tried without success to get several communities that are nearby in Tuscany to support the Centro De Giorgi. Even the city government of Pisa, home to the Centro, turned him down, as did nearby Florence. But what really puzzles him is the lack of response from the Italian government. It is not that the government has decided against giving funds to the Centro. Rather, Giaquinta's inquiries are simply ignored. "If I had a letter from [the ministry of universities and research] saying, 'We have considered what you are doing and we don't think it's interesting', that would already have been a positive answer for me—just some sort of reaction, even a negative reaction," he said. The silence from the government is especially surprising considering that the Centro is the only institute of its kind in Italy and that it has from the beginning organized high-powered programs with leading mathematicians from around the world.

The Centro De Giorgi is one of Europe's newest mathematics institutes, having been launched in 2001. Despite the lack of funding from the Italian government, the Centro in some ways has had an easy time getting off the ground. For example, there was no need to build a new building, as Bundgaard did in Aarhus: the Scuola Normale provided the handsome 17th-century Palazzo Puteano, which sits on the Piazza dei Cavalieri in Pisa, directly across from the Scuola's main building. Also in contrast to Aarhus, where the university essentially provides no funds for research, the Centro receives steady funding from three universities in Pisa. And unlike the CRM, which was founded in Barcelona in 1984 with few exemplars beyond the FIM in Zurich to take as a model, the Centro De Giorgi was started at a time when there were many existing mathematics institutes with substantial track records.

The Palazzo Puteano is a lovely building but is not architecturally exceptional, so the Centro had a good deal of freedom in deciding on renovations. The result is a rustically elegant interior where exposed wooden ceiling beams and tall shuttered windows combine easily with eleven modern offices. The palazzo has nine kitchen-equipped sleeping rooms, which are, needless to say, in high demand, especially since they do not belong exclusively to the Centro but can be used by the Scuola Normale at large. (Most visitors to the Centro are put up in local hotels, which Giaquinta

said are "too few, not very good, and expensive.") The larger of the building's two seminar rooms holds only about thirty people, but bigger lecture halls are available at the Scuola Normale. Surprisingly, there is no wireless network in the building, but this might not be a disadvantage: the wired Internet connections in the offices are faster and more user-friendly than the wireless networks at Aarhus and the CRM. Keeping the place running smoothly is the friendly and efficient two-person staff, Cecilia Cappelli (who replaced Ilaria Gabbani in fall 2008) and Antonella Gregorace.

The Centro's largest source of funding is the Scuola Normale, which provides €200,000 per year (financial difficulties reduced this amount to €150,000 in 2009); the University of Pisa, just across town, contributes €100,000, and the Scuola Superiore di Studi Avanzati Sant'Anna, a newly established university for applied research, chips in €50,000. These funds come with very few restrictions, so Giaquinta has plenty of flexibility in how he can use the money. The Centro also gets smaller amounts from other sources. One is the Istituto Nazionale di Alta Matematica, which is the main funder of mathematics meetings in Italy and which the Centro can turn to for support for specific programs. A few Italian universities whose mathematics departments want to support the Centro have contributed small amounts, and a foundation connected to a bank in the Tuscan town of Lucca gives the Centro around €15,000 per year. Organizers of the programs often use money from their research grants to pay for travel and housing for students and other participants. By cobbling together these sources of support, the Centro runs fairly well on its total budget of about half a million euros per year, Giaquinta said. "But we could do much better with one million." His unsuccessful efforts to get the attention of the Italian government centered on bringing the budget up to that level.

Giaquinta said that the Centro is based loosely on the model of the Newton Institute in Cambridge, England, though the Centro is much smaller and more informal. "There are no very strict regulations concerning how the institute can be run," he noted. Indeed, since the Centro's inaugural activities began in early 2002, it has had a fluctuating mix of "intensive research periods", which last a few months, and shorter workshops, which run for up to a week. In 2003 there were four intensive research periods and one workshop; by 2007 the balance had nearly reversed, with one intensive research period and fifteen workshops. The Centro also sponsors "research nuclei", which are small groups of Italian mathematicians who are working together on a long-term basis and who use the Centro as a place to meet and collaborate. (Descriptions of past, present, and future activities of the Centro, including the annual financial and scientific reports of the director, are available on the Centro's website.)

From the start the Centro has attracted top mathematicians. The first intensive research period, organized in 2002, lasted two and a half months and had about eighty participants. It focused on dynamical systems and was organized by a scientific committee, including two Fields Medalists (John Milnor and Jean-Christoph Yoccoz; the other members were Stefano Marmi, John Mather, and Jacob Palis). Giaquinta pointed to the 2005 research program in Diophantine geometry as one of the Centro's best so far; with seventy-five participants over a four-month period, the program was organized by Yuri Bilu, Enrico Bombieri, David Masser, Lucien Szpiro, and Umberto Zannier. The intensive research program in 2007, on dynamical systems and number theory, was especially large, with a total of over 200 participants. Organized by Grigori Margulis, Stefano Marmi, Peter Sarnak, Jean-Christoph Yoccoz, and Don Zagier, it included a workshop for 100 graduate students that was funded by the Clay Mathematics Institute. The total number of mathematicians coming to the Centro per year has increased over time, hitting 800 in 2007.

Local expenses are provided for all participants, including meals at the Scuola Normale cafeteria—and, this being Italy, the food in the cafeteria is quite good. Many participants are able to fund their travel through grants, and for those who cannot, the Centro can sometimes help with travel expenses. For visitors who stay for at least a month, Giaquinta said, the Centro provides "a kind of salary"—but not a full salary, as the Centro does not have enough money. In fact, Giaquinta said that one of his dreams for the future of the Centro is to have more long-term visitors who stay six to twelve months, so that there is deeper and more sustained activity. But this would require having, say, three or four long-term visitors who could interact—and that is much more than the Centro can afford right now.

As director, Giaquinta has a great deal of latitude in making decisions about the activities of the Centro. There is no committee to evaluate proposals for programs; in fact, there is no formal call for proposals. So how does one apply to organize a research program at the Centro De Giorgi? Pick up the phone and call Giaquinta. But the Centro is not a one-man show. Giaquinta consults widely with many colleagues, especially those in the Scuola Normale, about what activities would be best to host. And he does not simply sit back and wait for calls to come in; he actively pursues ideas for program topics and persuades people to serve as organizers. This highly flexible style seems to suit the small size of the Centro and allows it to put a premium on quality. Giaquinta and his colleagues at the Scuola make most of the major decisions

about directions the Centro takes, leading to some grumbling on the part of mathematicians at the University of Pisa, who see their institution contributing a tidy sum to the Centro and sometimes feeling a bit distant from its activities.

One program for which the Centro does have an organized call for applications is the program for "junior visitors" (these are essentially postdoctoral positions, but the word "junior" is used to circumvent Italian government regulations relating to positions referred to as "postdoctoral"). These positions are in high demand: In 2007 there were about 100 applications for just three or four positions. Only five of the applicants lived in Italy (applications also came from Italians living outside the country). The reason for the lack of applications in Italy could stem from the hiring traditions there, which remain extremely local. The usual method of filling positions is to pave the way for a local candidate, rather than hiring someone from outside. Such inbred hiring traditions mean that a postdoc at the Centro is not especially attractive to a young Italian mathematician whose long-term plan is to stay in Italy. The restricted hiring opportunities in Italy have caused some "brain-drain". In particular, new Ph.D.s from the Scuola Normale—which traditionally has attracted some of the most talented students from across Italy—are at a disadvantage, because the Scuola has very few positions in mathematics, and the Scuola Ph.D.s are often considered as outsiders by other departments in the country. As a result, some of the best young Italian mathematicians have ended up outside their home country.

Simon Salamon of the Politecnico di Torino was on the organizing committee for two programs at the Centro De Giorgi, including a large one in 2004 that ran for three months. He is an enthusiastic supporter of the Centro. There are several venues in Italy that have become traditional sites for mathematics conferences and short courses, but the Centro offers the possibility for longer-term activities. "There is nothing else like it in Italy," he said. Having the Centro in Pisa not only offers ease of access from most parts of Italy and from many cities abroad, but it also takes advantage of the fact that Pisa is, and long has been, a vibrant center for mathematics. "Pisa is one of the cities that has traditionally been important in mathematics," noted Salamon. "You only need to go to the *camposanto* [cemetery] and see the graves of mathematical giants."

One indication of Pisan traditions in mathematics is the statue of Ulisse Dini (1845–1918), which stands just across the plaza from the Centro. Dini was on the faculty of the University of Pisa, and late in life he became the director of the Scuola Normale. That he was also a member of the Italian Parliament might be the reason for his memorialization in a statue, yet the statue neverthless symbolizes the long heritage of mathematics in Italy. It is therefore surprising to find that the Italian system for supporting research and for funding enterprises like the Centro De Giorgi is weak. "You have isolated good situations, but the entire system doesn't work," Giaquinta remarked. "That is typical of everything—mathematics, physics, medicine. The system is very bad." What saves it, he said, is that "there are some very good people around."

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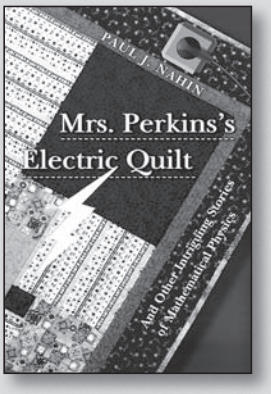

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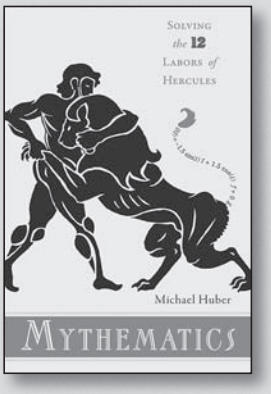

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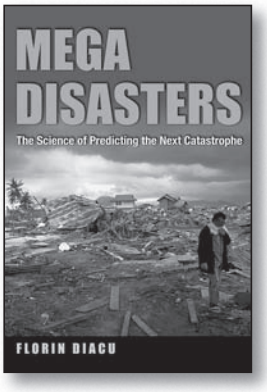

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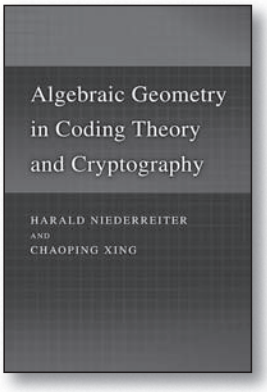

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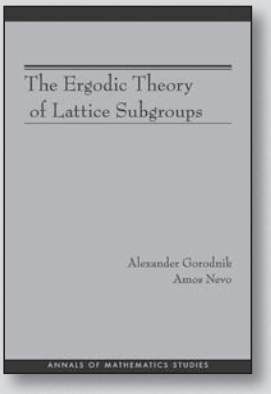

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WHAT IS . . .

a Rota-Baxter Algebra?

Li Guo

A **Rota-Baxter algebra**, also called a **Baxter algebra**, is an associative algebra with a linear operator that generalizes the algebra of continuous functions with the integral operator. More precisely, for a given commutative ring $\mathbf{k}$ and $\lambda \in \mathbf{k}$, a **Rota-Baxter k-algebra (of weight λ)** is a $\mathbf{k}$-algebra R together with a $\mathbf{k}$-linear map $P : R \to R$ such that

$$P(x)P(y) = P(P(x)y) + P(xP(y)) + \lambda P(xy) \tag{1}$$

for all $x, y \in R$. Such a linear operator is called a **Rota-Baxter operator (of weight λ)**. Note that the relation (1) still makes sense when the associative algebra R is replaced by a k-module with a bilinear binary operation, such as the Lie bracket. Despite its simple form, the Rota-Baxter operator has appeared in a wide range of areas in pure and applied mathematics, providing a unified framework to study these different areas. Advances in one of these areas often stimulated developments in Rota-Baxter algebra, which, in turn, inspired progress in other related areas.

Let R be the $\mathbb{R}$-algebra of continuous functions on $\mathbb{R}$ and P the integral operator sending a function $f(x)$ in R to the function $P(f)(x) := \int_0^x f(t)\,dt$. Then the integration by parts formula

$$\int_0^x P(f)'(t)P(g)(t)dt = P(f)(x)P(g)(x) - \int_0^x P(f)(t)P(g)'(t)dt$$

is just (1) with $\lambda = 0$.

In the discrete context, consider the algebra of sequences in a $\mathbf{k}$-algebra A, with componentwise addition and multiplication. Define an operator P that sends a sequence $(a_1, a_2, a_3, \cdots, a_n, \cdots)$ in A to the sequence of partial sums $(0, a_1, a_1 + a_2, \cdots, \sum_{k<n} a_k, \cdots)$. Then it is easy to check that P is a Rota-Baxter operator of weight 1.

Despite its natural connection with integral analysis, the Rota-Baxter algebra was not introduced as an abstraction of integral analysis, as in the well-known differential case, but was introduced in 1960 by Glenn Baxter [1] in his probability study of fluctuation theory, in particular the Spitzer identity with the algebraic formulation

$$b = \exp(-P(\log(1 - ax))) \tag{2}$$

for the solution of the fixed point equation

$$b = 1 + P(bax)$$

in the power series ring $A[[x]]$, where (A, P) is any commutative Rota-Baxter algebra of weight -1. It was then studied in the 1960s and 1970s by Cartier and the school of Rota [3] in connection with combinatorics. For example, they showed that the well-known Waring's formula,

$$\exp\left(-\sum_{k=1}^{\infty}(-1)^k p_k(x_1, \ldots, x_m)t^k/k\right) = \sum_{n=0}^{\infty} e_n(x_1, \ldots, x_m)t^n, \ \forall\ m \geq 1$$

between the power sum symmetric functions $p_k(x_1, \cdots, x_m)$ and the elementary symmetric functions $e_n(x_1, \cdots, x_m)$, is equivalent to Spitzer's identity in a free Rota-Baxter algebra.

In part to acknowledge Rota's contribution in Rota-Baxter algebra and in part to distinguish this algebraic structure from the well-known Yang-Baxter equation, named after the distinguished physicists, the term *Rota-Baxter algebra* has been used recently in place of Baxter algebra. Quite remarkably, even though the two Baxters are not

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The author was partially supported by NSF grant DMS 0505643.

related genealogically, they are mathematically—the operator form of a skew-symmetric solution of the classical Yang-Baxter equation in a Lie algebra is just a Rota-Baxter operator of weight zero on this Lie algebra. An analogous relationship has been established for associative algebras through the work of Aguiar and several other authors.

Another connection of Rota-Baxter algebra with mathematical physics was found in the seminal work of Connes and Kreimer in the late 1990s in their Hopf algebra approach to renormalization of quantum field theory. There divergent Feynman integrals, through dimensional regularization, acquire Laurent series expansions in the Laurent series ring $\mathbb{C}[\varepsilon^{-1}, \varepsilon]]$, which gives back the divergent integrals when $\varepsilon = 0$. The splitting of $\mathbb{C}[\varepsilon^{-1}, \varepsilon]]$ as a vector space direct sum of the two subrings $\mathbb{C}[[\varepsilon]]$ and $\varepsilon^{-1}\mathbb{C}[\varepsilon^{-1}]$ means that the projection $\mathbb{C}[\varepsilon^{-1}, \varepsilon]] \to \varepsilon^{-1}\mathbb{C}[\varepsilon^{-1}]$ is a Rota-Baxter operator of weight -1. This operator and the Hopf algebra structure on the Feynman diagrams uncovered by Connes and Kreimer allowed them to give an algebraic formulation for the BPHZ process of QFT renormalization, which is named after Bogoliubov, Parasiuk, Hepp, and Zimmermann for their work in the 1950s and 1960s. In particular, the algebraic Birkhoff decomposition of Connes and Kreimer decomposes a regularized Feynman rule into the renormalized part and the counterterm.

Quite unexpectedly, the algebraic Birkhoff decomposition can be naturally derived from the generalization of a factorization theorem for Rota-Baxter algebras whose original form was discovered by Atkinson in 1963 and was independently established for Lie algebras as a fundamental theorem of integrable systems by Reyman and Semenov-Tian-Shansky in 1979. This generalization of the Atkinson factorization theorem also implies the factorization theorem of Barron, Huang, and Lepowsky in vertex operator algebras; the even-odd decomposition of Aguiar, Bergeron, and Sottile in combinatorial Hopf algebras; and the Lie algebra polar decomposition of Zanna et al. in matrix exponentials of ODEs.

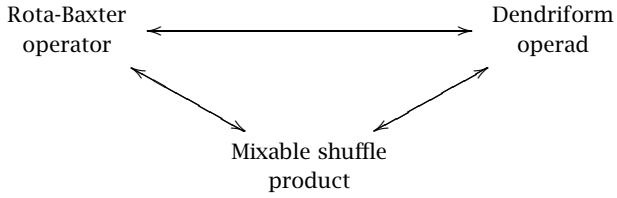
Free commutative Rota-Baxter algebras were first constructed by Rota and Cartier in the 1970s. A third construction was later obtained in terms of the mixable shuffle product that includes both the shuffle product from iterated integrals and its discrete analogue of quasi-shuffle product of Hoffman. The latter two products play a prominent role in the study of multiple zeta values, where stuffle instead of quasi-shuffle had been used. For example, it is conjectured that all algebraic relations among multiple zeta values can be derived by intertwining the shuffle and stuffle relations among these values that come from their definition as iterated sums and from their integral representations shown by Kontsevich. More recently, the algebraic framework of Connes and Kreimer on renormalization of Feynman integrals has been adapted to study divergent multiple zeta values.

In the middle 1990s Loday introduced an operad called dendriform dialgebra with motivation from algebraic K-theory. This operad has two binary operations, $\prec$ and $\succ$, that satisfy certain relations so that the binary operator

$$x \star y := x \prec y + x \succ y \tag{3}$$

is associative. Aguiar showed that for a Rota-Baxter algebra (R, P) of weight 0, the binary operations $x \prec_P y = xP(y)$ and $x \succ_P y = P(x)y$ define a dendriform dialgebra structure on R, giving rise to a functor from the category of Rota-Baxter algebras of weight 0 to the category of dendriform dialgebras analogous to the functor from the category of associative algebras to the category of Lie algebras. Further investigation of this analog led to the study of the adjoint functor that assigns a dendriform dialgebra to its enveloping Rota-Baxter algebra. As in the case of enveloping (associative) algebras of Lie algebras obtained from free associative algebras, the enveloping Rota-Baxter algebras are obtained from free *noncommutative* Rota-Baxter algebras. These free Rota-Baxter algebras carry natural combinatorial structures of trees and Motzkin paths.

A large part of the theoretical study of Rota-Baxter algebras can be summarized in the following relationship diagram:



As it turns out, the dendriform dialgebra is just the first case of a class of closely related operads that share the property of "splitting of associativity", as in (3). Also, there are several operators, such as the averaging operator and Nijenhuis operator, resembling the Rota-Baxter operator, particularly in their special form of products. The study of these three classes of objects should greatly enrich our understanding of these operators, operads, and products.

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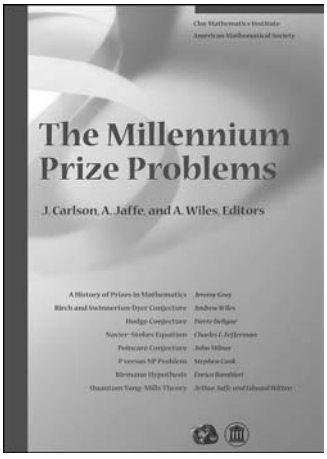
Book Review



The Millenium Prize Problems

Reviewed by Robert C. Gunning

The Millenium Prize Problems
J. Carlson, A. Jaffe, and A. Wiles, editors
American Mathematical Society, 2006
US$29.00, 169 pages
ISBN-13:9780821836798

Problems are the lifeblood of mathematics. A good deal of time and effort is spent on solving problems while learning almost any part of mathematics, from addition in grade school through calculus and differential equations in college and on to the wide range of graduate courses introducing prospective mathematicians to current work. One of the hardest parts of supervising doctoral theses is finding or, even better, leading students to find on their own reasonable problems to attack: problems that are not too easy, so lead to nothing interesting, nor too difficult, so lead to nothing at all; problems that require the right amount of background, not too little so as to encourage triviality, nor too much so that there is no time and energy left to tackle the problem itself; problems that lie in reasonable areas, not those areas of no current interest, so that the solutions might be a waste of time, nor those areas that are so overwhelmed by current attention that it is difficult to discover what is already known in the time available. That the final reports of mathematical meetings and conferences frequently include lists of problems related to the topic of the meeting is quite common, and is greatly appreciated.

A number of mathematicians have proposed on their own lists of problems in the areas of mathematics in which they were particularly interested; and some, such as Paul Erdős for instance, have even proposed prizes for their solutions. From time to time particularly daring and thoughtful mathematicians even have proposed lists of problems of interest throughout all of mathematics.[1] The great example, of course, is the list of twenty-three problems that David Hilbert proposed in his speech at the International Congress of Mathematicians held in Paris in 1900 and in somewhat extended forms in some subsequent publications.[2] The extent to which that list of problems is known and has influenced the direction of mathematical research is truly amazing. In part that is no doubt due to the stature of the proposer, one of the giants of mathematics of that or any period; but it is also due to the proposer's wide knowledge of mathematics and insight into the importance both of problems in general and of the particular problems that he posed, an insight substantiated by the amount of effort that has been put into solving these problems since they were first proposed. The Symposium in Mathematics devoted to further problems inspired by Hilbert's list and sponsored by the American Mathematical Society in 1974 attests to the interest of the original list three-quarters of a century later. The *Proceedings* of that symposium included a range of problems in twenty-seven different areas of mathematics, proposed by a number of mathematicians and edited by Jean Dieudonné, in homage to the Hilbert list and in an effort to compose another list of important and interesting problems that might serve to guide mathematical research for another three-quarters of a century. Like most of the other general lists of problems, however, this list has

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[1] *A few examples are S. Ulam, "A collection of mathematical problems",* Interscience, *1960; V. Arnold, M. Atiyah, P. Lax, and B. Mazur, editors,* Mathematical Frontiers and Perspectives, *IMU/AMS 2000.*

[2] Göttinger Nachrichten, *1900, pp. 253-297;* Archiv der Mathematik und Physik, *vol. 1 (1901), pp. 44-63 and 213-37.*

vanished into the depths of libraries across the world with very few ripples to mark its passing.

The incredible growth of mathematics since the beginning of the twentieth century and the astonishingly wide range of current mathematical research really preclude anything as comprehensive or brash as Hilbert's list today. The problem list in the volume under review here is of a somewhat different nature, not so much a prevision or prescription for mathematics of the future as a collection of some well-known problems that have been circulating throughout the world of mathematics for a number of years, indeed from later in the nineteenth century through the middle of the twentieth century, that have been the focus of a great deal of mathematical research for a long time, and that doubtless will continue to attract the efforts of numerous mathematicians to tackle them without any further inducements. However, this list stands a much better chance of having a lasting existence than almost any other post-Hilbert list, not just from the quality of the problems selected, but also from the liberality of the awards for their solutions. The idea of prizes for solutions of mathematical problems is an old one; an excellent history by Jeremy Gray of the role of prizes in mathematics, from ancient Greece through the Fields Prize in the middle of the twentieth century, is included in the book and is well worth reading on its own. Landon T. Clay, through the Clay Mathematical Institute that he and his wife, Lavinia D. Clay, founded and endowed, has been an outstanding modern patron of mathematical research; sponsoring this volume of problems and the prizes for their solutions is one of his many contributions to the development and flourishing of mathematics, beyond the research conferences, research awards, research fellowships, senior scholarships, liftoff fellowships, and other mathematical activities that the Clay Foundation supports, with the advice of a distinguished and remarkably sensible scientific advisory board. This list, with the excitement and publicity aroused by the munificence of the prizes, may have been intended to serve a purpose other than those of most other lists: that of increasing the awareness of and interest in mathematical research among nonmathematicians and of inspiring budding prospective mathematicians and scientists to pursue challenging careers involving mathematics and its applications.

The seven prize problem areas (the Birch and Swinnerton-Dyer conjecture, the Hodge conjecture, the existence and smoothness of solutions of the Navier-Stokes equation, the Poincaré conjecture, the P versus NP problem, the Riemann hypothesis, quantum Yang-Mills theory) that the scientific advisory board selected are sufficiently well known that it is not necessary to include any more detailed discussion in this review. The individual articles briefly describing the background and significance of the problems are excellent and written by current major figures in mathematics. The photographs of the authors of the individual essays, and of other mathematicians who have worked on these problems and closely related areas, are a part of a very handsome publication that should also inspire many nonprofessional mathematicians to have a look, and perhaps be inspired to take modern mathematical research more seriously.

Changing Faces: The Mistaken Portrait of Legendre

Peter Duren

Adrien-Marie Legendre (1752–1833) made great contributions to analysis, number theory, celestial mechanics, and practical science. His name is attached to the Legendre differential equation, Legendre polynomials, the Legendre transformation, the Legendre symbol in number theory, the Legendre conditions in calculus of variations, the Legendre relation for elliptic integrals, the Legendre duplication formula for the gamma function, and the list goes on. He wrote important books on advanced calculus, number theory, and elliptic integrals. His textbook adaptation of Euclid's geometry had a long life, was translated to many languages, and brought him popular fame. His work is honored today, yet curiously he was not so highly regarded during his lifetime and there was no publication of his collected works. Little is known of Legendre's personal life and he remains a shadowy figure.

For over a century one familiar portrait (Figure 1) has been displayed wherever Legendre's work has been discussed in historical writing. It is included in books on history of mathematics such as Struik [14] and Eves [5]. It has been printed repeatedly to illustrate articles about Legendre, and it appears on many mathematical websites. Generations of mathematicians have known and recognized Legendre by that portrait.

But the portrait has nothing to do with Adrien-Marie Legendre. It is not his likeness. Instead it portrays a politician named Louis Legendre, an active participant in the French Revolution, no relation to the mathematician. This shocking and rather embarrassing revelation has emerged in the last few years, supported by strong evidence, as we will explain.

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Figure 1. Louis Legendre.

It seems incredible that such an egregious error could have gone undetected for so many years. Both men were repeatedly depicted in the literature by the same lithograph portrait of Louis Legendre (Figure 1), yet no one seemed to notice the anomaly until the advent of the computer

age, when powerful search engines transformed the art of information retrieval. Sometime during the year 2005, two students at the University of Strasbourg were astonished to find a single portrait for two different men. Their discovery was posted on the mathematics department website les-mathematiques.u-strasbg.fr. The error was then confirmed and actively discussed by bloggers in France, who uncovered most of the sources cited in this report.

After the error was confirmed, the first task was to determine the identity of the shared portrait. Was it a likeness of Adrien-Marie or Louis Legendre, or neither? A mystery to be solved. The website of Jean-Bernard François [6] was central to that investigation and still shows a record of the chain of discoveries which identified the portrait as that of Louis Legendre. In particular, it shows that bloggers traced the portrait to its source in a book [2] of lithographs published in 1833.

Once the traditional portrait was known to be false, a feverish search began for a true portrait of Adrien-Marie Legendre. Miraculously, an authentic portrait was discovered during the year 2008 in the library of the Institut de France in Paris, among a rare collection [1] of seventy-three caricatures of members of the Institute. One of the watercolor sketches (depicted on the cover of this issue of the *Notices*) shows the heads of Legendre and Fourier, with bodies lightly sketched in pencil. Their names "Legendre" and "Fourier" are written below the sketch. Fourier is easily recognized from existing portraits, but Legendre takes on a totally new appearance. This is the only image of Adrien-Marie Legendre known to exist.

Here is the sequence of events that brought the true portrait to light. Late in the year 2007 the mathematician Gérard Michon learned of the ongoing controversy through the website of François and posted a report (in English) on his own website [10]. Some months later, he came across an obscure website http://institut-de-france.fr/bibliotheques/Enrichissements2000_2001.doc that described the album containing caricature portraits ("tête seule achevée") of Legendre and Fourier. Michon announced the discovery on his website, and François used that information to obtain a copy of the sketch, which Michon posted on his website in December 2008. This writer first learned about the story from Michon's account, which contained a link to François [6]. In response to inquiries, both Michon and François kindly furnished additional information for use in this article.

Louis Legendre (ca. 1755–1797) was a butcher in Paris when the Revolution broke out in 1789. (His year of birth is variously recorded as 1752 [4], 1755 [8], and 1756 [2].) He participated in the storming of the Bastille and subsequent revolutionary events, and was elected a deputy

Figure 2. L. Legendre pictured with Montagnards (lower left and inset).

to the National Convention, where as a member of the far-left party known as the Montagne, he contributed to the fall of the more conservative Gironde party and voted for the execution of the king. Among the Montagnards were famous figures of the Revolution such as Danton, Marat, Robespierre, and Saint-Just. A "group portrait" [3] of the Montagnards in 1793 is shown in Figure 2. Note that Louis Legendre is represented by a variant of the familiar lithograph.

That lithograph portrait of Louis Legendre was created by the artist François-Séraphin Delpech (1778–1825) and was included in a book [2] of similar portraits of many prominent figures of the time: politicians, scientists, artists, military officers, royalty, even the unfortunate King Louis XVI. Beneath each portrait was a surname and a signature (cf. Figure 1). The book displays individual portraits of 13 of the 21 Montagnards who appear in the group portrait of 1793, including Louis Legendre. In addition, one finds mathematicians such as Lagrange, Monge, Carnot, and Condorcet

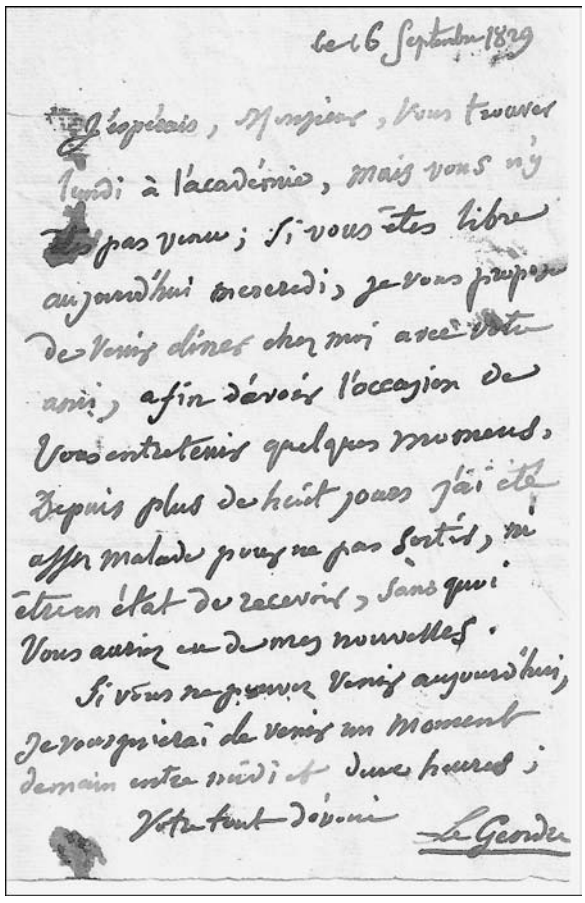

Figure 3. Letter from A.-M. Legendre to Jacobi.

portrayed in the book. All four were public figures, as was Adrien-Marie Legendre, with reputations extending beyond academia. The last three were prominent in politics, and Lagrange headed a national commission on weights and measures, among other assignments. It is easy to understand how the "Legendre" portrait could have been mistaken years later for the mathematician, although the book does contain an index of formal identifications. In the index one finds, for instance, the entry "LEGENDRE (Louis), né à Paris, en 1756, mort à Paris, le 13 décembre 1797". [Born in Paris in 1756, died in Paris on 13 December 1797.]

The signature of Louis Legendre, as displayed with his portrait, is distinctly different from that of Adrien-Marie, who actually signed his name "Le Gendre" (see the sample in the letter to Jacobi, Figure 3), but the disparity appears not to have attracted attention until the last few years.

When was the erroneous portrait first introduced into the literature? That is difficult to say, but in a book by Alphonse Rebière [13] published as early as 1900 we find the portrait of Louis Legendre adorning a discussion of Adrien-Marie's work. Why did mathematicians not challenge the error? The obvious answer is that the mistaken portrait made its appearance so long after Legendre's death in 1833 that no one who remembered him was still alive, and no true likeness was available to contradict it. (Photography was invented only about 1840.) We know from testimony of Poisson that Legendre did not welcome personal attention, but wanted his work to speak for itself. Speaking at Legendre's funeral, Poisson [12] said, "Notre confrère a souvent exprimé le desir qu'en parlant de lui il ne fût question que des ses travaux, qui sont, en effet, toute sa vie. Je me conformerai religieusement à sa volonté, dans cet hommage que je viens rendre ..." [Our colleague often expressed the desire that in speaking of him it would be only a question of his works, which are in fact his whole life. I will comply strictly with his wish in this tribute that I come to pay ...] In view of these remarks, it seems likely that Legendre actively discouraged the making of portraits.

The album of caricatures [1] has a mysterious history. It is the work of Julien-Léopold Boilly (1796–1874). His father Louis-Léopold Boilly (1761–1845) was a more famous artist, a member of the Académie des Beaux-Arts best known for his oil portraits. The younger Boilly was commissioned to do a series of engravings of members of the Institute, but the work was never finished; the partial collection (also in the library of the Institut de France) includes a formal portrait of Fourier but apparently none of Legendre. The album of caricatures had been in private hands until it was donated to the Institute by Daniel Wildenstein, himself a member of the Académie des Beaux-Arts, in 2001. Wildenstein had bought the album at a public auction held by Christie's in New York on January 28, 1999. According to the 1999 Christie's catalog, the album had been listed in the auction of the artist's studio (lot number 160) on December 14, 1874, shortly after his death. We are indebted to Fabienne Queyroux, curator of manuscript collections at the Institut de France, for all of this information.

The collection [1] also contains a caricature of Laplace, but no other mathematicians are represented. The entire album can be viewed on the website of the Réunion des musées nationales `www.photo.rmn.fr`. (Click on "recherche", then type in "Boilly" for searching and click repeatedly on "suivante".) The two Boilly artists appear to be confused, since the website attributes the album of caricatures to the father Louis-Léopold.

In the juxtaposition of Legendre and Fourier, the artist seems to be commenting on a contrast of personalities: Fourier fat and jolly, Legendre lean and acerbic. However, the historical record sometimes portrays Legendre in quite a different light. A case in point is the kind reception he gave to Abel and Jacobi.

In the latter part of his career, Legendre devoted many years to research in the theory of elliptic integrals. His monumental treatise [9] was finally published in 1827, in two volumes: one for the mathematical theory, the other for extensive numerical tables largely compiled by Legendre himself. Shortly thereafter, the two young mathematicians N. H. Abel (1802–1829) and C. G. J. Jacobi (1804–1855) made sensational discoveries that revolutionized the subject. Legendre learned of their work through published papers and by direct correspondence. He might well have reacted with dismay, but to his credit he welcomed the innovations with open arms, carried on an enthusiastic mathematical correspondence [11] with Jacobi for two years, and added a third volume to his treatise to present the new discoveries in coordination with his earlier work. (Poisson [12], departing from his stated mission, comments at length about this episode.)

On August 19, 1829, Jacobi wrote to tell Legendre that he had traveled as far as Frankfurt and had decided to come to Paris for several weeks because "I am burning with desire to see the man to whom I am so much indebted for kindnesses…". On 16 September 1829, while Jacobi was in Paris, Legendre wrote him the letter displayed in Figure 3. [Translation: I was hoping to find you Monday at the Academy, but you didn't come. If you are free today (Wednesday), come to dinner at my place with your friend, so that I will finally have a chance to speak with you for a few minutes. For more than eight days I was too sick to go out or to receive company; otherwise you would have had my news. It you are not able to come today, I beg you to come for a moment tomorrow between noon and two o'clock.]

We will never know the news (presumably mathematical) that Legendre was so eager to convey to Jacobi. One thing is clear, however. The letter is written with the warmth of friendship. The tone is hardly lean and acerbic!

Acknowledgements. We are very grateful to Fabienne Queyroux for authoritative information on the provenance of the album of caricatures [1]. Ms. Earnshaw of St. Michael's Library, University of Toronto, kindly sent us a copy of Louis Legendre's portrait from the book [2]. Marguerite de Marcillac gave permission to reprint the portrait (Figure 2) of the Montagnards from the *Dictionnaire d'Histoire de France* [3]. We thank Mikael Ragstedt, librarian at the Mittag-Leffler Insitute, for the copy of Legendre's letter. Finally, the writer wants to express his appreciation to Bill Casselman, graphics editor of the *Notices*, who went far beyond the call of duty and joined in the search for information as well as images for this article.

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Steven G. Krantz Appointed *Notices* Editor

Elaine Kehoe

Steven G. Krantz of Washington University in St. Louis will begin a three-year term as editor in chief of the *Notices* starting with the January 2010 issue. He succeeds Andy Magid of the University of Oklahoma, who has been editor since 2004.

Steven Krantz did his undergraduate work at the University of California Santa Cruz and earned his Ph.D. from Princeton University in 1974 under the direction of Elias M. Stein. He then became an assistant professor at the University of California Los Angeles. He served on the faculty at Pennsylvania State University from 1981 to 1987, then went to Washington University, where he has chaired the mathematics department.

Krantz has published more than 150 research articles and more than fifty books. His research interests include several complex variables, one complex variable, harmonic analysis, analysis on Lie groups, partial differential equations, and differential geometry. He received the Chauvenet Prize of the Mathematical Association of America (MAA) for an outstanding expository article in 1992 for "What is several complex variables?", published in the *American Mathematical Monthly*. He was also awarded the MAA's Beckenbach Book Prize in 1994 for *Complex Analysis: The Geometric Viewpoint*. Among other honors and awards, he has held a Richardson Fellowship at Australian National University and received a Faculty Mentor Award from Washington University in 2007. Most recently he was elected to the Sequoia High School Hall of Fame. He has held visiting professorships at many universities, including Princeton, the Institute for Advanced Study, Beijing University, and the Mittag-Leffler Institute. He has organized and been principal speaker at many meetings, including the AMS Summer Research Institute on Operator Theory (1993), the NATO Conference on Several Complex Variables in Edinburgh (1995), the Conference in Honor of Lars V. Ahlfors at Stanford University (1997), and the Joint Mathematics Meetings in Atlanta (2005).

Krantz has had a long association with the AMS, of which he has been a member since 1971. He has served on the Council and the Executive Committee and has chaired the Committee on Publications. He has been an associate editor of the *Notices* and is a book review editor for the *Bulletin.* He serves on the Editorial Committee for the Graduate Texts series and on the Committee on Committees. He has been a steady contributor to the *Notices* in many forms, including editorials, book reviews, and articles.

Steven G. Krantz

A large part of Krantz's contribution to the profession has been in the areas of pedagogy and of forging a career in mathematics teaching and research. With such books as *How to Teach Mathematics, A Primer of Mathematical Writing, A Mathematician's Survival Guide, Mathematical Publishing: A Guidebook*, and *The Survival of a Mathematician: From Tenure to Emeritus*, all published by AMS, as well as numerous other articles and books, he has established himself as a specialist in mentoring new mathematicians.

"I've always been interested in teaching," Krantz said. "I was serving on an NSF panel for an education program in the late 1980s and an NSF officer came to our table to chat us up in preparation for our work. He began by saying, 'Are we all agreed that the lecture is dead?' I must say that I'd never heard this before, and I was dumbfounded. That question, together with my experience on that panel, got me interested and concerned with teaching reform."

He remembers an experience while he was a visiting faculty member at Princeton in 1980 and attending an orientation session. "The person conducting the session, a very senior and famous mathematician, got up in front of the room and said, 'These days you can prove the Riemann hypothesis or you can learn how to teach.' And that was the extent of his advice to us on the craft of teaching. I started to wonder whether we could do better."

Later Krantz taught a graduate course on teaching and found all the available texts wanting. He decided to write his own book on teaching and used his manuscript as the class text. When he

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wanted to publish the book, however, despite very positive responses from mathematicians, "things went nowhere with the commercial publishers," he said. "Fortunately John Ewing and Don Babbitt at the AMS took a great interest in the book, and I ended up publishing with the AMS."

About the "survival guides", Krantz said, "I've always been fascinated with the observed fact that mathematicians, upon leaving school, are just supposed to figure out what to do. There is nobody there to guide them. And the attrition rate is therefore very high. I thought perhaps I could do something about it. Ed Dunne at the AMS encouraged me in this mission, and those two books resulted."

Krantz's interests extend beyond writing for mathematicians and their students. His two books *Mathematical Apocrypha* and *Mathematical Apocrypha Redux*, published by the MAA, aim at a general audience by presenting brief stories that illuminate the human side of many well-known mathematicians, including their foibles and vulnerabilities. For instance, he recounts a story of how William (Willy) Feller (1906–1970) and his wife were once trying to move a large circular table from their living room into the dining room. No matter how hard they pushed, pulled, and maneuvered, they could not get the table through the door. Feller sat down with a pencil and paper and devised a mathematical model that proved that what they were trying to do was impossible. While he was busy doing this, his wife got the table into the dining room.

The eclectic nature of Krantz's interests extends to the interactions of mathematics with other disciplines. He appreciates that the *Notices* "is a primary tool for communication among mathematicians," and as editor he hopes to broaden the scope of its offerings, including more articles about applications and about the interaction of mathematics with other fields."We hope to provide forums for opinion and discussion of issues of broad interest," he said. "We hope to attract a broad range of contributors." He is already planning some articles based on mathematics and art and has begun reviewing articles.

Overall, Krantz's work is a reflection of his philosophy. "I think that one of the keys to success in life—not just in academics but in art and in any creative field—is to find the means to periodically reinvent yourself. If you don't, then you atrophy, you want for ideas, and your creativity dries up. If you can manage to be reborn, then you get a fresh start with rekindled enthusiasm and new viewpoints." An academic mathematician, he said, has "a great deal of freedom and independence to explore your own thoughts and create your own intellectual path. With luck, you can have considerable influence over the development of others, just as my many fine mentors have had over me."

AIM Workshops: The Moderated Discussion Session

David W. Farmer and Sally Koutsoliotas

Introduction

The American Institute of Mathematics (AIM) runs around twenty mathematics workshops each year. Each workshop involves approximately thirty people, and is designed to have the participants collaborate on some topic of common mathematical interest. While a workshop has some specific mathematical goals, its real purpose is to enhance the research of the participants by fostering collaboration. There are few talks, usually two each day, and lots of time for people to work together.

A difficulty which presents itself immediately is: how can thirty mathematicians effectively work together? Is it possible for thirty mathematicians to have a productive conversation? Surprisingly, this is possible, and AIM has developed the *moderated discussion session* as a mechanism to help this happen.

Example Discussion Sessions

AIM has developed several styles of moderated discussion sessions. The *moderated problem session* is the easiest to describe. We will use that example throughout this article and end by briefly mentioning some other scenarios in which the moderated discussion session can be useful.

A "problem session" is a gathering of mathematicians with a common research interest at which the participants identify open problems and share information about those problems. Problem sessions are common at many workshops and specialized conferences. Moderated problem sessions have the same purpose as a standard problem session; what is different is the format.

At a traditional problem session, a succession of people goes to the board and writes down problems. This is intended to popularize the problem and also to obtain feedback from the other participants. In our experience the usefulness of such events varies widely. Sometimes an interesting problem is discussed or some new idea about an old problem arises. Other times, someone spends a long time at the board writing out uninteresting or, worse, incomprehensible problems, often resulting in little discussion. It is rare for a traditional problem session to be useful and interesting for its entire duration and to its entire audience.

Often these traditional problem sessions do not take full advantage of the collective knowledge of their participants, and this led AIM to develop a new approach. The main feature of this new mode is the moderator, a participant who stays at the front of the room encouraging discussion and the exchange of ideas and who helps to organize the material on the board.

The Rule

A moderated discussion session is easy to describe: a moderator at the front, people sitting in their chairs taking turns talking, the moderator responding to the people and occasionally writing something on the board. To watch it, it looks more like a traditional lecture than a traditional problem session. But it *is* a problem session, with people posing and discussing problems. And what makes it all work is one simple rule:

The Rule: *Only the moderator is allowed to write on the board.*

From this one rule flows a wealth of consequences. If you want to pose a problem, you

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must first get the moderator to understand it. This usually leads most of the other participants to understand it too. During the discussion of the problem, the moderator can keep track of the conversation, occasionally giving a summary, and strike a balance between the more vocal and frequent contributors and those more reluctant to interrupt. This process also helps everyone to understand. And the moderator can fairly assess the amount of time to be spent on a topic, treating everything in sufficient depth but not spending too much time on little details. In fact, moderators may have to say, "This discussion is getting too technical; let's discuss it later."

The moderator listens to the problems as well as the discussion and puts a concise summary on the board, usually paraphrasing the information to ensure that the information is accurately conveyed. This keeps the conversation reasonably paced and also results in an organized summary. A simple glance at the board will reveal the progression of the session.

One of the main features of these moderated discussion sessions is that it seems to be an environment in which people are willing to share their thoughts on open problems. It is common for experts to begin debating basic issues, and this is a valuable experience for the other participants, who can listen to what the experts think. What often emerges is a picture of the current understanding of the open problems in the area.

Implementation

The above description sounds simple, but there are several key elements that enable the moderated discussion session to be successful. AIM has developed this approach by trial and error over the course of many workshops.

Choosing a Topic

Since the purpose of the moderated discussion session is to organize people's thoughts about open problems, it is helpful to choose a fairly narrow focus for the session. At AIM workshops, where there can be more than one discussion session during the week, we carefully choose topics that are appropriate to the overall plan of the workshop and the needs for that particular day. For example, many workshops have one problem session on fundamental problems and another session on possible applications to other areas. We work with the workshop organizers to determine the focus of each discussion session.

Choosing a Moderator

The AIM staff works with the organizers to choose a moderator. After deciding on a topic for the discussion, we explain the purpose of the moderator and their role in facilitating the discussion.

Opening Statement

Example statement to open a moderated discussion session:

The purpose of this session is to identify and discuss unsolved problems: big problems, little problems, any problem you find interesting. The premise is that you all have interesting ideas about the important problems in this area, and what we want to do is gather that material together and organize it in a way that can help form a clearer picture.

At AIM we have developed a simple mechanism to help these problem sessions run smoothly. We call this a "moderated discussion session". The way it works is that someone is chosen as the moderator, and she or he stands at the front. There is only one rule, and that is: only the moderator is allowed to write on the board. [pause] The rest of you stay in your seats and talk to the moderator. [pause] Your moderator is [name], so tell [him or her] your problems.

We stress that the moderator should be someone who can suppress the urge to contribute his or her own problems and who can occasionally "play dumb" to encourage others to explain their ideas more thoroughly. For these reasons it is often best to choose someone whose expertise is on the periphery of the focus for the discussion session. We also suggest that the moderator not be one of the organizers and not be someone who has already given a lecture.

Who would be a good moderator? We tell the organizers: someone you would be happy to put in front of a calculus class. Moderating is closer to good teaching than to good lecturing. The moderator helps slow down the conversation, making sure that everyone is absorbing the information. A slick presentation is not helpful and can even be counterproductive.

The moderator must keep control of a large group while simultaneously creating an environment where everyone can talk freely. This is slightly tricky, and just like giving a lecture, some people are better at it than others. And just like preparing a lecture, a small amount of basic training can go a long way. This is why we do "moderator training".

Moderator Training

The workshop organizers choose a moderator, but the AIM staff does not approach the person until shortly before the session. Usually they agree to be the moderator, but occasionally we need to quickly find someone else to ask. We meet briefly, ideally no more than five minutes, to prepare the moderator for the discussion session.

How to Be a Good Moderator

- After the session is introduced, begin by saying, "I'm ready"; then wait quietly for someone to say something. Be patient. Do not interject any of your own thoughts until the session is well under way, even if there is uncomfortable silence.
- Listen to the complete statement of a problem and restate it to the proposer before writing it on the board. *Don't become a dictation machine.*
- If people start talking among themselves, just let them go. Once a point has been made, provide a summary and then write it on the board.
- If you notice that someone wanted to say something but didn't get a chance, call on that person at the next opportunity.
- If someone introduces a new topic, first ask everyone if there was anything else to say on the previous topic.
- If people start trying to solve a problem or if a small group pursues a minor point too far, stop the discussion and suggest that they continue after the session.
- If possible, try to group related topics on the board.
- Occasionally "play dumb" so that the proposer will have to rephrase and expand on her or his idea. This will help other people to gain a better understanding.

This meeting is critical, because being a good moderator does not come naturally to most people. It is one of those tasks which, ironically, people perform worse the more they think about it. This is why we do the moderator training immediately before the discussion session.

We begin by explaining that the organizers suggested her/him as a moderator and we hope they are willing to give it a try. We then explain their main purpose: the participants have lots of information in their heads, and it is the moderator's job to bring it out and to organize it.

We then explain "the rule" and its consequences: forcing everyone to explain things to the moderator usually leads to most of the other people understanding too. This also slows things down so that people don't get lost. And since the moderator controls everything, she or he can help structure the discussion and put an organized summary on the board.

We then talk about some of the specific things to keep in mind, which are listed in the box "How to be a good moderator".

We end by explaining that one of the AIM staff will introduce the session, and following the introduction the moderator should begin by just saying, "I'm ready," or words to that effect. Then just wait for someone to suggest a problem. We remind the moderator to listen to the whole problem and restate it to the whole group *before* writing it on the board.

Introducing the Session

It is important that someone other than the moderator introduce the session and explain the rule. For AIM workshops, this is usually done by one of the staff. The reason is that you want the moderator and the participants to work together. If it appears that the moderator is forcing everyone to stay in their seats and preventing them from writing on the board, then the participants will not be receptive to the idea of explaining everything to the moderator. By having someone else explain the rule, it creates an environment of "we're all in this together", and the moderator and participants can join together to make the best of the situation.

A sample opening statement is given in the accompanying box.

When Things Go Wrong

Sometimes the moderated discussion session is not successful, and we have identified two standard ways in which the session can fail.

1. Some moderators write everything on the board as the speaker says it. This fails to achieve the purpose of the moderator as a sounding board. The other extreme, writing very little on the board, is almost as bad, because it makes it difficult for the participants to follow the progression of ideas.

2. The other way we have seen these sessions fail is for the moderator to open with a little speech or, even worse, to begin by posing one of his or her own problems. The moderator is not a lecturer, and beginning with a lecture just stifles the conversational aspect of the session. This is why it is important for the moderator to begin by just waiting until someone suggests a problem. This pitfall is partially addressed by choosing a moderator who is not expected to be a major contributor to the discussion.

One problem which never seems to occur is people running out of things to talk about. Even a seemingly narrow topic can easily lead to a lively 90-minute discussion. We stress this point when we talk to workshop organizers and encourage them to choose a narrow focus for each session.

We believe that a moderated discussion session is a productive alternative to the standard problem session. It addresses the true purpose of the problem session: to convey research problems and to facilitate a discussion of those problems. We have described the features of a moderated discussion session that have been developed through trial and error over the course of several years at AIM,

and we hope that our description is sufficiently compelling to encourage others to give it a try.

Other Uses of the Moderated Discussion Session

At AIM we use the moderated discussion session whenever the objective is to bring out the ideas of the participants and to give some organization to those ideas. We now list some examples.

For a workshop designed to:

•**Bring together two groups with different approaches to a common mathematical interest:** Each group should identify *What do you think the basic concepts are?* and *Describe how you think about them.* This discussion session often follows an introductory lecture on each of the two areas. Having people go into detail about their perspective on the subject more effectively conveys the ideas to the other camps than would several more lectures.

•**Understand a difficult new proof:** *What steps of the proof need more clarification?* This discussion session identifies the steps people find difficult and allows the experts to suggest what background material would be helpful, as well as estimating how much time would be needed to fill in the gaps. Having all that information in one place makes it is easier to plan other useful activities for the rest of the workshop. (Note that the purpose of the session is to identify the places where people need clarification and not to answer questions about the proof.)

•**Make progress on some open problems:** *What problems would people like to work on right now?* Participants are invited to suggest problems that they would like to work on with other workshop people. The discussion of each problem is much more brief than is typical for a problem session and centers on issues like: what background is needed to begin working? how is that problem related to a larger problem? and why is there reason to think that progress is possible? This session is immediately followed by the participants breaking into small groups to work on the problems. Note that it is not expected that the problems be solved immediately, merely that it may be useful for a small group to begin working on them.

For this session, sometimes we suggest that a workshop organizer be the moderator, in contrast to our usual policy. Breaking into groups in an organized manner is not common for mathematicians, and often there is some hesitation to do so. A workshop organizer is better able to exert some authority to overcome this apprehension.

•**On the last afternoon of almost any workshop:** *How should people concentrate their efforts over the next few years?* At the end of a workshop, it is natural to take stock of the progress that has been made and to plan for the future. What problems have reasonable hope of progress? What approaches are more likely to be successful? What resources, such as a webpage of background information, would be useful to other people interested in this area?

While the above examples are quite distinct, they all involve eliciting and organizing information that is already in people's heads. These sessions are not intended for solving problems or for doing new work.

Follow-up

Moderated discussion sessions are a mechanism for helping the advancement of some area, or areas, of mathematics. The discussion sessions lay the foundation for future advances, and what happens after the session is more important than the session itself.

For the first of the three examples in the previous section, those discussion sessions usually occur on the first or second afternoon of an AIM workshop. Their early placement in the week's schedule makes the session a part of the planning of the workshop. Through the discussion session, the participants help to shape the workshop activities. Often the later afternoons of the workshop involve the participants breaking into small groups to work on topics arising from the earlier discussion.

Problem sessions generally occur in the middle of a five-day workshop—after some basic material has been covered, but still early enough to be useful in planning later activities. A problem session generates a list of problems along with comments on those problems. This annotated list of open problems is valuable to the research community. Not only does it form the focus of working groups during the workshop, it also can serve as a blueprint for work after the workshop.

At AIM we feel it is important to preserve this information, so we ask the organizers to designate someone as the "Web liaison" to take notes which will be posted on the Web. Initially the notes are circulated just to the workshop participants shortly after the workshop. After incorporating comments, the notes are made public on the AIM website.

At the time they are created, these problem lists represent the current state of knowledge in a particular specialized field. Unfortunately, the lists quickly become dated as new results occur. To preserve their value, AIM is currently developing new tools to keep the problem lists continually up-to-date and relevant.

Just Visiting

Joshua D. Laison

The Seven-Year Search

I received my Ph.D. from Dartmouth College in 2001 and started my search for an academic position in earnest in the fall of 2000. Little did I know it was a search that would eventually span seven years, hundreds of applications, and dozens of meetings with fellow math professors across the country. In the beginning, I wasn't sure what type of school I was interested in, and I applied my first year to over a hundred schools of all descriptions. After extensive research and many, many interviews, I began to understand more what I really wanted in my career, and I became more selective. Each year I applied to fewer schools while spending more time learning about each one. My goal was a position at a small liberal arts college with a commitment to promoting both high-quality teaching and research among its faculty, within an hour of a big city.

In 2007 I found my ideal match. Willamette University, in addition to meeting all of these criteria, has many more great qualities: It's located in the beautiful Willamette River Valley in northwestern Oregon; has a dynamic, vibrant, and exceptionally collegial mathematics department and faculty; a new building housing mathematics opening this year; and a new Research Experiences for Undergraduates grant in consortium with four other schools in the Willamette Valley. It's also a great location for my wife's career in environmental policy and planning.

I submit my file for tenure in fall 2010. In spite of the long road I traveled from my degree to the job I hope I'll keep until retirement, I consider my search to be a successful one. In fact, I think I'll stay at Willamette until they pry my cold dead hands from the whiteboard marker.

This year we had the last in a string of retirements in our department and hired a new colleague. After my years of searching, I found myself on the other side of the application process, reading applicant files, interviewing candidates at the Joint Meetings, and hosting interviews on the Willamette campus. This gave me a new perspective on the academic job market I thought I knew so well.

This past January, Aaron Luttman, Ralucca Gera, and I organized the panel *Finding Your nth Job for* $n \geq 2$ at the Joint Meetings. In this panel I described some of my positive experiences as a visiting professor, and some advice for folks applying from their first, or second, or nth visiting position. While I'm definitely not an expert, and I don't even hold the record among my friends for the most years searching, in this article I'll describe a few things I've learned and some positive experiences I've had in my seven years on the market.

The Joy of Visiting

Due to the recent difficult economic times, this past year has been particularly tough on candidates for academic employment. In the past year I've seen many highly qualified candidates struggle to find positions. One visiting professor I know, after failing to secure a position for 2009–2010, lost his visa and was forced to leave the United States. Another has started looking in the actuarial sciences and may not return to academia. Some luckier souls have had the option of a temporary position. In 2001 I was one of these lucky ones. I spent six years as a visiting assistant professor, first at Kenyon College in Gambier, Ohio, then at Colorado College in Colorado Springs, Colorado, and finally at St. Olaf College in Northfield, Minnesota.

These six years were sometimes exhausting, particularly for our poor Honda Civic, which has gained 150,000 miles and some baseball-sized hail dents. It was frustrating and humbling when I was turned down for dream job after dream job. There were trying times for my wife and her career, as she extremely generously followed me through

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four states. But this time was also immensely valuable and enjoyable. In many ways, I think of the knowledge and experience I've gained as a visiting professor as another academic degree. Certainly, I learned an enormous amount in those six years.

Although a tenure-track position straight out of graduate school at an institution that fits you well is the best possible result of an academic job search, those landing a visiting position have a lot to be thankful for. Here are some reasons why a visiting position can be a good thing.

A Much Better Application the Next Time Around

The difference between an application from a new Ph.D. and a candidate with a few years' experience is dramatic. My own application materials improved greatly over the years I applied, enabling me to be considered for some positions that were previously out of reach. The most valuable addition to my file was a list of recommenders who could praise me as a colleague instead of as a student. After reading hundreds of applications, I know how much more impressive this type of recommendation letter typically is.

More Teaching Experience

As a visiting professor, I taught many more courses, in a much wider variety, than when I was a graduate student. Hiring committees at liberal arts colleges look for demonstrated teaching effectiveness. In my experience reading files, a candidate has a distinct edge if he or she can talk about a teaching strategy that was successful in a course instead of one that he or she hopes to try in the future. A visiting position is an opportunity to implement and test these innovative strategies. Multiple visiting positions give you a chance to test them on different audiences!

In addition to strengthening my application, my teaching experience as a visiting professor was also rewarding and fun. I had the opportunity to work with some fantastic students, many of whom I'm still in touch with. A couple of them will be looking for academic jobs themselves soon!

More Research Experience

There's a wide range of expectations for research at different institutions—and I speak from my own experience applying to schools that weigh research heavily in their decisions but not as heavily as teaching. For these institutions, it's most important that a future colleague have a continuing research program and be able to continue publishing beyond his or her dissertation work. A visiting position is an ideal way of demonstrating this quality. A research statement that includes a discussion of research done, or even begun, since the Ph.D. carries a lot more weight than one that includes only plans for the future.

Opportunities for Mentorship

At many colleges around the country and the world, a visiting position is like an apprenticeship. Just as a postdoctoral position gives a new Ph.D. an opportunity to develop his or her research program more fully, a visiting position at a college or university that values teaching highly is an excellent opportunity for a new Ph.D. to develop his or her teaching skills and learn from the knowledge and experience of his or her colleagues. I took advantage of this opportunity whenever I could. My favorite technique was to stop at an open doorway and listen for a few minutes to one of my colleagues teaching a class. You'd be surprised how interesting and useful these few minutes can be.

Many schools and math departments have official policies designed to further this mentorship. At St. Olaf I was assigned a faculty mentor from within the department, and we met regularly to talk about how my year was going. At Willamette I had an official faculty mentor from the chemistry department during my first year. I think these policies are an excellent idea, and I'd like to see us develop them even more in the wider academic community. As programs such as Project NExT have shown, there's a lot to learn about teaching and about developing a career in academia, and a supportive network of mentors and peers makes a huge difference. A visiting position (or three) can be a great way to develop such a network. Even if organized mentoring isn't available at your school, there are always helpful colleagues you can find who are willing to offer advice.

Note that there's a big difference between *visiting* positions and *adjunct* positions in this respect. For better or worse, adjunct instructors typically do not receive the same kind of mentorship. I think this distinction needs to be made clear on both sides: an advertised position that includes this more intensive mentorship deserves to be more competitive and more sought after among candidates, and a candidate with such a position on his or her CV should be more highly desired than one who held an adjunct position.

Opportunities to See the World

My three visiting positions and ultimate tenure-track position took me back and forth across the country, from my graduate school in picturesque New England, to the rolling plains of the midwest, the red and brown mountains of the southwest, and finally the rain-nourished forests and vineyards of the northwest. On our way through the country, my wife and I spent time at the Grand Canyon, the lakes of upper Minnesota, Rocky Mountain

National Park, and many more beautiful places around the country. We could have been even more adventurous: A recent check of the employment listings on the AMS website found job postings all over the world, including in China, India, Australia, Wales, and Germany. Spending a year or more in one of these countries in a visiting position would be an amazing opportunity that you might not get again.

Opportunities to Obtain Different Perspectives

One of the most valuable benefits of teaching at more than one school is the opportunity to get an inside look at how different institutions function. There are lots of departmental decisions which seem like no-brainers at one school and are hotly debated at another. Many departments are looking to get a fresh perspective from their new colleagues. Experience at a college or university that does things differently can be truly valuable.

Applications

Applying to hundreds of schools over seven years, I picked up a few tips on the application process. Some of these took many years for me to figure out. I hope that others find them easier lessons to learn than I did!

Think About Getting Tenure at the Place You Want to Work

What are the job requirements for a visiting professor? Often an institution has detailed guidelines, even workshops, explaining the expectations for tenure-track assistant professors seeking tenure. But for a visiting professor looking for a position elsewhere, the guidelines are not so clear. The key is to look for guidelines not from the institution where you work, but from the institution where you're applying. If, for example, you're interested in a position at a school that requires frequent publications for tenure, then try to keep to that standard, even if you're teaching at a school that requires fewer. This has a few advantages. First, your CV will be comparable to those of the professors reading your file. Second, if you do get the position, and a reduced tenure clock for your additional years of experience, you'll be well positioned in your quest for tenure. Finally, if you find that this pace of research really isn't for you, you have the opportunity to rethink where you'd like to work before you make a bad fit and are forced to apply again!

Make Connections

Over the years I've gotten in the habit of meeting as many mathematicians as I can. You never know who might be sitting across the table in the employment center, and indeed my connections helped me a lot in my job search. A friend can't offer you a job, but he or she can tell you whether the department really needs an applied mathematician or whether you're still in the running. I've also found that knowing a lot of mathematicians has had some very nice and sometimes unexpected consequences. For example, it's great to have so many friends I can call to fill an empty slot in our department colloquium series.

A visiting position comes with the opportunity to get to know members of the math department at your school, as well as nearby schools, through regional conferences or colloquium talks. Such a position often also has travel funds available to make research connections with mathematicians worldwide.

Balance Time Between Your Current Job and Your Future Job

Teaching is hard work, and teaching a full semester load often results in long evenings preparing classes. Like most professors I know, I don't like to reduce this preparation time, since I want to give my students the best possible learning experience. But if you're applying for another position and also spending countless hours working on applications and flying to interviews, it's easy to run out of time and sleep. Too often I found myself inadequately prepared, or inadequately rested, or both, when it came time to impress potential future colleagues. Please learn from my mistakes. Don't give up on your current students, but remember to be dedicated to your own career as well.

Don't Lick the Envelopes

The administrative tasks that go along with applying for jobs can be a big burden, and you should do whatever you can to make them easier. For example, after a few years of a variety of envelope-sticking options, I discovered that I could just put a big piece of tape over the flap of the envelope, and ignore the adhesive completely. This may seem like a small thing, but tasks like licking envelopes can suck away time and energy already in short supply. Sites such as `mathjobs.org` that offer an electronic application process will significantly reduce this administrative burden in the long run but in the next few years will make it even heavier by providing multiple application methods.

Remember That Members of a Hiring Committee Are Not Experts in the Hiring Process

A hiring committee is mostly a bunch of math professors. They don't hire other professors for a living and have little or no training in this field. For example, those few paragraphs in the job announcement describing the position and their ideal candidate may have been the outcome of hours of thoughtful discussion by the committee, or hours of heated debate, or possibly pulled with

a few quick modifications from the search a few years before. A mention of the use of technology in the classroom may reflect the consensus of a department committed to the technology ideal, or two adamant department members, or one persuasive dean. Members of the hiring committee may have significantly different opinions about what qualities they want in a new colleague, and those opinions may change significantly during the hiring process. This means, in part, that an impressive candidate can change their minds about what they consider to be important qualities. If you have a particular strength as a candidate and it doesn't seem to match the job description, don't give up hope, and don't radically change your image in your application. It also means that it's useful to have multiple sources of information about an institution before making up your mind. Don't be afraid to ask the same question of many different people. And remember that the folks on the other side of the interview table are human, and they make mistakes.

Don't Take It Personally

There are many quirky and unusual reasons why one candidate is eventually chosen over another. A linear ordering of all the candidates for a particular position would be impossible, and it's not the way a hiring committee works. As a candidate, it's difficult to believe the countless rejection letters informing you that you're one of a large number of excellent candidates. After serving on a search committee, I know that it's really true. Remember that not getting a position or an interview does not mean that the faculty on that committee don't think highly of you and won't value working with you in the future. This is just as important to remember when you're a member of a hiring committee yourself and a candidate turns down a position at your institution.

Future Directions

There are reasons you might be discouraged when you're forced to take a visiting position instead of a permanent one, but there are also reasons to celebrate. If you're lucky enough to land a visiting position this year, or a second or a third one, remember that there's light at the end of the tunnel, and make sure you enjoy the journey until you get there.

About the cover

Adrien-Marie Legendre and Joseph Fourier

The article by Peter Duren in this issue explains the cover. As he points out, this caricature, which has come down to us through a striking series of accidents, is probably the only extant portrait of Legendre. Although the name of Legendre is well known in our era, and his present renown reflects many significant accomplishments, he seems not to have been admired by all of his contemporaries. We do not know all the reasons for his poor reputation, but some of it may be due to his mathematical errors. One of these is alluded to in the caricature—the diagram of Pythagoras' Theorem—is there undoubtedly because to the public his fame rested on his textbook of plane geometry, which possibly held the record among mathematics books for the number of copies sold (at least until twentieth century calculus texts appeared). Although it is a valuable book, containing among other things a readable version of Lambert's proof of the irrationality of π, several successive editions contained false proofs of Euclid's fifth postulate, over which Legendre wasted much effort.

A beautiful copy of an early edition of Legendre's text is available on the website of the Max Planck Institute for the History of Science in Dahlem: `http://echo.mpiwg-berlin.mpg.de/home`. We thank the Bibliothèque de l'Institut de France for providing the image through their North American agent, Art Resource.

—Bill Casselman, Graphics Editor
(`notices-covers@ams.org`)

Mathematics People

Prizes of the Mathematical Society of Japan

The Mathematical Society of Japan (MSJ) has awarded several prizes for 2009. NARUTAKA OZAWA of the University of Tokyo has been awarded the 2009 Spring Prize for his outstanding contributions to discrete group and operator algebra. The Spring Prize is awarded to a mathematician less than forty years of age who has made outstanding contributions to mathematics.

KEIJI OGUISO of Keio University and AKIHIKO YUKIE of Tohoku University have been awarded Algebra Prizes. Oguiso was honored for his contributions to the theory of generalized Calabi-Yau manifolds, and Yukie was chosen for his contributions to the theory of prehomogeneous vector spaces.

The Publication Prize is given for distinguished contributions to the mathematical literature. MASAHITO TAKASE of Kyushu University was honored for his translations of important classic books, including those of Euler, Gauss, and Legendre, and for his writings on mathematics. Two book series were awarded prizes. The Joy of Mathematical Sciences series, by the Hayakawa Shobou Publishing Company, helped to popularize mathematics by publishing many new as well as older mathematics books in the genre of popular science in a reader-friendly manner. The Chikuma Library on Arts and Sciences, Math and Science, by the Chikuma Shobou Publishing Company, helped to popularize more serious mathematical sciences through the publication of many good books on the motives and philosophy behind the development of mathematical sciences.

—From a Mathematical Society of Japan announcement

Computer-Aided Verification Prize Awarded

The 2009 Computer-Aided Verification (CAV) award has been presented to the following seven individuals: CONOR F. MADIGAN, Kateeva, Inc.; SHARAD MALIK, Princeton University; JOAO P. MARQUES-SILVA, University College Dublin, Ireland; MATTHEW W. MOSKEWICZ, University of California Berkeley; KAREM A. SAKALLAH, University of Michigan; LINTAO ZHANG, Microsoft Research, and YING ZHAO, Wuxi Capital Group. They were honored for fundamental contributions to the development of high-performance Boolean satisfiability solvers.

The award recipients worked in two different teams, one at the University of Michigan and one at Princeton University, where they created powerful programs for checking whether a logic formula has a consistent solution. This is known as a "Boolean satisfiability problem". Satisfiability, or SAT, solvers can be used to solve a number of different problems, and it must be determined whether there is any way of satisfying all of them. SAT solvers have had a profound impact on the field of computer-aided verification, which is dedicated to the creation of tools that allow hardware and software designers to detect possible flaws in their systems and programs. Sakallah and Marques-Silva's GRASP solver, developed at the University of Michigan, started with a classic algorithm devised by Davis, Putnam, Logemann, and Loveland and denoted by DPLL in 1962. DPLL applies a backtracking search to enumerate different assignments to the variables of a formula until either a solution is found or the set of possible solutions is exhausted. Sakallah and Marques-Silva modified the DPLL algorithm to more effectively detect large classes of assignments that cannot possibly yield satisfying solutions. In doing so, they shifted the core strategy of SAT solvers from one of searching for a solution to one of pruning away the unsatisfying assignments. This change in strategy was critical to the successful application of GRASP to verification problems, where formulas typically have very few, if any, satisfying solutions (because such solutions signify errors in the system being verified). They also changed the method of measuring SAT solver performance away from solving randomly generated problems to solving benchmark problems arising from real-world examples. This shift favors tuning SAT solvers to take advantage of structures and characteristics found in actual systems.

With his students Moskewicz, Madigan, Zhao, and Zhang, Malik developed the Chaff solver, which was built on the ideas of GRASP but also introduced a more careful

engineering-based approach to solver design. They identified memory performance as a critical bottleneck in DPLL SAT solvers and devised clever data structures to reduce the portions of a formula that must be rechecked as the effects of the variable assignments are propagated. Chaff was able to handle SAT problems of far greater size than anyone had imagined possible. Many research projects and many industrial verification tools have been devised with SAT solvers at their core. The impact of GRASP and Chaff on the CAV community has been profound.

Sharad Malik is the George Van Ness Lothrop Professor of Engineering at Princeton. He received his Ph.D. in computer science from the University of California, Berkeley, in 1990 and joined the Princeton faculty in 1991. Awards he has received include a National Science Foundation Young Investigator Award (1994), an Institute of Electrical and Electronics Engineers (IEEE) Fellowship (2002), a Best Paper Award from the IEEE/ACM Design Automation and Test in Europe (DATE) (2003), IBM Faculty Awards (2006 and 2007), and Princeton University's President's Award for Distinguished Teaching (2009).

Joao P. Marques-Silva is the SFI Stokes Professor of Computer Science and Informatics at University College Dublin. He received his Ph.D. from the University of Michigan and a Habilitation in Computer Science from the Technical University of Lisbon. He has held positions at the University of Southampton, United Kingdom, and at IST/Technical University of Lisbon, Portugal. He is a member of the editorial board of the *Journal on Satisfiability, Boolean Modeling and Computation* and associate editor of *Integration: The VLSI Journal.* His research interests include decision and optimization procedures, including Boolean satisfiability and extensions; applied formal methods; applications in system verification and model checking; artificial intelligence; design automation; and bioinformatics.

Karem Sakallah is a professor of electrical engineering and computer science at the University of Michigan. He received his Ph.D. from Carnegie Mellon University in 1981. Before joining the University of Michigan faculty in 1988, he was employed at Digital Equipment Corporation, where he headed the Analysis and Simulation Advanced Development Team. He is associate editor of the *IEEE Transactions on Computers.* His research interests include computer-aided design with emphasis on logic and layout synthesis, Boolean satisfiability, discrete optimization, and hardware and software verification.

The CAV Award is given annually for a specific fundamental contribution or series of outstanding contributions to the field of computer-aided verification. CAV is the subdiscipline of computer science that is concerned with ensuring that software and hardware systems operate correctly and reliably. The award was established in 2008 by the steering committee of the annual CAV conference. It includes a cash prize of US$10,000. The presentation was made at the CAV conference held in Grenoble, France, June 26–July 2, 2009.

—Randy Bryant, Carnegie-Mellon University

Pi Mu Epsilon Student Paper Presentation Awards

Pi Mu Epsilon (PME), the U.S. honorary mathematics society, makes annual awards to recognize the best papers by undergraduate students presented at a PME student paper session. This year PME held a session in conjunction with the Mathematical Association of America MathFest in Portland, Oregon, August 5–8, 2009. The AMS and the American Statistical Association sponsor awards to student speakers for excellence in exposition and research. Each awardee received a check for US$150. The names, chapters, institutions, and paper titles of the award-winning students follow.

MATT ALEXANDER, Ohio Xi Chapter at Youngstown State University, "Application of the Riemann zeta function"; NEIL BIEGALLE, Michigan Iota Chapter at Grand Valley State University, "The extremality of Bernstein polynomials"; ADAM BOSEMAN, North Carolina Epsilon Chapter at the University of North Carolina at Greensboro, "Zeros of Riemann's zeta function"; LISA CURLL, Ohio Iota Chapter at Youngstown State University, "Bacterial resistance: When selenite is your kryptonite"; THOMAS ELIOT, Oregon Zeta Chapter at Willamette University, "Negative voting"; HAROLD L. GOMES, New York Alpha Chapter at the City University of New York, Queens College, "The brain and mathematical modeling"; MASAKI IKEDA, Oregon Zeta Chapter at Western Oregon University, "Random juggling"; JENNIFER JORDAN, Maryland Theta Chapter at Goucher College, "Follow the food feeding function"; JASON LUTZ, Minnesota Delta Chapter at St. John's University, "An analog for a basis in finite groups"; SEAN WATSON, Texas Pi Chapter at Southwestern University, "Series in Banach spaces"; MORIAH WRIGHT, Ohio Xi Chapter at Youngstown State University, "Mathematically modeling cardiac myocytes".

—From a Pi Mu Epsilon announcement

NDSEG Fellowships Awarded

Sixteen young mathematicians have been awarded National Defense Science and Engineering Graduate (NDSEG) Fellowships by the Department of Defense (DoD). As a means of increasing the number of U.S. citizens trained in disciplines of military importance in science and engineering, DoD awards fellowships to individuals who have demonstrated ability and special aptitude for advanced training in science and engineering. The fellowships are sponsored by the United States Army, Navy, and Air Force.

The following are the names of the fellows in mathematics, their institutions, and the offices that awarded the fellowships: JOSHUA BATSON, Army Research Office (ARO); DORIS DOBI, Massachusetts Institute of Technology, Office of Naval Research (ONR); DMITRIY DRUSVYATSKIY, Cornell University, Air Force Office of Scientific Research (AFOSR); CHRISTOPHER DUBOIS, University of California Irvine, ONR; ADAM ELMACHTOUB, Massachusetts Institute of

Technology, AFOSR; NICHOLAS HABER, Stanford University, ARO; RUSSELL HOWES, University of California Los Angeles, ONR; JOHN KOLINSKI, Harvard University, ONR; KATHRYN LINDSEY, Cornell University, ARO; PO-LING LOH, University of California Berkeley, ARO; AARON PIXTON, Princeton University, ARO; STEVEN SAM, Massachusetts Institute of Technology, ONR; STANLEY SNELSON, Courant Institute of Mathematical Sciences, New York University, AFOSR; ELY SPEARS, Brown University, AFOSR; KERRY STEVENS, Columbia University, AFOSR; VLADISLAV VORONINSKI, University of California Berkeley, AFOSR.

—From an NDSEG announcement

2009 Clay Liftoff Fellows Chosen

The Clay Mathematics Institute (CMI) has selected seven young mathematicians as Clay Liftoff Fellows for 2009. The Liftoff Fellows program provides one month of summer employment to new Ph.Ds to allow them to carry out mathematics research prior to starting a faculty or postdoctoral position. The fellows for 2009 are: DAVID ANDERSON, University of Michigan; JONAH BLASIAK, University of California Berkeley; VICTOR LIE, University of California Los Angeles; GRIGOR SARGSYAN, University of California Berkeley; ANDREW SNOWDEN, Princeton University; MELANIE MATCHETT WOOD, Princeton University; and XINWEN ZHU, University of California Berkeley.

—From a CMI announcement

B. H. Neumann Awards Given

The Board of the Australian Mathematics Trust has named the winners of the B. H. Neumann Awards for 2009. KATRINA SIMS of Canberra holds a master's degree in gifted education and established a gifted and talented program at a Canberra primary school. She won a National Teaching Award in 1999 and joined the Problems Committee of the Mathematics Challenge for Young Australians, specializing in problems for the younger age groups. She has involved students in codes and ciphers and has been at the forefront of using computers in the classroom; her students won a national webpage competition. She also taught herself animation skills and completed a diploma in multimedia. She has also established chess clubs and taught a robotics program. She is now teaching in a middle school, running special programs for students up to year 10.

ELENA STOYANOVA works for the Western Australian Department of Education. While a resident of Bulgaria, she was deputy leader of the Bulgarian International Mathematical Olympiad (IMO) team that participated in the IMO in Canberra in 1988. She designed and conducted mathematics enrichment programs with mathematically able students in years 5, 6, and 7. She initiated and drove the development of the annual Western Australian Junior Mathematics Olympiad, now in its tenth year.

LATCHEZAR (NEDELTCHEV) STOYANOV is a professor of mathematics at the University of Western Australia. He was instrumental in training the Bulgarian national team before moving to Australia. He and his wife, Elena Stoyanova, founded the University of Western Australia Academy for Young Mathematicians, an enrichment program for students in years 10 and 11, in 1995. Together they ran the Western Australia Mathematics Training Seminars, an intensive training session for a group of ten to fifteen high school students taking part in the IMO training. Stoyanov has served on the Problems Committee for the Western Australian Junior Mathematics Olympiad each year since its inception, and for many years he played a key role in its detailed organization.

The awards, named for Bernhard H. Neumann, are presented each year to mathematicians who have made important contributions over many years to the enrichment of mathematics learning in Australia and its region.

—From a Board of Mathematics Trust announcement

Invited Speakers for ICM 2010, Hyderabad

A number of speakers have been invited to deliver lectures at the International Congress of Mathematicians (ICM) in Hyderabad, India, August 19–27, 2010. Current information about the 2010 ICM is available at `http://www.icm2010.org.in/`.

S. R. SRINIVASA VARADHAN of the Courant Institute of Mathematical Sciences, New York University, will deliver the Abel Lecture, sponsored by the Norwegian Academy of Sciences. IDUN REITEN of the Norwegian University of Science and Technology will deliver the Emmy Noether Lecture.

The following individuals will deliver plenary lectures: DAVID ALDOUS, University of California Berkeley; ARTUR AVILA, Université Pierre et Marie Curie and Instituto Nacional de Matemática Pura e Aplicada (IMPA), Brazil; R. BALASUBRAMANIAN, Institute of Mathematical Science, Madras; JEAN-MICHEL CORON, Université Pierre et Marie Curie; IRIT DINUR, Weizmann Institute of Science; HILLEL FURSTENBERG, Israel; THOMAS J. R. HUGHES, University of Texas at Austin; PETER JONES, Marquette University; CARLOS KENIG, University of Chicago; NGO BAO CHAU, Institute for Advanced Study, Princeton; STANLEY OSHER, University of California Los Angeles; R. PARIMALA, Emory University; A. N. PARSHIN, Russia; SHIGE PENG, Shandong University; KIM PLOFKER, Union College; NICOLAI RESHETIKHIN, University of California Berkeley; RICHARD SCHOEN, Stanford University; CLIFFORD TAUBES, Harvard University; CLAIRE VOISIN, Institut de Mathématiques de Jussieu; HUGH WOODIN, University of California Berkeley.

—Elaine Kehoe

Mathematics Opportunities

NSF Computing Equipment and Instrumentation Programs

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) plans a limited number of awards for the support of computing environments for research in the mathematical sciences. SCREMS (Scientific Computing Research Environments for the Mathematical Sciences) supports computing environments dedicated to research in the mathematical sciences. Proposals may request support for the purchase of computing equipment and limited support for professional systems administrators or programmer personnel for research computing needs. These grants are intended to support research projects of high quality that require access to advanced computing resources. Requests for routine upgrades of standard desk environment workstations or laptop computers are not appropriate for this program. Awards are made to provide support for specific research projects rather than to provide general computing capacity. Proposers are encouraged to include projects involving symbolic and algebraic computations, numerical computations and simulations, and graphical representations (visualization) in aid of the research.

For more information see the website `http://www.nsf.gov/pubs/2007/nsf07502/nsf07502.htm`. The deadline for proposals is **January 28, 2010.**

—From an NSF announcement

National Academies Christine Mirzayan Graduate Fellowship Program

The Christine Mirzayan Science and Technology Policy Graduate Fellowship Program of the National Academies is designed to engage graduate science, engineering, medical, veterinary, business, and law students in the analysis and creation of science and technology policy and to familiarize them with the interactions of science, technology, and government. As a result, students develop essential skills different from those attained in academia and make the transition from graduate student to professional.

Applications for the fellowships are invited from scholars from graduate through postdoctoral levels in any physical, biological, or social science field or any field of engineering, medicine and health, or veterinary medicine, as well as business, law, education, and other graduate and professional programs. Postdoctoral scholars should have received their Ph.D.s within the past five years.

The fall session for 2010 will run August 30–November 19, 2010; there will be no summer session in 2010. The stipend for the 12-week session is US$8,000. Deadline for receipt of materials for the fall program is **May 1, 2010**. More information and application forms and instructions can be found on the website `http://sites.nationalacademies.org/PGA/policyfellows/index.htm` or by contacting The National Academies Christine Mirzayan Science and Technology Policy Graduate Fellowship Program, 500 Fifth Street, NW, Room 508, Washington, DC 20001; telephone: 202-334-2455; fax: 202-334-1667; email: `policyfellows@nas.edu`.

—From a National Academies announcement

EDGE for Women Summer Program

The Enhancing Diversity in Graduate Education (EDGE) Program is a postbaccalaureate summer enrichment program designed to strengthen the ability of women and minority students to successfully complete graduate programs in the mathematical sciences.

The summer program consists of two core courses in analysis and algebra/linear algebra. There will also

be minicourses in vital areas of mathematical research in pure and applied mathematics, short-term visitors from academia and industry, guest lectures, graduate student mentors, and problem sessions. In addition, a follow-up mentoring program and support network will be established with the participants' respective graduate programs.

Applicants to the program should be women who are (1) graduating seniors who have applied to graduate programs in the mathematical sciences, (2) recent recipients of undergraduate degrees who are now entering graduate programs, or (3) first-year graduate students. All applicants should have completed standard junior- or senior-level undergraduate courses in analysis and abstract algebra and have a desire to earn the doctorate degree. Women from minority groups who fit one of the above three categories are especially encouraged to apply. A stipend of US$2,000 plus travel, room, and board will be provided to participants. Final acceptance to the program is contingent on acceptance to a graduate program in the mathematical sciences.

The EDGE Program will be held in the summer of 2010 at North Carolina State University in Raleigh. The application deadline is **February 15, 2010**. See the website `http://www.edgeforwomen.org/?page_id=5` for further information as it becomes available.

—EDGE Program announcement

MfA Fellowship Program

The Math for America Foundation (MfA) sponsors the MfA Fellowship Program, which trains mathematically talented individuals to become high school mathematics teachers in New York City; Los Angeles; Washington, DC; or San Diego. The fellowship provides an aggregate stipend of up to US$100,000 over five years, a full-tuition scholarship for a master's-level teaching or teacher credentialing program at one of MfA's partner universities, and ongoing support mechanisms, including mentoring and professional development.

Candidates should hold a bachelor's degree with substantial coursework in mathematics and should be new to teaching and able to demonstrate a strong interest in teaching. Candidates must be U.S. citizens or permanent residents of the United States. The deadline for applications is **February 5, 2010**. For more detailed information, see the website at `http://www.mathforamerica.org/`.

—From an MfA announcement

ETS Visiting Scholars Program

The Educational Testing Service (ETS) established the ETS Visiting Scholar Program to further its commitment to creating a corporate environment that reflects the culture of its test takers. Each summer, visiting scholars from underrepresented groups spend four weeks at ETS studying issues of test design and learning to develop test questions and related materials for a variety of assessment programs. Participants may also work on educational measurement and policy issues related to assessment equity and may attend seminars on fairness in testing from question conception through test administration and research.

Each visiting scholar will be in residence at ETS June 7–July 2, 2010. Applicants should be teachers at universities or community colleges, should be members of underrepresented groups, and should have at least three years of teaching experience in U.S. schools. The teaching experience can be in one of nine academic areas, including mathematics and statistics. Visiting scholars receive a US$3,500 honorarium plus transportation and accommodations.

Further information is available at `http://www.ets.org/visitingscholars`. The deadline for applications is **December 4, 2009**.

—From an ETS announcement

News from IPAM

The Institute for Pure and Applied Mathematics (IPAM), located at the University of California Los Angeles, holds long- and short-term research programs and workshops throughout the academic year for junior and senior mathematicians and scientists who work in academia, the national laboratories, and industry. IPAM also sponsors two summer programs. IPAM's upcoming programs are listed below. See the website `http://www.ipam.ucla.edu` for detailed information and to find online application and registration forms. IPAM's Science Advisory Board meets in November, when it considers program proposals. Program proposals from the community are encouraged; instructions are available at our website.

Public Lecture Series. David Gross (University of California Santa Barbara), 2004 Nobel Laureate in physics, will give a public lecture on Monday, February 22, 2010.

Winter 2010 Short Programs. You may apply for support or register for each workshop online.

• *New Directions in Financial Mathematics.* January 5–9, 2010. Includes a short course on environmental markets by Rene Carmona (Princeton University) and on agent-based models by Pierre-Louis Lions (Université de Paris IX).

• *Metamaterials: Applications, Analysis and Modeling.* January 25–29, 2010.

• *Mathematical Problems, Models, and Methods in Biomedical Imaging.* February 8–12, 2010.

• *Statistical and Learning-Theoretic Challenges in Data Privacy.* February 22–26, 2010.

• *Infinite Possibilities Conference (with Building Diversity in Science).* March 19–20, 2010.

Model and Data Hierarchies for Simulating and Understanding Climate. March 8–June 11, 2010. This long program includes the following workshops that are also open for participation. You may apply online for support to be a core participant for the entire program or to attend individual workshops.

• *Tutorials.* March 9–12, 2010.

• *Workshop I: Equation Hierarchies for Climate Modeling.* March 22–26, 2010.

• *Workshop II: Numerical Hierarchies for Climate Modeling.* April 12–16, 2010.

• *Workshop III: Simulation Hierarchies for Climate Modeling.* May 3–7, 2010.

• *Workshop IV: Data Hierarchies for Climate Modeling.* May 24–28, 2010.

Research in Industrial Projects for Students (RIPS). June 20–August 20, 2010. This undergraduate summer research program matches student teams with projects sponsored by industry. We are expecting to offer programs in Los Angeles, Beijing, and Berlin. Applications are due **February 15, 2010**.

Networks and Network Analysis for the Humanities: An NEH Institute for Advanced Topics in Digital Humanities. August 15–27, 2010. A main goal of this institute is to teach humanities scholars some of the most accessible computational tools for the discovery and analysis of networks.

Modern Trends in Optimization and Its Application. September 13–December 17, 2010. This long program includes the following workshops that are also open for participation. You may apply online for support to be a core participant for the entire program or to attend individual workshops.

• *Tutorials.* September 14–17, 2010.

• *Workshop I: Convex Optimization and Algebraic Geometry.* September 28–October 1, 2010.

• *Workshop II: Numerical Methods for Continuous Optimization.* October 11–15, 2010.

• *Workshop III: Discrete Optimization.* October 26–29, 2010.

• *Workshop IV: Robust Optimization.* November 16–19, 2010.

• *Workshop V: Applications of Optimization in Science and Engineering.* November 29–December 3, 2010.

Navigating Chemical Compound Space for Materials and Bio Design. March 14–June 17, 2011. This long program includes the following workshops that are also open for participation. You may apply online for support to be a core participant for the entire program or to attend individual workshops.

• *Tutorials.* March 15–18, 2011.

• *Workshop I: Design of Drugs and Chemicals That Influence Biology.* April 4–8, 2011.

• *Workshop II: Optimization, Search and Graph-Theoretical Algorithms for Chemical Compound Space.* April 11–15, 2011.

• *Workshop III: Materials Design in Chemical Compound Space.* May 2–6, 2011.

• *Workshop IV: Physical Frameworks for Sampling Chemical Compound Space.* May 16–20, 2011.

—IPAM announcement

News from the Mathematical Biosciences Institute

The Mathematical Biosciences Institute (MBI) at the Ohio State University is accepting applications for Early Career Visitors during the 2010–11 year on *Evolution, Synchronization, and Environmental Interactions: Insights from Plants and Insects*. In addition, the MBI is accepting applications for Postdoctoral Fellows to start September 2010.

Early Career Visitors are hired for a term of up to one year. They are engaged in the integrated program of tutorials, working seminars, and workshops tied to the scientific theme of the year, and are expected to interact with local and visiting researchers. More information about the 2010–11 program may be found at `http://mbi.osu.edu/2010/scientific2010.html`. Early Career visiting positions are aimed at non-tenured scientists who currently have continuing employment.

Postdoctoral Fellows are immersed in the topics of the MBI emphasis year programs (see `http://mbi.osu.edu`). The MBI Postdoctoral Fellows engage in a three-year integrated program of tutorials, working seminars or journal clubs, and workshops, and in interactions with their mathematical and bioscience mentors. These activities are geared toward providing the tools to pursue an independent research program with an emphasis on collaborative research in the mathematical biosciences. MBI-facilitated activities for Postdoctoral Fellows are tailored to the needs of each young scientist.

Applications for the Early Career Visitor and Postdoctoral Fellow positions should be submitted online at `http://www.mathjobs.org/jobs/MBI`. Applicants should provide a curriculum vita and a research statement, and arrange for three letters of recommendation. For additional information please contact Rebecca Martin (`rebecca@mbi.osu.edu` or 614-292-3648). Applications completed before December 16, 2009, will receive full consideration.

—MBI Announcement

Inside the AMS

Epsilon Scholarships Awarded for 2009

The AMS has awarded eight scholarships to students attending programs for mathematically talented high school students held during the summer of 2009. Five students received Ky and Yu-Fen Fan Scholarships, one received a Roderick P. C. Caldwell Scholarship, and two received Robert H. Oehmke Scholarships.

The Fan Scholarships were awarded to: JEGHANG WEE to attend the Ross Mathematics Program at Ohio State University; ABIGAIL MUNIZ for the Texas State University Honors Summer Math Camp in San Marcos, Texas; ADRIAN MAYORAL for the Michigan Math and Science Scholars Summer Program at the University of Michigan, Ann Arbor; MINH-TAM TRINH for PROMYS (Program in Mathematics for Young Scholars) at Boston University; and NGOC BAO TRAN DO for HCSSiM (Hampshire College Summer Studies in Mathematics) in Amherst, Massachusetts.

KARLA SAXTON was awarded the Caldwell Scholarship to attend the Texas State University Honors Summer Math Camp.

The Oehmke Scholarships were awarded to REED LANDRUM to attend the Ross Mathematics Program and JACQUELINE SODERSTROM for PROMYS.

The Epsilon Scholarships are supported by the Ky and Yu-Fen Fan Endowment, by a gift from the Robert H. Oehmke Charitable Fund, and by a gift from Winifred A. Caldwell in memory of her husband, Roderick P. C. Caldwell. For more information on the Epsilon Program, see http://www.ams.org/development/epsilon.html.

—AMS announcement

From the AMS Public Awareness Office

2010 Calendar of Mathematical Imagery. The 2010 calendar includes mathematically generated and inspired works and sculptures in bronze and wood, a crocheted Lorenz manifold, simulated snowflake, beaded Möbius frame, digital landscape, origami, and more. Email paoffice@ams.org with subject line "2010 calendar" to order up to three complimentary copies.

Information for Department Leaders. This webpage includes a wealth of resources for chairs and faculty, including links to: the Society's annual Workshop for Department Chairs, Award for an Exemplary Program or Achievement in a Mathematics Department, Award for Mathematics Programs That Make a Difference, Information Statements on the Culture of Research and Scholarship in Mathematics, surveys, and Proceedings of the Conference on Promoting Undergraduate Research in Mathematics. See http://www.ams.org/employment/mathdept.html.

***Who Wants to Be a Mathematician?* National Contest.** Ten contestants from around the United States will compete in the popular game for high school students. The event will be held at the Joint Mathematics Meetings on January 14, 2010, and meeting participants are invited to see and cheer on some of the nation's best high school math students. For information about the game, see http://www.ams.org/wwtbam/national/index.html.

—Annette Emerson and Mike Breen
AMS Public Awareness Officers
paoffice@ams.org

Reference and Book List

*The **Reference** section of the* Notices *is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.*

Contacting the *Notices*

The preferred method for contacting the *Notices* is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.ou.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

November 15, 2009: Applications for National Academies Research Associateship Programs. See http://www7.nationalacademies.org/rap/ or contact Research Associateship Programs, National Research Council, Keck 568, 500 Fifth Street, NW, Washington, DC 20001; telephone 202- 334-2760; fax 202-334-2759; email: rap@nas.edu

December 1, 2009: Applications for AMS Centennial Fellowships. See http://www.ams.org/employment/centflyer.html; telephone 401-455-4105; email: prof-serv@ams.org; or contact the Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294.

December 4, 2009: Applications for Educational Testing Service Visit-

Where to Find It

A brief index to information that appears in this and previous issues of the *Notices*.

ing Scholars Program. See "Mathematics Opportunities" in this issue.

December 4, 2009: Entries for 2009 Ferran Sunyer i Balaguer Prize. See http://ffsb.iec.cat.

December 8, 2009: Applications for East Asia and Pacific Summer Institutes (EAPSI). See http://www.nsf.gov/pubs/2008/nsf08603/nsf08603.htm.

December 15, 2009: Applications for AMS Epsilon Fund grants. See http://www.ams.org/outreach/epsilon.html or contact the AMS Membership and Programs Department, telephone: 800-321-4267, ext. 4170; email: prof-serv@ams.org.

December 15, 2009: Nominations for the International Mathematical Union (IMU) Chern Medal Award. See http://www.mathunion.org/fileadmin/IMU/Prizes/Chern/.

January 10, 2010: Applications for AAUW Educational Foundation Fellowships and Grants. See http://www.aauw.org/fga/fellowships_grants/selected.cfm or contact the AAUW Educational Foundation, Selected Professions Fellowships, Dept. 60, 301 ACT Drive, Iowa City, IA 52243-4030; telephone: 800-326-2289; email: connect@aauw.org.

January 15, 2010: Applications for AMS-AAAS Mass Media Summer Fellowships. See http://www.aaas.org/programs/education/MassMedia/, or contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone 202-326-6441; fax 202-371-9849; email: spasco@aaas.org. Also see http://www.ams.org/government/massmediaann.html or contact the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone 202-588-1100; fax 202-588-1853; email: amsdc@ams.org.

January 15, 2010: Applications for Jefferson Science Fellows Program. See http://www7.nationalacademies.org/jefferson/ or email: jsf@nas.edu or telephone 202-334-2643.

January 28, 2010: Proposals for National Science Foundation Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). See "Mathematics Opportunities" in this issue.

February 1, 2010: Applications for AWM Travel Grants and Mentoring Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 5, 2010: Applications for Math for America Fellowship Program. See "Mathematics Opportunities" in this issue.

February 15, 2010: Applications for Enhancing Diversity in Graduate Education (EDGE) Summer Program. See "Mathematics Opportunities" in this issue.

February 15, 2010: Applications for Institute for Pure and Applied Mathematics (IPAM) Research in Industrial Projects for Students (RIPS) undergraduate summer research program. See "Mathematics Opportunities" in this issue.

February 15, 2010: Applications for AMS-AAAS Congressional Fellowship. See http://www.ams.org/government/congressfellowann.html or contact the AMS Washington Office, telephone: 202-588-1100; email: amsdc@ams.org.

April 15, 2010: Applications for fall 2010 semester of Math in Moscow. See http://www.mccme.ru/mathinmoscow or write to: Math in Moscow, P.O. Box 524, Wynnewood, PA 19096; fax: +7095-291-65-01; email: mim@mccme.ru. For information on AMS scholarships see http://www.ams.org/outreach/mimoscow.html or write to: Math in Moscow Program, Membership and Programs Department, American Mathematical Society, 201 Charles Street, Providence RI 02904-2294; email: student-serv@ams.org.

May 1, 2010: Applications for the fall 2010 program of the Christine Mirzayan Science and Technology Policy Graduate Fellowship program of the National Academies. See "Mathematics Opportunities" in this issue.

May 1, 2010: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; or email: awm@awm-math.org. The postal address is: Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

June 1, 2010: Applications for NSF's Enhancing the Mathematical Sciences Workforce in the Twenty-First Century (EMSW21) program. See http://www.nsf.gov/pubs/2005/nsf05595/nsf05595.htm.

October 1, 2010: Applications for AWM Travel Grants. See http://www.awm-math.org/travelgrants.html; telephone: 703-934-0163; email: awm@awm-math.org; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

NSF Mathematics Education Staff

The Directorate for Education and Human Resources (EHR) of the National Science Foundation (NSF) sponsors a range of programs that support educational projects in mathematics, science, and engineering. Listed below is contact information for those EHR program officers whose fields are in the mathematical sciences or mathematics education. These individuals can provide information about the programs they oversee, as well as information about other EHR programs of interest to mathematicians. The postal address is: Directorate for Education and Human Resources, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230. The EHR webpage is http://www.nsf.gov/dir/index.jsp?org=EHR.

Division of Research on Learning in Formal and Informal Settings

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IMU Executive Committee

The Executive Committee of the International Mathematical Union (IMU) consists of ten voting members elected for four-year terms: the four officers (president, two vice presidents, and secretary) and six other members. The retiring president is an ex-officio member of the Executive Committee without vote for a period of four years. The current members (terms January 1, 2007, to December 31, 2010) of the IMU Executive Committee are:

President:
László Lovász (Hungary)

Secretary:
Martin Grötschel (Germany)

Vice Presidents:
Zhi-Ming Ma (China)
Claudio Procesi (Italy)

Members at Large:
M. Salah Baouendi (USA)
Manuel de León (Spain)
Ragni Piene (Norway)
Cheryl E. Praeger (Australia)
Victor A. Vassiliev (Russia)
Marcelo Viana (Brazil)

Ex Officio:
John M. Ball, Past President
(United Kingdom)

Book List

The Book List highlights books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and the general public. When a book has been reviewed in the Notices*, a reference is given to the review. Generally the list will contain only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to* notices-booklist@ams.org.

An Abundance of Katherines, by John Green. Dutton Juvenile Books, September 2006. ISBN-13:978-0-5254-7688-7. (Reviewed October 2008.)

The Annotated Turing: A Guided Tour Through Alan Turing's Historic Paper on Computability and the Turing Machine, by Charles Petzold. Wiley, June 2008. ISBN-13: 978-04702-290-57.

The Archimedes Codex: How a Medieval Prayer Book Is Revealing the True Genius of Antiquity's Greatest Scientist, by Reviel Netz and William Noel. Da Capo Press, October 2007. ISBN 978-03068-1580-5. (Reviewed September 2008.)

The Best of All Possible Worlds: Mathematics and Destiny, by Ivar Ekeland. University of Chicago Press, October 2006. ISBN-13: 978-0-226-19994-8. (Reviewed March 2009.)

The Book of Numbers: The Secret of Numbers and How They Changed the World, by Peter J. Bentley. Firefly Books, February 2008. ISBN-13: 978-15540-736-10.

The Calculus of Friendship: What a Teacher and Student Learned About Life While Corresponding About Math, by Steven Strogatz. Princeton University Press, August 2009. ISBN-13: 978-06911-349-32.

The Calculus Wars: Newton, Leibniz, and the Greatest Mathematical Clash of All Time, by Jason Socrates Bardi. Thunder's Mouth Press, April 2007. ISBN-13: 978-15602-5992-3. (Reviewed May 2009.)

The Cat in Numberland, by Ivar Ekeland. Cricket Books, April 2006. ISBN-13: 978-0-812-62744-2. (Reviewed January 2009.)

Chez les Weils (French), by Sylvie Weil. Buchet-Chastel, January 2009. ISBN-13: 978-22830-236-93.

Crossing the Equal Sign, by Marion D. Cohen. Plain View Press, January 2007. ISBN-13: 978-18913-866-95.

Crocheting Adventures with Hyperbolic Planes, by Daina Taimina. A K Peters, March 2009. ISBN-13: 978-15688-145-20.

Decoding the Heavens: A 2,000-Year-Old Computer—and the Century-Long Search to Discover Its Secrets, by Jo Marchant. Da Capo Press, February 2009. ISBN-13: 978-03068-174-27.

Digital Dice, by Paul J. Nahin. Princeton University Press, March 2008. ISBN-13: 978-06911-269-82.

Dimensions, by Jos Leys, Etienne Ghys, and Aurélien Alvarez. DVD, 117 minutes. Available at http://www.dimensions-math.org.

The Drunkard's Walk: How Randomness Rules Our Lives, by Leonard Mlodinow. Pantheon, May 2008. ISBN-13: 978-03754-240-45.

Einstein's Mistakes: The Human Failings of Genius, by Hans C. Ohanian. W. W. Norton, September 2008. ISBN-13: 978-0393062939.

Embracing the Wide Sky: A Tour Across the Horizons of the Human Mind, by Daniel Tammet. Free Press, January 2009. ISBN-13: 978-14165-696-95.

Emmy Noether: The Mother of Modern Algebra, by M. B. W. Tent. A K Peters, October 2008. ISBN-13: 978-15688-143-08. (Reviewed October 2009.)

Ernst Zermelo: An Approach to His Life and Work, by Heinz-Dieter Ebbinghaus. Springer, April 2007. ISBN-13 978-3-540-49551-2. (Reviewed August 2009.)

Euler's Gem: The Polyhedron Formula and the Birth of Topology, by David S. Richeson. Princeton University Press, September 2008. ISBN-13: 97-80691-1267-77.

Fifty Mathematical Ideas You Really Need to Know, by Tony Crilly. Quercus, 2007. ISBN-13: 978-18472-400-88.

Fighting Terror Online: The Convergence of Security, Technology and the Law, by Martin Charles Golumbic. Springer, 2008. ISBN: 978-0-387-73577-1.

Five-Minute Mathematics, by Ehrhard Behrends (translated by David Kramer). AMS, May 2008. ISBN-13: 978-08218-434-82.

Gaming the Vote (Why Elections Aren't Fair and What We Can Do About It), by William Poundstone. Hill and Wang, February 2009. ISBN-13: 978-08090-489-22.

Geekspeak: How Life + Mathematics = Happiness, by Graham Tattersall. Collins, September 2008. ISBN-13: 978-00616-292-42.

Geometric Folding Algorithms: Linkages, Origami, Polyhedra, by Erik D. Demaine and Joseph O'Rourke. Cambridge University Press, July 2007. ISBN-13: 978-05218-57574.

Geometric Origami, by Robert Geretschläger. Arbelos, October 2008. ISBN-13: 978-09555-477-13.

The Golden Section: Nature's Greatest Secret (Wooden Books), by Scott Olsen. Walker and Company, October 2006. ISBN-13: 978-08027-153-95.

Group Theory in the Bedroom, and Other Mathematical Diversions, by Brian Hayes. Hill and Wang, April 2008. ISBN-13: 978-08090-521-96. (Reviewed February 2009.)

Hexaflexagons, Probability Paradoxes, and the Tower of Hanoi: Martin Gardner's First Book of Mathematical Puzzles and Games, by Martin Gardner. Cambridge University Press, September 2008. ISBN-13: 978-0-521-73525-4.

The Housekeeper and the Professor, by Yoko Ogawa. Picador, February 2009. ISBN-13: 978-03124-278-01.

How Math Explains the World: A Guide to the Power of Numbers, from Car Repair to Modern Physics, by James D. Stein. Collins, April 2008. ISBN-13: 978-00612-417-65.

How to Think Like a Mathematician: A Companion to Undergraduate Mathematics, by Kevin Houston. Cambridge University Press, March 2009. ISBN-13: 978-05217-197-80.

The Indian Clerk, by David Leavitt. Bloomsbury USA, September 2007. ISBN-13: 978-15969-1040-9. (Reviewed September 2008.)

Is God a Mathematician? by Mario Livio. Simon & Schuster, January 2009. ISBN-13: 978-07432-940-58.

Kiss My Math: Showing Pre-Algebra Who's Boss, by Danica McKellar. Hudson Street Press, August 2008. ISBN-13: 978-1594630491.

The Last Theorem, by Arthur C. Clarke and Frederik Pohl. Del Rey, August 2008. ISBN-13: 978-0345470218.

Leonhard Euler and His Friends: Switzerland's Great Scientific Expatriate, by Luis-Gustave du Pasquier (translated by John S. D. Glaus). CreateSpace, July 2008. ISBN: 978-14348-332-73.

Lewis Carroll in Numberland: His Fantastical Mathematical Logical Life: An Agony in Eight Fits, by Robin Wilson. W. W. Norton & Company. ISBN-13: 978-03930-602-70.

Logic's Lost Genius: The Life of Gerhard Gentzen, by Eckart Menzler-Trott, Craig Smorynski (translator), Edward R. Griffor (translator). AMS-LMS, November 2007. ISBN-13: 978-0-8218-3550-0.

The Map of My Life, by Goro Shimura. Springer, September 2008. ISBN-13: 978-03877-971-44.

Mathematical Omnibus: Thirty Lectures on Classic Mathematics, by Dmitry Fuchs and Serge Tabachnikov. AMS, October 2007. ISBN-13: 978-08218-431-61. (Reviewed December 2008).

The Mathematician's Brain, by David Ruelle. Princeton University Press, July 2007. ISBN-13 978-0-691-12982-2. (Reviewed November 2008.)

Mathematicians of the World, Unite!: The International Congress of Mathematicians: A Human Endeavor, by Guillermo P. Curbera. A K Peters, March 2009. ISBN-13: 978-15688-133-01.

Mathematics and the Aesthetic: New Approaches to an Ancient Affinity, edited by Nathalie Sinclair, David Pimm, and William Higginson. Springer, November 2006. ISBN-13: 978-03873-052-64. (Reviewed February 2009.)

Mathematics and Common Sense: A Case of Creative Tension, by Philip J. Davis. A K Peters, October 2006. ISBN 1-568-81270-1. (Reviewed June/July 2009.)

Mathematics and Democracy: Designing Better Voting and Fair-Division Procedures, by Steven J. Brams. Princeton University Press, December 2007. ISBN-13: 978-0691-1332-01.

Mathematics at Berkeley: A History, by Calvin C. Moore. A K Peters, February 2007. ISBN-13: 978-1-5688-1302-8. (Reviewed November 2008.)

Mathematics Emerging: A Sourcebook 1540–1900, by Jacqueline Stedall. Oxford University Press, November 2008. ISBN-13: 978-01992-269-00.

Mathematics in Ancient Iraq: A Social History, by Eleanor Robson. Princeton University Press, August 2008. ISBN-13: 978-06910-918-22.

Mathematics in India, by Kim Plofker. Princeton University Press, January 2009. ISBN-13: 978-06911-206-76.

Mathematics in 10 Lessons: The Grand Tour, by Jerry P. King. Prometheus Books, May 2009. ISBN: 978-1-59102-686-0.

The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Sourcebook, by Victor J. Katz et al. Princeton University Press, July 2007. ISBN-13: 978-0-6911-2745-3.

**The Millenium Prize Problems*, J. Carlson, A. Jaffe, and A. Wiles, editors. American Mathematical Society, 2006. ISBN-13: 978-0-8218-3679-8. (Reviewed in this issue.)

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell, 2002. ISBN 0-943396743.

Number and Numbers, by Alain Badiou. Polity, June 2008. ISBN-13: 978-07456-387-82.

The Numbers Behind NUMB3RS: Solving Crime with Mathematics, by Keith Devlin and Gary Lorden. Plume, August 2007. ISBN-13: 978-04522-8857-7. (Reviewed March 2009.)

The Numbers Game: The Commonsense Guide to Understanding Numbers in the News, in Politics, and in Life, by Michael Blastland and Andrew Dilnot. Gotham, December 2008. ISBN-13: 978-15924-042-30.

The Numerati, by Stephen Baker. Houghton Mifflin, August 2008. ISBN-13: 978-06187-846-08. (Reviewed October 2009.)

One to Nine: The Inner Life of Numbers, by Andrew Hodges. W. W. Norton, May 2008. ISBN-13: 978-03930-664-18.

Origami, Eleusis, and the Soma Cube: Martin Gardner's Mathematical Diversions, by Martin Gardner. Cambridge University Press, September 2008. ISBN-13: 978-0-521-73524-7.

Our Days Are Numbered: How Mathematics Orders Our Lives, by Jason Brown. McClelland and Stewart, April 2009. ISBN-13: 978-07710-169-67.

Out of the Labyrinth: Setting Mathematics Free, by Robert Kaplan and Ellen Kaplan. Oxford University Press, January 2007. ISBN-13: 978-0-19514-744-5. (Reviewed June/July 2009.)

A Passion for Discovery, by Peter Freund. World Scientific, August 2007. ISBN-13: 978-9-8127-7214-5.

Picturing the Uncertain World: How to Understand, Communicate, and Control Uncertainty Through Graphical Display, by Howard Wainer, Princeton University Press, April 2009. ISBN-13: 978-06911-375-99.

Plato's Ghost: The Modernist Transformation of Mathematics, by Jeremy Gray. Princeton University Press, September 2008. ISBN-13: 978-06911-361-03.

The Princeton Companion to Mathematics, edited by Timothy Gowers (June Barrow-Green and Imre Leader, associate editors). Princeton University Press, November 2008. ISBN-13: 978-06911-188-02. (Reviewed November 2009.)

Professor Stewart's Cabinet of Mathematical Curiosities, by Ian Stewart. Basic Books, December 2008. ISBN-13: 978-0-465-01302-9.

Pythagoras' Revenge: A Mathematical Mystery, by Arturo Sangalli. Princeton University Press, May 2009. ISBN-13: 978-06910-495-57.

Pythagorean Crimes, by Tefcros Michalides. Parmenides Publishing, September 2008. ISBN-13: 978-19309-722-78. (Reviewed January 2009.)

Recountings: Conversations with MIT Mathematicians, edited by Joel Segel. A K Peters, January 2009. ISBN-13: 978-15688-144-90.

Reminiscences of a Statistician: The Company I Kept, by Erich Lehmann. Springer, November 2007. ISBN-13: 978-0-387-71596-4.

Rock, Paper, Scissors: Game Theory in Everyday Life, by Len Fisher. Basic Books, November 2008. ISBN-13: 978-04650-093-81.

Roots to Research: A Vertical Development of Mathematical Problems, by Judith D. Sally and Paul J. Sally Jr. AMS, November 2007. ISBN-13: 978-08218-440-38. (Reviewed December 2008.)

Sacred Mathematics: Japanese Temple Geometry, by Fukagawa Hidetoshi and Tony Rothman. Princeton University Press, July 2008. ISBN-13: 978-0-6911-2745-3.

The Shape of Content: An Anthology of Creative Writing in Mathematics and Science, edited by Chandler Davis, Marjorie Wikler Senechal, and Jan Zwicky. A K Peters, November 2008. ISBN-13: 978-15688-144-45.

Souvenirs sur Sofia Kovalevskaya (French), by Michèle Audin. Calvage et Mounet, October 2008. ISBN-13: 978-29163-520-53.

Strange Attractors: Poems of Love and Mathematics, edited by Sarah Glaz and JoAnne Growney. A K Peters, November 2008. ISBN-13: 978-15688-134-17. (Reviewed September 2009.)

Super Crunchers: Why Thinking-by-Numbers Is the New Way to Be Smart, by Ian Ayres. Bantam, August 2007. ISBN-13: 978-05538-054-06. (Reviewed April 2009.)

Symmetry: The Ordering Principle (Wooden Books), by David Wade. Walker and Company, October 2006. ISBN-13: 978-08027-153-88.

Tools of American Math Teaching, 1800–2000, by Peggy Aldrich Kidwell, Amy Ackerberg-Hastings, and David Lindsay Roberts. Johns Hopkins University Press, July 2008. ISBN-13: 978-0801888144.

The Unfinished Game: Pascal, Fermat, and the Seventeenth-Century Letter That Made the World Modern, by Keith Devlin. Basic Books, September 2008. ISBN-13: 978-0-4650-0910-7.

The Unimaginable Mathematics of Borges' Library of Babel, by William Goldbloom Bloch. Oxford University Press, August 2008. ISBN-13: 978-01953-345-79.

What Is a Number?: Mathematical Concepts and Their Origins, by Robert Tubbs. Johns Hopkins University Press, December 2008. ISBN-13: 978-08018-901-85.

What's Happening in the Mathematical Sciences, by Dana Mackenzie. AMS, 2009. ISBN-13: 978-08218-447-86.

Why Does $E=mc^2$? (And Why Should We Care?), by Brian Cox and Jeff Forshaw. Da Capo Press, July 2009. ISBN-13: 978-03068-175-88.

The Wraparound Universe, by Jean-Pierre Luminet. A K Peters, March 2008. ISBN 978-15688-130-97. (Reviewed December 2008.)

Zeno's Paradox: Unraveling the Ancient Mystery Behind the Science of Space and Time, by Joseph Mazur. Plume, March 2008 (reprint edition). ISBN-13: 978-0-4522-8917-8.

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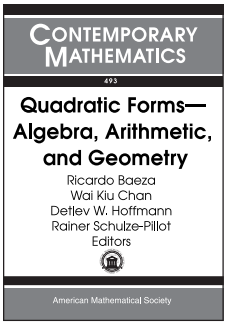
Algebra and Algebraic Geometry



Quadratic Forms—Algebra, Arithmetic, and Geometry

Ricardo Baeza, *University of Talca, Talca, Chile*, **Wai Kiu Chan**, *Wesleyan University, Middletown, CT*, **Detlev W. Hoffmann**, *University of Nottingham, England*, and **Rainer Schulze-Pillot**, *Universitat des Saarlandes, Saarbruecken, Germany*, Editors

This volume presents a collection of articles that are based on talks delivered at the International Conference on the Algebraic and Arithmetic Theory of Quadratic Forms held in Frutillar, Chile in December 2007.

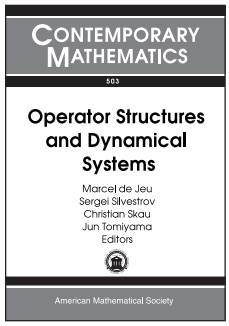
The theory of quadratic forms is closely connected with a broad spectrum of areas in algebra and number theory. The articles in this volume deal mainly with questions from the algebraic, geometric, arithmetic, and analytic theory of quadratic forms and related questions in algebraic group theory and algebraic geometry.

This item will also be of interest to those working in number theory.

Contents: R. Aravire and **B. Jacob**, $H^1(X, \nu)$ of conics and Witt kernels in characteristic 2; **K.J. Becher** and **D. B. Leep**, Pythagoras numbers and quadratic field extensions; **A.-M. Bergé** and **J. Martinet**, On perfection relations in lattices; **S. Böcherer**, **Y. Hironaka**, and **F. Sato**, Linear independence of local densities of quadratic forms and its application to the theory of Siegel modular forms; **M. Dickmann** and **F. Miraglia**, Representation of reduced special groups in algebras of continuous functions; **T. D. Browning** and **R. Dietmann**, Solubilty of Fermat equations; **A. G. Earnest** and **R. W. Fitzgerald**, Multiplicative properties of integral binary quadratic forms; **L. Fukshansky**, Effective structure theorems for symplectic spaces via height; **S. Garibaldi** and **K. Zainoulline**, Orthogonal involutions on algebras of degree 16 and the Killing form of E_8 (Appendix A: Non-hyperbolicity of orthogonal involutions); **S. Gille**, The first Zariski cohomology group of the Witt sheaf over a split simply connected simple algebraic group; **P. Gładki** and **M. Marshall**, On families of testing formulae for a pp formula; **T. Ibukiyama** and **S. Wakatsuki**, Siegel modular forms of a small weight and the Witt operator; **N. A. Karpenko**, On isotropy of quadratic pairs; **M. Knebusch**, Specialization of forms in the presence of characteristic 2: first steps; **W. Kohnen**, Representation of integers by special positive definite integral quadratic forms; **A. Laghribi** and **P. Mammone**, Hyper-isotropy of bilinear forms in characteristic 2; **D. B. Leep**, A historical view of the Pythagoras numbers of fields; **M. Machura** and **K. Osiak**, The extensions of $\mathbb{R}$-places and application; **A. S. Merkurjev**, Essential dimension; **R. Parimala**, **V. Suresh**, and **J.-P. Tignol**, On the Pfister number of quadratic forms; **R. Scharlau**, Martin Kneser's work on quadratic forms and algebraic groups; **A. Schürmann**, Enumerating perfect forms; **N.-P. Skoruppa**, Reduction mod ℓ of Theta series of level ℓ^n; **L. H. Walling**, On a reciprocity theorem of Gauss; **T. Watanabe** and **R. Yoshimitsu**, A bound of the number of reduced Arakelov divisors of a number field.

Contemporary Mathematics, Volume 493

August 2009, 408 pages, Softcover, ISBN: 978-0-8218-4648-3, LC 2009009821, 2000 *Mathematics Subject Classification:* 11Hxx, 11Exx, 11Fxx, 12Dxx, 12Exx, 14Cxx, 14Fxx, 14Pxx, 19Gxx, 20Gxx, **AMS members US$92**, List US$115, Order code CONM/493



Operator Structures and Dynamical Systems

Marcel de Jeu, *Leiden University, The Netherlands*, **Sergei Silvestrov**, *Lund University, Sweden*, **Christian Skau**, *Norwegian University of Science and Technology, Trondheim, Norway*, and **Jun Tomiyama**, Editors

This volume contains the proceedings of a Leiden Workshop on Dynamical Systems and their accompanying Operator Structures, which took place at the Lorentz Center in Leiden, The Netherlands, on July 21–25, 2008.

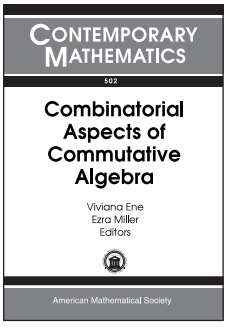
These papers offer a panorama of selfadjoint and non-selfadjoint operator algebras associated with both noncommutative and

commutative (topological) dynamical systems and related subjects. Papers on general theory, as well as more specialized ones on symbolic dynamics and complex dynamical systems, are included.

Contents: **J. Arnlind** and **S. Silvestrov**, Affine transformation crossed product type algebras and noncommutative surfaces; **G. G. de Castro**, C*-algebras associated with iterated function systems; **K. R. Davidson** and **E. G. Katsoulis**, Nonself-adjoint operator algebras for dynamical systems; **S. Dirksen**, **M. de Jeu**, and **M. Wortel**, Extending representations of normed algebras in Banach spaces; **T. Kajiwara**, Countable bases for Hilbert C*-modules and classification of KMS states; **W. Krieger** and **K. Matsumoto**, Subshifts and C^*-algebras from one-counter codes; **K. Matsumoto**, Orbit equivalance in C^*-algebras defined by actions of symbolic dynamical systems; **M. McGarvey** and **I. G. Todorov**, Normalisers, nest algebras and tensor products; **I. V. Nikolaev**, Noncommutative geometry as a functor; **J. Öinert**, Simple group graded rings and maximal commutativity; **H. Osaka**, **K. Kodaka**, and **T. Teruya**, The Rohlin property for inclusions of C^*-algebras with a finite Watatani index; **J. R. Peters**, The C*-envelope of a semicrossed product and Nest representations; **N. C. Phillips**, Freeness of actions of finite groups on C*-algebras; **J. Renault**, Examples of masas in C*-algebras; **T. Timmermann**, A definition of compact C^*-quantum groupoids; **Y. Watatani**, Complex dynamical systems and associated C^*-algebras; **J. D. M. Wright**, On classifying monotone complete algebras of operators.

Contemporary Mathematics, Volume 503

December 2009, 317 pages, Softcover, ISBN: 978-0-8218-4747-3, LC 2009027923, 2000 *Mathematics Subject Classification:* 46L55, 37Bxx, 47Lxx; 46L08, 46L35, 46H25, 37B10, 37Fxx, 16S35, 54H20, **AMS members US$79**, List US$99, Order code CONM/503



Combinatorial Aspects of Commutative Algebra

Viviana Ene, *Ovidius University, Constanţa, Romania*, and **Ezra Miller**, *Duke University, Durham, NC*, Editors

This volume contains the proceedings of the Exploratory Workshop on Combinatorial Commutative Algebra and Computer Algebra, which took place in Mangalia, Romania on May 29–31, 2008. It includes research papers and surveys reflecting some of the current trends in the development of combinatorial commutative algebra and related fields.

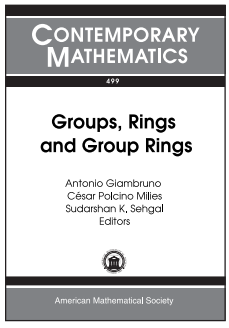
This volume focuses on the presentation of the newest research results in minimal resolutions of polynomial ideals (combinatorial techniques and applications), Stanley-Reisner theory and Alexander duality, and applications of commutative algebra and of combinatorial and computational techniques in algebraic geometry and topology. Both the algebraic and combinatorial perspectives are well represented and some open problems in the above directions have been included.

This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: **F. Ambro**, On the classification of toric singularities; **V. Bonanzinga**, **V. Ene**, **A. Olteanu**, and **L. Sorrenti**, An overview on the minimal free resolutions of lexsegment ideals; **V. Bonanzinga** and **L. Sorrenti**, Cohen-Macaulay squarefree lexsegment ideals generated in degree 2; **H. Charalambous** and **A. Thoma**, On simple $\mathcal{A}$-multigraded minimal resolutions; **T. C. Benítez** and **S. Z. Armengou**, Tangent cones of numerical semigroup rings; **D. Ibadula**, The Igusa local zeta functions of $GL_2(\mathbb{Q})_p$-orbit of Fermat's binary form; **K. Kimura**, **N. Terai**, and **K. Yoshida**, Arithmetical rank of monomial ideals of deviation two; **A. D. Măcinic**, A survey of combinatorial aspects in the topology of complex hyperplane arrangements; **N. Manolache**, A class of locally complete intersection multiple structures on smooth algebraic varieties as support; **E. Miller**, Topological Cohen-Macaulay criteria for monomial ideals; **A. Olteanu**, Regularity and the case of few generators for Stanley-Reisner ideals of subword complexes; **A. Ştefan**, The type of the base ring associated to a transversal polymatroid.

Contemporary Mathematics, Volume 502

December 2009, 184 pages, Softcover, ISBN: 978-0-8218-4758-9, LC 2009026845, 2000 *Mathematics Subject Classification:* 13-06; 13A30, 14B05, 52C35, 13D02, 13F55, 13H10, 13P10, 32S22, 55U10, **AMS members US$55**, List US$69, Order code CONM/502



Groups, Rings and Group Rings

Antonio Giambruno, *Università di Palermo, Italy*, **César Polcino Milies**, *Universidade de São Paulo, Brazil*, and **Sudarshan K. Sehgal**, *University of Alberta, Edmonton, Canada*, Editors

This volume represents the proceedings of the conference on Groups, Rings and Group Rings, held July 28–August 2, 2008, in Ubatuba, Brazil.

Papers in this volume contain results in active research areas in the theory of groups, group rings and algebras (including noncommutative rings), polynomial identities, Lie algebras and superalgebras. In particular, topics such as growth functions on varieties, groups of units in group rings, representation theory of Lie algebras, Jordan, alternative and Leibniz algebras, graded identities, automorphisms of trees, and partial actions are discussed.

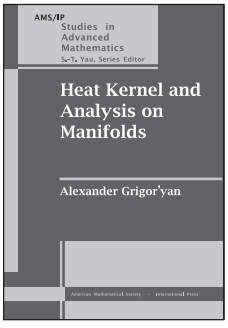
Contents: **F. Cedó**, **E. Jespers**, and **J. Okniński**, The radical of the four generated algebra of alternating type; **W. Cortes** and **M. Ferrero**, Globalization of partial actions on semiprime rings; **W. Cortes**, **M. Ferrero**, and **S. O. Juriaans**, The Colombeau quaternion algebra; **E. Dan-Cohen**, **I. Penkov**, and **J. A. Wolf**, Parabolic subgroups of real direct limit Lie groups; **I. Dimitrov**, **V. Futorny**, and **D. Grantcharov**, Parabolic sets of roots; **O. M. Di Vincenzo** and **E. Spinelli**, Some results on *-minimal algebras with involution; **M. Dokuchaev** and **J. J. Simón**, Invariants of partial group algebras of finite p-groups; **R. A. Ferraz**, Units of $\mathbb{Z}C_p$; **J. Z. Gonçalves** and **M. Shirvani**, Algebraic elements as free factors in simple artinian rings; **J. Z. Gonçalves** and **P. M. Veloso**, Special units, unipotent units and free groups in group algebras; **D. Grantcharov**, Explicit realizations of simple weight modules of classical Lie superalgebras; **S. A. Jorge**, **V. R. da Silva**, and **A. C. Vieira**, Combinatorial aspects in the computation of proper multiplicities; **I. Kashuba** and **I. Shestakov**, An estimate of the dimension of the varieties of alternative and Jordon algebras; **S. G. Klementyev** and **V. M. Petrogradsky**, On growth of almost polynilpotent Lie algebras; **P. Koshlukov**, **A. Krasilnikov**, and **D. D. P. Silva**, Graded identities for Lie algebras; **D. La Mattina**, Polynomial codimension growth of graded algebras; **I. S. Lima**

and **P. A. Zalesskii**, Euclidean Bianchi groups are conjugacy separable; **C. Lomp** and **A. Sant'Ana**, Comparability, distributivity and non-commutative ϕ-rings; **S. López-Permouth**, **J. Moore**, and **S. Szabo**, Algebras having bases consisting entirely of units; **S. Mishchenko** and **A. Valenti**, On the growth of varieties of algebras; **A. P. Pozhidaev**, 0-Dialgebras with bar-unity, Rota-Baxter and 3-Leibniz algebras; **A. Regev** and **A. Regev**, The Golod-Shafarevich counterexample without Hilbert series; **H. L. Talpo** and **M. Firer**, Automorphism groups of semi-homogeneous trees.

Contemporary Mathematics, Volume 499

November 2009, 270 pages, Softcover, ISBN: 978-0-8218-4771-8, LC 2009020526, 2000 *Mathematics Subject Classification:* 05A16, 16R10, 16S36, 17B01, 17B20, 20E08, 20C05, 20M05; 05C05, 13F05, 16S15, 17C10, 20E05, **AMS members US$71**, List US$89, Order code CONM/499

Differential Equations



Heat Kernel and Analysis on Manifolds

Alexander Grigor'yan, *University of Bielefeld, Germany*

The heat kernel has long been an essential tool in both classical and modern mathematics but has become especially important in geometric analysis as a result of major innovations beginning in the 1970s. The methods based on heat kernels have been used in areas as diverse as analysis, geometry, and probability, as well as in physics. This book is a comprehensive introduction to heat kernel techniques in the setting of Riemannian manifolds, which inevitably involves analysis of the Laplace–Beltrami operator and the associated heat equation.

The first ten chapters cover the foundations of the subject, while later chapters deal with more advanced results involving the heat kernel in a variety of settings. The exposition starts with an elementary introduction to Riemannian geometry, proceeds with a thorough study of the spectral-theoretic, Markovian, and smoothness properties of the Laplace and heat equations on Riemannian manifolds, and concludes with Gaussian estimates of heat kernels.

Grigor'yan has written this book with the student in mind, in particular by including over 400 exercises. The text will serve as a bridge between basic results and current research.

This item will also be of interest to those working in geometry and topology.

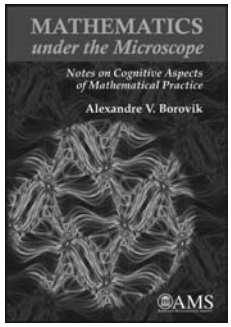
Titles in this series are co-published with International Press, Cambridge, MA.

Contents: Laplace operator and the heat equation in $\mathbb{R}^n$; Function spaces in $\mathbb{R}^n$; Laplace operator on a Riemannian manifold; Laplace operator and heat equation in $L^2(M)$; Weak maximum principle and related topics; Regularity theory in $\mathbb{R}^n$; The heat kernel on a manifold; Positive solutions; Heat kernel as a fundamental solution; Spectral properties; Distance function and completeness; Gaussian estimates in the integrated form; Green function and Green operator; Ultracontractive estimates and eigenvalues; Pointwise Gaussian estimates I; Pointwise Gaussian estimates II; Reference material; Bibliography; Some notation; Index.

AMS/IP Studies in Advanced Mathematics, Volume 47

December 2009, 482 pages, Hardcover, ISBN: 978-0-8218-4935-4, LC 2009034350, 2000 *Mathematics Subject Classification:* 58J35; 31B05, 35K05, 35P15, 47D07, 53C20, **AMS members US$95**, List US$119, Order code AMSIP/47

General and Interdisciplinary



Mathematics under the Microscope

Notes on Cognitive Aspects of Mathematical Practice

Alexandre V. Borovik, *University of Manchester, United Kingdom*

This is an unusual and unusually fascinating book.

Readers who never thought about mathematics after their school years will be amazed to discover how many habits of mind, ideas, and even material objects that are inherently mathematical serve as building blocks of our civilization and everyday life.

A professional mathematician, reluctantly breaking the daily routine, or pondering on some resisting problem, will open this book and enjoy a sudden return to his or her young days when mathematics was fresh, exciting, and holding all promises.

And do not take the word "microscope" in the title too literally: in fact, the author looks around, in time and space, focusing in turn on a tremendous variety of motives, from mathematical "memes" (genes of culture) to an unusual life of a Hollywood star.

—Yuri I. Manin, Max-Planck Institute of Mathematics, Bonn, and Northwestern University

It is an unusual book that casts new and paradoxical light on the nature of mathematics.

This book will be interesting—perhaps for different reasons—to school teachers of mathematics, to math majors at universities, to graduate students in mathematics and computer science, to research mathematicians and computer scientists, to philosophers and historians of mathematics, and to psychologists and neurophysiologists.

The author's goal is to start a dialogue between mathematicians and cognitive scientists. He discusses, from a working mathematician's point of view, the mystery of mathematical intuition: why are certain mathematical concepts more intuitive than others? To what extent does the "small scale" structure of mathematical concepts and algorithms reflect the workings of the human brain? What are the "elementary particles" of mathematics that build up the mathematical universe?

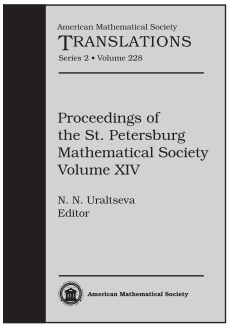
One of the principal points of the book is the essential vertical unity of mathematics, the natural integration of its simplest objects and concepts into the complex hierarchy of mathematics as a whole. The same ideas and patterns of thinking can be found in elementary school arithmetic and in cutting-edge mathematical theories.

There are no boundaries between "recreational", "elementary", "undergraduate", and "research" mathematics; the book freely moves throughout the whole range. Nevertheless, the author takes great care in keeping the book as non-technical as possible.

The book is saturated with amusing examples from a wide range of disciplines—from turbulence to error-correcting codes to logic—as well as with just puzzles and brainteasers. Despite the very serious subject matter, the author's approach is lighthearted and entertaining.

Contents: *Simple things: How structures of human cognition reveal themselves in mathematics:* A taste of things to come; What you see is what you get; The wing of the hummingbird; Simple things; Infinity and beyond; Encapsulation of actual infinity; *Mathematical reasoning:* What is it that makes a mathematician?; "Kolmogorov's logic" and heuristic reasoning; Recovery vs. discovery; The line of sight; *History and philosophy:* The ultimate replicating machines; The vivisection of the Cheshire Cat; References; Index.

January 2010, approximately 331 pages, Hardcover, ISBN: 978-0-8218-4761-9, LC 2009029174, 2000 *Mathematics Subject Classification:* 00A30, 00A35, 97C50, **AMS members US$47**, List US$59, Order code MBK/71



Proceedings of the St. Petersburg Mathematical Society, Volume XIV

N. N. Uraltseva, *St. Petersburg State University, Russia*, Editor

This volume contains articles on analysis, probability, partial differential operators, frames, and other areas of mathematics. The volume also contains a comprehensive article about the classification of pseudo-regular convex polyhedra.

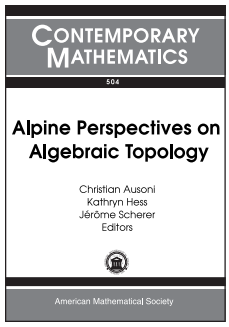
This book is suitable for a broad group of graduate students and researchers interested in the topics presented here.

Contents: V. A. Zheludev, **V. N. Malozemov**, and **A. B. Pevnyi**, Filter banks and frames in the discrete periodic case; **A. I. Karol′**, Newton polyhedra, asymptotics of volumes, and asymptotics of exponential integrals; **S. G. Kryzhevich** and **A. Yu. Skolyarov**, Approximation methods for unstable manifolds of equilibrium points of autonomous systems; **N. G. Kuznetsov** and **O. V. Motygin**, The Steklov problem in symmetric domains with infinitely extended boundary; **S. A. Nazarov**, On the spectrum of the Steklov problem in peak-shaped domains; **V. A. Sloushch**, Generalisations of the Cwikel estimate for integral operators; **A. N. Frolov**, Asymptotic behavior of probabilities of moderate deviations; **A. M. Gurin** and **V. A. Zalgaller**, On the history of the study of convex polyhedra with regular faces and faces composed of regular ones.

American Mathematical Society Translations—Series 2, Volume 228

December 2009, approximately 230 pages, Hardcover, ISBN: 978-0-8218-4802-9, 2000 *Mathematics Subject Classification:* 00B15, **AMS members US$87**, List US$109, Order code TRANS2/228

Geometry and Topology



Alpine Perspectives on Algebraic Topology

Christian Ausoni, *University of Bonn, Germany*, **Kathryn Hess**, *Ecole Polytechnique Federale de Lausanne, Switzerland*, and **Jérôme Scherer**, *Universitat Autónoma de Barcelona, Ballaterra, Spain*, Editors

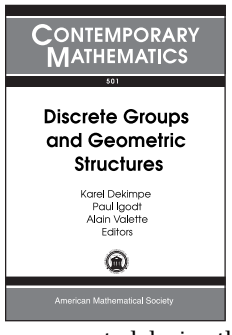
This volume contains the proceedings of the Third Arolla Conference on Algebraic Topology, which took place in Arolla, Switzerland, on August 18–24, 2008.

This volume includes research papers on stable homotopy theory, the theory of operads, localization and algebraic K-theory, as well as survey papers on the Witten genus, on localization techniques and on string topology—offering a broad perspective of modern algebraic topology.

Contents: A. Baker, *L*-complete Hopf algebroids and their comodules; **M. A. Batanin** and **C. Berger**, The lattice path operad and Hochschild cochains; **A. J. Blumberg**, **R. L. Cohen**, and **C. Teleman**, Open-closed field theories, string topology, and Hochschild homology; **W. Chachólski**, **E. D. Farjoun**, **R. Göbel**, and **Y. Segev**, Cellular covers of divisible abelian groups; **A. Dessai**, Some geometric properties of the Witten genus; **W. G. Dwyer** and **E. D. Farjoun**, Localization and cellularization of principal fibrations; **B. Fresse**, Operadic cobar constructions, cylinder objects and homotopy morphisms of algebras over operads; **B. Jahren**, Involutions on the rational *K*-theory of group rings of finite groups; **J. A. Neisendorfer**, A quick trip through localization; **B. Richter**, Divided power structures and chain complexes.

Contemporary Mathematics, Volume 504

December 2009, 254 pages, Softcover, ISBN: 978-0-8218-4839-5, LC 2009028123, 2000 *Mathematics Subject Classification:* 16E40, 18D50, 18G30, 19C09, 19D50, 53C20, 55N22, 55P60, 55U35, 58J26, **AMS members US$63**, List US$79, Order code CONM/504



Discrete Groups and Geometric Structures

Karel Dekimpe and **Paul Igodt**, *Katholieke Universiteit Leuven, Kortrijk, Belgium*, and **Alain Valette**, *Université de Neuchâtel, Switzerland*, Editors

This volume reports on research related to Discrete Groups and Geometric Structures, as presented during the International Workshop held May 26–30, 2008, in Kortrijk, Belgium.

Readers will benefit from impressive survey papers by John R. Parker on methods to construct and study lattices in complex hyperbolic space and by Ursula Hamenstädt on properties of group actions with a rank-one element on proper CAT(0)-spaces.

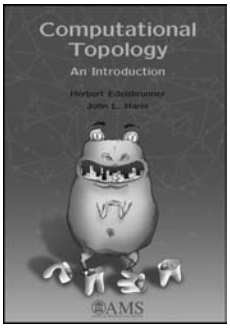
This volume also contains research papers in the area of group actions and geometric structures, including work on loops on a twice punctured torus, the simplicial volume of products and fiber bundles, the homology of Hantzsche–Wendt groups, rigidity of real Bott towers, circles in groups of smooth circle homeomorphisms, and groups generated by spine reflections admitting crooked fundamental domains.

This item will also be of interest to those working in analysis.

Contents: **J. R. Parker**, Complex hyperbolic lattices; **U. Hamenstädt**, Rank-one isometries of proper CAT(0)-spaces; **R. Águeda**, Trace polynomial for simple loops on the twice punctured torus; **M. Bucher**, Simplicial volume of products and fiber bundles; **K. Dekimpe** and **N. Petrosyan**, Homology of Hantzsche-Wendt groups; **Y. Kamishima** and **A. Nazra**, Seifert fibred structure and rigidity on real Bott towers; **A. Adouani** and **H. Marzougui**, Exotic circles in groups of piecewise smooth circle homeomorphisms; **V. Charette**, Groups generated by spine reflections admitting crooked fundamental domains.

Contemporary Mathematics, Volume 501

November 2009, approximately 156 pages, Softcover, ISBN: 978-0-8218-4647-6, LC 2009026844, 2000 *Mathematics Subject Classification:* 20F67, 20J06, 22E40, 30F40, 37E10, 51M10, 53C50, 55R10, 57S25, **AMS members US$47**, List US$59, Order code CONM/501



Computational Topology

An Introduction

Herbert Edelsbrunner, *Duke University, Durham, NC, and Geomagic, Research Triangle Park, NC*, and **John L. Harer**, *Duke University, Durham, NC*

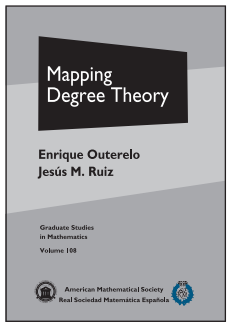
Combining concepts from topology and algorithms, this book delivers what its title promises: an introduction to the field of computational topology. Starting with motivating problems in both mathematics and computer science and building up from classic topics in geometric and algebraic topology, the third part of the text advances to persistent homology. This point of view is critically important in turning a mostly theoretical field of mathematics into one that is relevant to a multitude of disciplines in the sciences and engineering.

The main approach is the discovery of topology through algorithms. The book is ideal for teaching a graduate or advanced undergraduate course in computational topology, as it develops all the background of both the mathematical and algorithmic aspects of the subject from first principles. Thus the text could serve equally well in a course taught in a mathematics department or computer science department.

This item will also be of interest to those working in applications.

Contents: *Computational geometric topology:* Graphs; Surfaces; Complexes; *Computational algebraic topology:* Homology; Duality; Morse functions; *Computational persistent topology:* Persistence; Stability; Applications; References; Index.

January 2010, 241 pages, Hardcover, ISBN: 978-0-8218-4925-5, LC 2009028121, 2000 *Mathematics Subject Classification:* 00-01, 52-XX, 55-XX, 57-XX, 68-XX, **AMS members US$47**, List US$59, Order code MBK/69



Mapping Degree Theory

Enrique Outerelo and **Jesús M. Ruiz**, *Universidad Complutense de Madrid, Spain*

This textbook treats the classical parts of mapping degree theory, with a detailed account of its history traced back to the first half of the 18th century. After a historical first chapter, the remaining four chapters develop the mathematics. An effort is made to use only elementary methods, resulting in a self-contained presentation. Even so, the book arrives at some truly outstanding theorems: the classification of homotopy classes for spheres and the Poincaré-Hopf Index Theorem, as well as the proofs of the original formulations by Cauchy, Poincaré, and others.

Although the mapping degree theory you will discover in this book is a classical subject, the treatment is refreshing for its simple and direct style. The straightforward exposition is accented by the appearance of several uncommon topics: tubular neighborhoods without metrics, differences between class 1 and class 2 mappings, Jordan Separation with neither compactness nor cohomology, explicit constructions of homotopy classes of spheres, and the direct computation of the Hopf invariant of the first Hopf fibration.

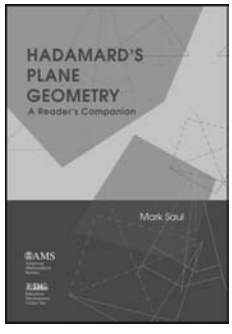
The book is suitable for a one-semester graduate course. There are 180 exercises and problems of different scope and difficulty.

This book is jointly published by the AMS and the Real Sociedad Matemática Española (RSME).

Contents: History; Manifolds; The Brouwer-Kronecker degree; Degree theory in Euclidean spaces; The Hopf theorems; Names of mathematicians cited; Historical references; Bibliography; Symbols; Index.

Graduate Studies in Mathematics, Volume 108

December 2009, 244 pages, Hardcover, ISBN: 978-0-8218-4915-6, LC 2009026383, 2000 *Mathematics Subject Classification:* 01A55, 01A60, 47H11, 55M25, 57R35, 58A12, 58J20, **AMS members US$50**, List US$62, Order code GSM/108



Hadamard's Plane Geometry

A Reader's Companion

Mark Saul

Jacques Hadamard, among the greatest mathematicians of the twentieth century, made signal contributions to a number of fields. But his mind could not be confined to the upper reaches of mathematical thought. He also produced a massive two-volume work, on plane and solid geometry, for pre-college teachers in the French school system.

In those books, Hadamard's style invites participation. His exposition is minimal, providing only the results necessary to

support the solution of the many elegant problems he poses afterwards. That is, the problems interpret the text in the way that harmony interprets melody in a well-composed piece of music.

The present volume offers solutions to the problems in the first part of Hadamard's work (*Lessons in Geometry. I. Plane Geometry*, Jacques Hadamard, Amer. Math. Soc. (2008)), and can be viewed as a reader's companion to that book. It requires of the reader only the background of high school plane geometry, which *Lessons in Geometry* provides. The solutions strive to connect the general methods given in the text with intuitions that are natural to the subject, giving as much motivation as possible as well as rigorous and formal solutions. Ideas for further exploration are often suggested, as well as hints for classroom use.

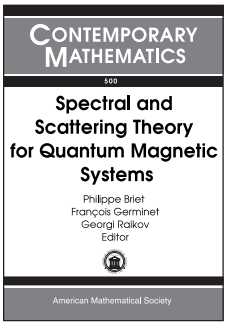
This book will be of interest to high school teachers, gifted high school students, college students, and those mathematics majors interested in geometry.

A co-publication of the AMS and Education Development Center.

Contents: Solutions and comments for problems in book I; Solutions and comments for problems in book II; Solutions and comments for problems in book III; Solutions and comments for complements to book III; Solutions and comments for problems in book IV.

January 2010, approximately 353 pages, Hardcover, ISBN: 978-0-8218-4368-0, LC 2009028578, 2000 *Mathematics Subject Classification:* 01A73, 51-01; 51-03, **AMS members US$47**, List US$59, Order code MBK/70

Mathematical Physics



Spectral and Scattering Theory for Quantum Magnetic Systems

Philippe Briet, *Université Sud Toulon-Var, Marseille, Cedex, France*, **François Germinet**, *Université Cergy-Pontoise, France*, and **Georgi Raikov**, *Pontificia Universidad Catolica de Chile, Santiago, Chile*, Editors

This volume contains the proceedings of the conference on Spectral and Scattering Theory for Quantum Magnetic Systems, which took place at CIRM, Luminy, France, in July 2008. The main purpose of this conference was to bring together a number of specialists in the mathematical modelling of magnetic phenomena in quantum mechanics, to mark the recent progress as well as to outline the future development in this area.

This volume contains original results presented by some of the invited speakers and surveys on recent advances in the mathematical theory of quantum magnetic Hamiltonians.

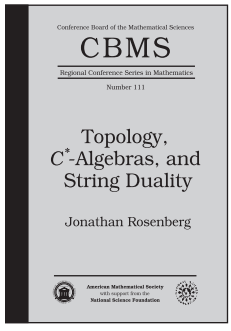
Most of the talks at the conference, as well as the articles in this volume, have been dedicated to one of the following topics:

- Spectral and scattering theory for magnetic Schrödinger operators
- Magnetic Pauli and Dirac operators
- Magnetic operators on manifolds
- Microlocal analysis of magnetic Hamiltonians
- Random Schrödinger operators and quantum Hall effect
- Ginsburg–Landau equation, supraconductivity, magnetic bottles
- Bose–Einstein condensate, Gross–Pitaevski equation
- Magnetic Lieb–Thirring inequalities, stability of matter

Contents: L. Amour, **J. Faupin**, **B. Grébert**, and **J.-C. Guillot**, On the infrared problem for the dressed non-relativistic electron in a magnetic field; **O. Bourget** and **C. Fernández**, Absence of singular spectrum for some time-periodic magnetic systems; **P. Briet**, **P. D. Hislop**, **G. D. Raikov**, and **E. Soccorsi**, Mourre estimates for a 2D magnetic quantum Hamiltonian on strip-like domains; **V. Bruneau**, **A. Khochman**, and **G. D. Raikov**, Perturbation of a magnetic Schrödinger operator near an embedded infinite-multiplicity eigenvalue; **R. L. Frank**, Remarks on eigenvalue estimates and semigroup domination; **F. Germinet**, **A. Klein**, and **B. Mandy**, Delocalization for random Landau Hamiltonians with unbounded random variables; **C. Hainzl** and **R. Seiringer**, A linear criterion for solutions of non-linear equations, with application to the BCS gap equation; **B. Helffer** and **Y. A. Kordyukov**, Semiclassical analysis of Schrödinger operators with magnetic wells; **V. Iftimie**, **M. Măntoiu**, and **R. Purice**, The magnetic formalism; new results; **A. Iwatsuka**, **T. Mine**, and **S.-i. Shimada**, Norm resolvent convergence to Schrödinger operators with infinitesimally thin toroidal magnetic fields; **F. Klopp**, Lifshitz tails for alloy type random models in constant magnetic fields: a short review; **S. Richard**, New formulae for the Aharonov-Bohm wave operators; **G. Rozenblum** and **G. Tashchiyan**, On the spectral properties of the Landau Hamiltonian perturbed by a moderately decaying magnetic field.

Contemporary Mathematics, Volume 500

November 2009, 186 pages, Softcover, ISBN: 978-0-8218-4744-2, LC 2009022736, 2000 *Mathematics Subject Classification:* 81Q10, 81V10, 35J10, 82B44, 60H25, 47B80, 81Q70, 35P20, 35P25, **AMS members US$55**, List US$69, Order code CONM/500



Topology, C*-Algebras, and String Duality

Jonathan Rosenberg, *University of Maryland, College Park, MD*

String theory is the leading candidate for a physical theory that combines all the fundamental forces of nature, as well as the principles of relativity and quantum mechanics, into a mathematically elegant whole. The mathematical tools used by string theorists are highly sophisticated and cover many areas of mathematics. As with the birth of quantum theory in the early 20th century, the mathematics has benefited at least as much as the physics from the collaboration. In this book, based on CBMS lectures given at Texas Christian University, Rosenberg describes some of the most recent interplay between string dualities and topology and operator algebras.

The book is an interdisciplinary approach to duality symmetries in string theory. It can be read by either mathematicians or theoretical physicists and involves a more-or-less equal mixture of algebraic topology, operator algebras, and physics. There is also a bit of algebraic geometry, especially in the last chapter. The reader is

assumed to be somewhat familiar with at least one of these four subjects, but not necessarily with all or even most of them. The main objective of the book is to show how several seemingly disparate subjects are closely linked with one another and to give readers an overview of some areas of current research, even if this means that not everything is covered systematically.

This item will also be of interest to those working in geometry and topology.

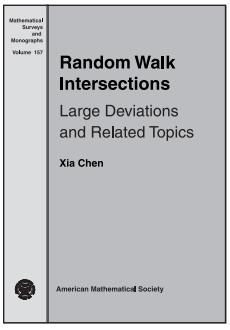
A co-publication of the AMS and CBMS.

Contents: Introduction and motivation; K-theory and its relevance to physics; A few basics of C^*-algebras and crossed products; Continuous-trace algebras and twisted K-theory; More on crossed products and their K-theory; The topology of T-duality and the Bunke-Schick construction; T-duality via crossed products; Higher-dimensional T-duality via topological methods; Higher-dimensional T-duality via C^*-algebraic methods; Advanced topics and open problems; Bibliography; Notation and symbols; Index.

CBMS Regional Conference Series in Mathematics, Number 111

December 2009, 110 pages, Softcover, ISBN: 978-0-8218-4922-4, LC 2009032465, 2000 *Mathematics Subject Classification:* 81T30; 81T75, 19K99, 46L80, 58B34, 55R10, 55P65, 55R50, 14J32, 53Z05, **AMS members US$26**, **All Individuals US$26**, List US$33, Order code CBMS/111

Probability



Random Walk Intersections

Large Deviations and Related Topics

Xia Chen, *University of Tennessee, Knoxville, TN*

The material covered in this book involves important and non-trivial results in contemporary probability theory motivated by polymer models, as well as other topics of importance in physics and chemistry. The development carefully provides the basic definitions of mutual intersection and self-intersection local times for Brownian motions and the accompanying large deviation results. The book then proceeds to the analogues of these concepts and results for random walks on lattices of R^d. This includes suitable integrability and large deviation results for these models and some applications. Moreover, the notes and comments at the end of the chapters provide interesting remarks and references to various related results, as well as a good number of exercises. The author provides a beautiful development of these subtle topics at a level accessible to advanced graduate students.

This item will also be of interest to those working in mathematical physics.

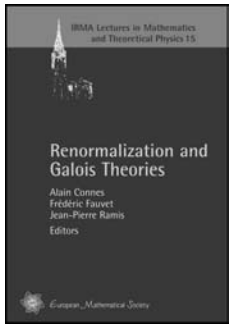
Contents: Basics on large deviations; Brownian intersection local times; Mutual intersection: large deviations; Self-intersection: large deviations; Intersections on lattices: weak convergence; Inequalities and integrabilities; Independent random walks: large deviations; Single random walk: large deviations; Green's function; Fourier transformation; Constant $\kappa(d,p)$ and related variations; Regularity of stochastic processes; Self-adjoint operators; Bibliography; List of general notations; Index.

Mathematical Surveys and Monographs, Volume 157

January 2010, approximately 357 pages, Hardcover, ISBN: 978-0-8218-4820-3, LC 2009026903, 2000 *Mathematics Subject Classification:* 60F05, 60F10, 60F15, 60F25, 60G17, 60G50, 60J65, 81T17, 82B41, 82C41, **AMS members US$72**, List US$90, Order code SURV/157

New AMS-Distributed Publications

Algebra and Algebraic Geometry



Renormalization and Galois Theories

Alain Connes, *College de France, Paris, France*, **Frédéric Fauvet**, *University Louis Pasteur et CNRS, Strasbourg, France*, and **Jean-Pierre Ramis**, *Université Paul Sabatier, Toulouse, France*, Editors

This volume is the outcome of a CIRM Workshop on Renormalization and Galois Theories held in Luminy, France, in March 2006. The subject of this workshop was the interaction and relationship between four currently very active areas: renormalization in quantum field theory (QFT), differential Galois theory, noncommutative geometry, motives and Galois theory.

The last decade has seen a burst of new techniques to cope with the various mathematical questions involved in QFT, with notably the development of a Hopf-algebraic approach and insights into the classes of numbers and special functions that systematically appear in the calculations of perturbative QFT (pQFT). The analysis of the ambiguities of resummation of the divergent series of pQFT, an old problem, has been renewed, using recent results on Gevrey asymptotics, generalized Borel summation, Stokes phenomenon and resurgent functions.

The purpose of the present book is to highlight, in the context of renormalization, the convergence of these various themes, orchestrated by diverse Galois theories. It contains three lecture courses together with five research articles and will be useful to both researchers and graduate students in mathematics and physics.

This item will also be of interest to those working in differential equations.

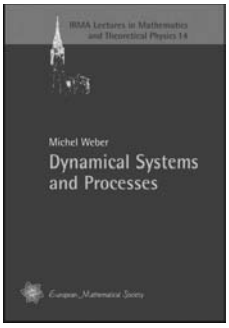
A publication of the European Mathematical Society. Distributed within the Americas by the American Mathematical Society.

Contents: **C. Consani**, Noncommutative geometry and motives (à quoi servent les endomotifs?); **V. Rivasseau** and **F. Vignes-Tourneret**, Renormalisation of non-commutative field theories; **D. Sauzin**, Mould expansions for the saddle-node and resurgence monomials; **Y. André**, Galois theory, motives and transcendental numbers; **K. Ebrahimi-Fard** and **D. Manchon**, The combinatorics of Bogoliubov's recursion in renormalization; **M. E. Hoffman**, (Non)commutative Hopf algebras of trees and (quasi)symmetric functions; **F. Menous**, Formal differential equations and renormalization; **S. Weinzierl**, Feynman integrals and multiple polylogarithms.

IRMA Lectures in Mathematics and Theoretical Physics, Volume 15

September 2009, 279 pages, Softcover, ISBN: 978-3-03719-073-9, 2000 *Mathematics Subject Classification:* 14F42, 34M30, 34M35, 34M37, 34M40, 81T15, 81T18, 81T75, 11S40, 33B30, 34M50, **AMS members US$46**, List US$58, Order code EMSILMTP/15

Analysis



Dynamical Systems and Processes

Michel Weber, *University Louis Pasteur et CNRS, Strasbourg, France*, Editor

This book presents in a concise and accessible way, as well as in a common setting, various tools and methods arising from spectral theory, ergodic theory and stochastic processes theory, which form the basis of and contribute interactively a great deal to the current research on almost-everywhere convergence problems.

Researchers working in dynamical systems and at the crossroads of spectral theory, ergodic theory and stochastic processes will find the tools, methods, and results presented in this book of great interest. It is written in a style accessible to graduate students.

This item will also be of interest to those working in probability.

A publication of the European Mathematical Society. Distributed within the Americas by the American Mathematical Society.

Contents: *Part I. Spectral theorems and convergence in mean:* The von Neumann theorem and spectral regularization; Spectral representation of weakly stationary processes; *Part II. Ergodic theorems:* Dynamical systems—ergodicity and mixing; Pointwise ergodic theorems; Banach principle and continuity principle; Maximal operators and Gaussian processes; The central limit theorem for dynamical systems; *Part III. Methods arising from the theory of stochastic processes:* The metric entropy method; The majorizing measure method; Gaussian processes; *Part IV. Three studies:* Riemann sums; A study of the system $(f(nx))$; Divisors and random walks; Bibliography; Index.

IRMA Lectures in Mathematics and Theoretical Physics, Volume 14

August 2009, 773 pages, Hardcover, ISBN: 978-3-03719-046-3, 2000 *Mathematics Subject Classification:* 37-02, 60-02, **AMS members US$102**, List US$128, Order code EMSILMTP/14

Mathematics Calendar

Please submit conference information for the Mathematics Calendar through the Mathematics Calendar submission form at http://www.ams.org/cgi-bin/mathcal-submit.pl .

The most comprehensive and up-to-date Mathematics Calendar information is available on the AMS website at http://www.ams.org/mathcal/ .

December 2009

1–4 (NEW DATE) **Combinatorics: Analytical Methods in Combinatorics, Additive Number Theory and Computer Science**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Dec. 2008, p. 1452)

7–9 **SIAM Conference on Analysis of Partial Differential Equations (PD09)**, Hilton Miami Downtown, Miami, Florida. (Feb. 2009, p. 310)

7–11 **IMA Workshop: Microfluidics: Electrokinetic and Interfacial Phenomena**, Institute for Mathematics and its Applications (IMA), University of Minnesota, Minneapolis, Minnesota. (Apr. 2009, p. 525)

8–11 **Operators and Operator Algebras in Edinburgh**, University of Edinburgh, Scotland, U.K. (Nov. 2009, p. 1358)

* 9–10 **National Conference on Discrete and Fuzzy Mathematics (NCDFM-2009)**, Karunya University, Coimbatore, Tamilnadu, India.
Description: Discrete Mathematics: Logic, Combinatorics, Lattice, Boolean Algebra, Modern Algebra, Graph Theory and Algorithms, Automata Theory, Number Theory, other related topics. Fuzzy Mathematics: Fuzzy Sets, Fuzzy Logic, Fuzzy Graphs, Fuzzy Decision Making and Management, Fuzzy Lattice, Fuzzy Automata, Fuzzy Topology, other fuzzy related topics.
Registration Fee: Academic Delegates- Rs. 500.
Important Dates: Full Manuscript: October 30, 2009. Intimation of Acceptance: November 16, 2009. Last date for Registration: November 25, 2009.
Information: `http://www.karunya.edu`.

9–12 **Advanced Course on Algebraic Cycles, Modular Forms, and Rational Points on Elliptic Curves**, Centre de Recerca Matemàtica (CRM), Bellaterra, Barcelona, Spain. (Sept. 2009, p. 1025)

10–19 **International Workshop on Harmonic Mappings and Hyperbolic Metrics**, Indian Institute of Technology Madras, Chennai-600036, India. (Nov. 2009, p. 1359)

14–18 **AMSI Workshop: New Directions in Geometric Group Theory**, The University of Queensland, Brisbane, Australia. (Aug. 2009, p. 863)

14–18 **Brownian motion and random matrices**, American Institute of Mathematics, Palo Alto, California. (May 2009, p. 659)

14–18 **Cycles and Special Values of L-series**, Centre de Recerca Matemàtica, UAB E-08193 Bellaterra, Barcelona, Spain. (Nov. 2009, p. 1359)

16–18 **The 4th Indian International Conference on Artificial Intelligence: (IICAI-09)**, Tumkur (near Bangalore), India. (Dec. 2008, p. 1452)

17–21 **The 14th Asian Technology Conference in Mathematics (ATCM 2009)**, Beijing Normal University, Beijing, China. (Apr. 2009, p. 525)

19–21 **International Conference on Current Trends in Mathematics**, Allahabad, Uttar Pradesh, India. (May 2009, p. 659)

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.

An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. If there is any application deadline with respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to `notices@ams.org` or `mathcal@ams.org`.

In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence **eight months** prior to the scheduled date of the meeting.

The complete listing of the Mathematics Calendar will be published only in the September issue of the *Notices*. The March, June/July, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.

The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through the AMS website on the World Wide Web. To access the AMS website, use the URL: `http://www.ams.org/`.

21–22 **Mathematical Sciences for Advancement of Science and Technology (MSAST 2009)**, IMBIC Hall, Salt Lake City, Kolkata, (Calcutta), West Bengal, India. (Aug. 2009, p. 863)

28–31 **Seventh International Triennial Calcutta Symposium on Probability and Statistics**, Department of Statistics, University of Calcutta, 35 Ballygunge Circular Road, Kolkata- 700019, West Bengal, India. (Aug. 2009, p. 863)

January 2010

3–10 **Groups, Representations and Number Theory NZIMA/NZMRI Summer Workshop**, Hanmer Springs, New Zealand. (Oct. 2009, p. 1147)

4–July 2 **Stochastic Partial Differential Equations**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1025)

5–9 **New Directions in Financial Mathematics**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Aug. 2009, p. 863)

* 11–15 **WONAPDE 2010: Third Chilean Workshop on Numerical Analysis of Partial Differential Equations**, Universidad de Concepción, Concepción, Chile.
Aim: Of the workshop is to present recent developments in Numerical Analysis of Partial Differential Equations.
Topics: Finite Element Methods, Boundary Element Methods, Finite Volume Methods for Conservation Laws, Discontinuous Galerkin Methods, A Posteriori Error Estimation and Adaptivity, Computational Fluid Dynamics, Computational Structural Mechanics and Computational Methods in Electromagnetism.
Information: `http://www.ing-mat.udec.cl/wonapde2010/`.

* 11–16 **Rokhlin Memorial Conference**, St. Petersburg, Russia.
Information: `http://www.pdmi.ras.ru/EIMI/2010/tgd/`.

11–July 2 **Stochastic Processes in Communication Sciences**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1025)

13–16 **Joint Mathematics Meetings**, San Francisco, California. (Sept. 2009, p. 1026)

* 16 **Algorithm Engineering and Experiments (ALENEX10)**, Austin, Texas.
Description: The aim of the ALENEX workshop is to provide a forum for presentation of original research in the implementation and experimental evaluation of algorithms and data structures. We invite submissions that present significant case studies in experimental analysis (such studies may tighten, extend, or otherwise improve current theoretical results) or in the implementation, testing, and evaluation of algorithms for realistic environments and scenarios, including specific applied areas (for example, databases, networks, operations research, computational biology and physics, computational geometry, and the World Wide Web) that present unique challenges in their underlying algorithmic problems. We also invite submissions that address methodological issues and standards in the context of empirical research on algorithms and data structures. The scientific program will include time for discussion and debate of topics in this rapidly evolving research area.
Information: `http://www.siam.org/meetings/alenex10/`.

* 16 **Analytic Algorithmics and Combinatorics (ANALCO10)**, Austin, Texas.
Description: The aim of the ANALCO workshop is to provide a forum for the presentation of original research in the analysis of algorithms and associated combinatorial structures. We invite both papers that study properties of fundamental combinatorial structures that arise in practical computational applications (such as permutations, trees, strings, tries, and graphs) and papers that address the precise analysis of algorithms for processing such structures, including: average-case analysis; analysis of moments, extrema, and distributions; probabilistic analysis of randomized algorithms, and so on. Submissions that present significant new information about classic algorithms are welcome, as are new analyses of new algorithms that present unique analytic challenges. We also invite submissions that address tools and techniques for the analysis of algorithms and combinatorial structures, both mathematical and computational.
Information: `http://www.siam.org/meetings/analco10/`.

17–19 **ACM-SIAM Symposium on Discrete Algorithms (SODA10)**, Hyatt Regency Austin, Austin, Texas. (Apr. 2009, p. 525)

18–22 **Stochastic Models in Neuroscience**, CIRM, Marseille, France. (Oct. 2009, p. 1147)

* 21–22 **MSRI—Connections for Women: Homology Theories of Knots and Links**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Elisenda Grigsby (Columbia), Olga Plamenevskaya (SUNY/Stonybrook), and Katrin Wehrheim (MIT).
Information: `http://www.msri.org/calendar/workshops/WorkshopInfo/510/show_workshop`.

24–26 **International Conference on Analysis and Applications (ICAA10)**, Sultan Qaboos University, Muscat, Oman. (May 2009, p. 659)

25–29 **III Internacional Conference on the Anthropological Theory of the Didactic**, The Vilar Rural Hotel, Sant Hilari Sacalm, Catalonia, Spain. (Sept. 2009, p. 1026)

25–29 **Metamaterials: Applications, Analysis and Modeling**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Jun./Jul. 2009, p. 769)

* 25–29 **MSRI—Introductory Workshop: Homology Theories of Knots and Links**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Aaron Lauda (Columbia University), Robert Lipshitz (Columbia University), Dylan Thurston (Columbia University).
Information: `http://www.msri.org/calendar/workshops/WorkshopInfo1/show_workshop`.

25–30 **International School on Combinatorics "Pilar Pisón-Casares"**, Facultad de Matemáticas, Universidad de Sevilla, Spain. (Sept. 2009, p. 1026)

25–31 **KAWA—Komplex Analysis Winter School**, Institut Mathematiques de Toulouse, Toulouse, France. (Oct. 2009, p. 1147)

* 30 **MSRI—Bay Area Circle for Teachers Winter Workshop**, Mathematical Sciences Research Institute, Berkeley, California.
Organizer: Brandy Wiegers.
Information: `http://www.msri.org/calendar/workshops/WorkshopInfo/546/ show_workshop`.

February 2010

2–4 **3rd Global Conference on Power Control and Optimization PCO 2010**, Courtyard Surfers Paradise Resort, Gold Coast, Queensland, Australia. (Sept. 2009, p. 1026)

8–11 **The International Symposium on Stochastic Models in Reliability Engineering, Life Sciences, and Operations Management**, Sami Shamoon College of Engineering, Bialik/Basel Sts., Beer Sheva, 84100, Israel. (May 2009, p. 659)

8–12 **Mathematical Problems, Models and Methods in Biomedical Imaging**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Jun./Jul. 2009, p. 770)

8–12 **PIA 2010 — The Arithmetic of Fundamental Groups**, Mathematics Center Heidelberg (MATCH), Heidelberg, Germany. (Sept. 2009, p. 1026)

18–19 **February Fourier Talks 2010**, Norbert Wiener Center, University of Maryland, College Park, Maryland. (Jun./Jul. 2009, p. 770)

* 20–21 **Palmetto Number Theory Series XII**, Clemson University, Clemson, South Carolina.
Description: The Palmetto Number Theory Series (PANTS) is a series of number theory meetings held at colleges and universities in South Carolina, the Palmetto State. The core members of the PANTS consortium are: Clemson University, University of South Carolina.
Goal: Of the PANTS meetings is to provide an opportunity for number theorists in South Carolina, and more generally, in the Southeast, to hear about recent research in all areas of number theory, pure and applied.
Plenary speakers for PANTS XII: Joseph Silverman (Brown University) and James Cogdell (The Ohio State University).
Information: `http://www.math.clemson.edu/~jimlb/PANTS/PANTS20092010/pants12.html`.

22–26 **IMA Workshop: Analysis and Computation of Incompressible Fluid Flow**, Institute for Mathematics and its Applications (IMA), University of Minnesota, Minneapolis, Minnesota. (Apr. 2009, p. 525)

22–26 **Statistical and Learning-Theoretic Challenges in Data Privacy**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Jun./Jul. 2009, p. 770)

* 24–26 **SIAM Conference on Parallel Processing and Scientific Computing (PP10)**, Seattle, Washington.
Description: The Society for Industrial and Applied Mathematics is proud to present the Fourteenth Conference on Parallel Processing for Scientific Computing. This series of conferences has played a key role in promoting parallel scientific computing, algorithms for parallel systems, and parallel numerical algorithms. The conference is unique in its emphasis on the intersection between high performance scientific computing and scalable algorithms, architectures, and software. The conference provides a forum for communication among the applied mathematics, computer science, and computational science and engineering communities.
Information: `http://www.siam.org/meetings/pp10/index.php`.

26–28 **Texas Geometry and Topology Conference**, Texas Christian University Fort Worth, TX. (Nov. 2009, p. 1359)

22–March 5 **Arithmetic Geometry for Function Fields of Positive Characteristic**, Centre de Recerca Matemàtica, UAB, E-08193 Bellaterra, Barcelona,Spain. (Nov. 2009, p. 1359)

24–26 **SIAM Conference on Parallel Processing and Scientific Computing (PP10)**, Hyatt Regency Seattle, Seattle, Washington. (Apr. 2009, p. 525)

March 2010

* 1–May 28 **Doc-Course IMUS**, IMUS, University of Sevilla, Sevilla, Spain.
Description: This is a post-graduate intensive school on "Constructive approximation, Optimization and Mathematical Modeling", to be held in Sevilla, Spain, from March 1 to May 28, 2010, proposed as an activity of IMUS (the Institute of Mathematics of the University of Sevilla) and sponsored by the INGENIO-CONSOLIDER program through i-math. The program consists of five Research Units: constructive approximation and special functions; modeling, numerical analysis and scientific computing; control of systems governed by differential equations; mathematical programming and bifurcation analysis of dynamical systems. There will be five specific courses and a research seminar. The main objective is doing research work under the supervision and guidance of an assigned academic tutor. Eventually, the proposed research problems could become the starting point of research or a doctoral thesis.
Information: `http://institucional.us.es/doc-course-imus/`.

8–12 **AIM Workshop: Mock Modular Forms in Combinatorics and Arithmetic Geometry**, American Institute of Mathematics, Palo Alto, California. (Jun./Jul. 2009, p. 770)

8–12 **Workshop on Graphs and Arithmetic**, Centre de recherches mathématiques, Université de Montréal, Montréal, Canada. (Oct. 2009, p. 1148)

8–June 11 **Long Program: Model and Data Hierarchies for Simulating and Understanding Climate**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Apr. 2009, p. 526)

9–12 **Model and Data Hierarchies for Simulating and Understanding Climate: Tutorials**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles,CA (Nov. 2009, p. 1359)

15–19 **Localization techniques in equivariant cohomology**, American Institute of Mathematics, Palo Alto, California. (May 2009, p. 659)

* 15–19 **MSRI—Research workshop: Homology Theories of Knots and Links**, Mathematical Sciences Research Institute, Berkeley, California.
Organizer: Peter S. Ozsváth (Columbia University).
Information: `http://www.msri.org/calendar/workshops/WorkshopInfo/512/show_workshop`.

17–19 **IAENG International Conference on Operations Research 2010**, Regal Kowloon Hotel, Hong Kong, China. (Aug. 2009, p. 863)

17–26 **Second International School on Geometry and Physics. Geometric Langlands and Gauge Theory**, Centre de Recerca Matemàtica, UAB, E-08193 Bellaterra, Barcelona, Spain. (Nov. 2009, p. 1359)

18–20 **44th Spring Topology and Dynamics Conference 2010**, Mississippi State University, Starkville, Mississippi. (Sept. 2009, p. 1027)

* 18–20 **Workshop on Categorical Topology**, University of Azores, Ponta Delgada, Island of São Miguel, Azores, Portugal.
Description: The Workshop on Categorical Topology will be held at the Department of Mathematics, University of Azores, in honour of Eraldo Giuli, on the occasion of his 70th birthday.
Scientific Committee: Guillaume Brummer (Cape Town, South Africa), Maria Manuel Clementino (Coimbra, Portugal), Eva Colebunders (Brussels, Belgium), Walter Tholen (Toronto, Canada), Anna Tozzi (L'Aquila, Italy).
Information: `http://www.mat.uc.pt/~catop`.

18–21 **First International Conference on Mathematics and Statistics, AUS-ICMS '10**, American University of Sharjah (AUS), Sharjah, United Arab Emirates. (Jun./Jul. 2009, p. 770)

* 21–26 **MSRI—Symplectic and Contact Topology and Dynamics: Puzzles and Horizons**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Paul Biran (Tel Aviv University), John Etnyre (Georgia Institute of Technology), Helmut Hofer (Courant Institute), Dusa McDuff (Barnard College), Leonid Polterovich (Tel Aviv University).
Information: `http://www.msri.org/calendar/workshops/WorkshopInfo/475/show_workshop`.

22–26 **Equation Hierarchies for Climate Modeling**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Sept. 2009, p. 1028)

27–28 **AMS Southeastern Section Meeting**, University of Kentucky, Lexington, Kentucky. (Sept. 2009, p. 1028)

29–April 2 **AIM Workshop: Computational optimization for tensor decompositions**, American Institute of Mathematics, Palo Alto, California. (Jun./Jul. 2009, p. 770)

30–April 1 **Second International Conference on Engineering Systems Management and Its Applications ICESMA2010**, American University of Sharjah, Sharjah, United Arab Emirates. (Oct. 2009, p. 1148)

April 2010

10–11 **AMS Central Section Meeting**, Macalester College, St. Paul, Minnesota. (Sept. 2009, p. 1028)

* 12–14 **SIAM Conference on Imaging Science (IS10)**, Chicago, Illinois.

Description: Current developments in the technology of imaging have led to an explosive growth in the interdisciplinary field of imaging science. With the advent of new devices capable of seeing objects and structures not previously imagined, the reach of science and medicine has been extended in a multitude of different ways. The impact of this technology has been to generate new challenges associated with the problems of formation, acquisition, compression, transmission, and analysis of images. By their very nature, these challenges cut across the disciplines of physics, engineering, mathematics, biology, medicine, and statistics. While the primary purpose of this conference is to focus on mathematical issues, the biomedical aspects of imaging will also play an important role.
Information: http://www.siam.org/meetings/is10/.

12–16 **Climate Modeling: Numerical Hierarchies for Climate Modeling**, Introduction for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Aug. 2009, p. 863)

12–16 **Computer Security and Cryptography**, Centre de recherches mathématiques, Université de Montréal, Pavillon André-Aisenstadt, 2920, Chemin de la tour, room 5357, Montréal (Québec) H3T 1J4, CANADA. (Nov. 2009, p. 1359)

12–16 **IMA Workshop: Transport and Mixing in Complex and Turbulent Flows**, Institute for Mathematics and its Applications (IMA), University of Minnesota, Minneapolis, Minnesota. (Apr. 2009, p. 526)

14–17 **International Workshop on Multivariate Risks and Copulas**, Mohamed Khider University of Biskra, Algeria. (Aug. 2009, p. 863)

14–18 **International Conference on Fundamental Structures of Algebra in honor of the 70th birthday of Professor S¸erban Basarab**, Faculty of Mathematics and Computer Science, Ovidius University, Constanta, Romania. (Nov. 2009, p. 1359)

15–17 **35th Spring Lectures Series, 2010 "Minimal Surfaces and Mean Curvature Flow"**, University of Arkansas, Fayetteville, Arkansas. (Aug. 2009, p. 864)

17–18 **AMS Western Section Meeting**, University of New Mexico, Albuquerque, New Mexico. (Sept. 2009, p. 1028)

* 23–25 **Midwest Algebra, Geometry and their Interactions Conference MAGIC'10**, University of Notre Dame, Notre Dame, Indiana.
Description: The conference continues a well established tradition of commutative algebra and algebraic geometry meetings in the Midwest, among which we single out MAGC97 at the University of Notre Dame in 1997, the first Bluegrass Algebra Conference at the University of Kentucky in 2003, the Lipman-Fest at Purdue University in 2004, MAGIC'05 at the University of Notre Dame in 2005, the Purdue-UIC Workshop at Purdue University in 2006,the Hartshorne's 70th birthday conference at the University of Illinois at Chicago in 2008, the second Bluegrass Algebra Conference at the University of Kentucky in 2009, and the Libgober's 60th birthday conference at the University of Illinois at Chicago in 2009. Young Mathematicians are especially encouraged to attend. There is a limited amount of funding. A registration page and further information will be shortly available at the meeting website.
Organizers: Nero Budur (Notre Dame), Alberto Corso (Kentucky), Juan Migliore (Notre Dame), Claudia Polini (Notre Dame).
Information: http://www.ms.uky.edu/~pasi2009/MAGIC'10/.

* 28–May 1 **SIAM Conference on Data Mining (SDM10)**, Columbus, Ohio.
Description: Data mining is an important tool in science, engineering, industrial processes, healthcare, business, and medicine. The datasets in these fields are large, complex, and often noisy. Extracting knowledge requires the use of sophisticated, high-performance and principled analysis techniques and algorithms, based on sound theoretical and statistical foundations. These techniques in turn require powerful visualization technologies; implementations that must be carefully tuned for performance; software systems that are usable by scientists, engineers, and physicians as well as researchers; and infrastructures that support them.
Information: http://www.siam.org/meetings/sdm10/index.php.

May 2010

3–7 **Advanced Course on Foliations: Dynamics-Geometry-Topology**, Centre de Recerca Matemàtica (CRM), Bellaterra, Barcelona, Spain. (Sept. 2009, p. 1028)

3–7 **Simulation Hierarchies for Climate Modeling**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Sept. 2009, p. 1029)

* 10–14 **MSRI—Symplectic Geometry, Noncommutative Geometry and Physics**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Robert Dijkgraaf (Amsterdam), Toru Eguchi (Kyoto), Yakov Eliashberg (Stanford), Kenji Fukaya (Kyoto), Yoshiaki Maeda (Yokohama), Dusa McDuff (Stony Brook), Paul Seidel (Cambridge, MA), Alan Weinstein (Berkeley).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/548/show_workshop.

17–20 **25th Annual Shanks Lecture and Conference: Optimal Configurations on the Sphere and Other Manifolds**, Vanderbilt University, Nashville, Tennessee. (Sept. 2009, p. 1029)

17–21 **AIM Workshop: Supercharacters and combinatorial Hopf algebras**, American Institute of Mathematics, Palo Alto, CA. (Nov. 2009, p. 1359)

17–22 **Frobenius splitting in algebraic geometry, commutative algebra, and representation theory**, University of Michigan, Ann Arbor, MI. (Nov. 2009, p. 1359)

22–23 **AMS Eastern Section Meeting**, New Jersey Institute of Technology, Newark, New Jersey. (Sept. 2009, p. 1029)

23–26 **SIAM Conference on Mathematical Aspects of Materials Science (MS10)**, Doubletree Hotel Philadelphia, Philadelphia, Pennsylvania. (Aug. 2009, p. 864)

* 23–29 **Almost Complex Geometry and Foliations**, University of Lille-1, Villeneuve d'Ascq, France.
Invited speakers: Barraud J.-F. (University of Toulouse); Dinh T.-C. (University Paris-6); Duval J. (University Paris-11); Fornaess J.-E. (University of Michigan); Forstneric F. (University of Ljubljana); Gaussier H. (University of Grenoble); Henkin G. (University Paris-6); Kruglikov B. (University of Tromso); Loray F. (University of Rennes-1); McKay B. (University College Cork); McQuillan M. (University of Glasgow); Nemirovski S. (Steklov Institute); Rosay J.-P. (University of Wisconsin-Madison); Shevchishin V. (University of Hamburg); Sikorav J.-C. (ENS Lyon); Tumanov A. (University of Illinois); Viterbo C. (Ecole Polytechnique, Paris).
Information: If you wish to participate in the Conference please send a confirmation e-mail to: sukhov@math.univ-lille1.fr. Visit: http://math.univ-lille1.fr/~ivachkov/conference2/index_acgf.html.

24–28 **Applied Linear Algebra—in Honor of Hans Schneider**, Department of Mathematics, Faculty of Science, Novi Sad, Serbia. (Aug. 2009, p. 864)

24–28 **Data Hierarchies for Climate Modeling**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, California. (Sept. 2009, p. 1029)

25–28 **8th AIMS Conference on Dynamical Systems, Differential Equations and Applications**, Dresden, Germany. (Jun./Jul. 2009, p. 770)

25–29 **BALWOIS 2010: Fourth International Scientific Conference**, Ohrid, Republic of Macedonia. (Jun./Jul. 2009, p. 771)

* 25–June 2 **The 14th Conference on Modern Group Analysis**, Storforsen Hotel, Vidsel (near Lulea, Sweden).
Description: The aim of MOGRAN-14 is to stimulate discussions of new ideas, mathematical methods and applications of group analysis to problems of nonlinear differential equations, difference equations and integro-differential equations in mathematical modeling.
Information: http://www.sm.luth.se/~norbert/mogran-14.html/.

26–28 **International Conference on Computational Mathematics (ICCM) 2010 Waorkshop on Advances in Numerical Partial Differential Equations**, Holiday Inn Tobu Narita 320-1 TOKKO, CHIBA NARITA, CHIBA, 286-0106 JAPAN. (Nov. 2009, p. 1360)

26–28 **Workshop in ICCM 2010 on Advances in Numerical Partial Differential Equations (NPDEs)**, Holiday Inn Tobu Narita 320-1 TOKKO, CHIBA NARITA, CHIBA, 286-0106 JAPAN. (Nov. 2009, p. 1360)

27–28 **From A=B to Z=60, A Conference in Honor of Doron Zeilberger's 60th Birthday**, Rutgers University, Piscataway,New Jersey. (Nov. 2009, p. 1360)

* 31–June 4 **Emerging Topics in Dynamical Systems and Partial Differential Equations**, Barcelona, Spain.
Description: This conference is devoted to fostering the interaction between the SIAM Activity Groups in Analysis of Partial Differential Equations (PDEs) and in Dynamical Systems and Applications (DS) with the Catalan and Spanish mathematical societies and RSME, SCM, and SEMA and the European applied mathematical community in general. The conference will put special emphasis in stimulating new promising research lines in PDEs and DS, encouraging bridges between academia and industry. Modelling, theoretical analysis, numerical analysis and simulation are the methodological core of these fields. Minisymposia and contributions in all these strategies are welcome, particularly those who use them in a unifying way.
Information: http://www.siam.org/meetings/dspdes/index.php.

June 2010

1–5 **IMA Workshop: Natural Locomotion in Fluids and on Surfaces: Swimming, Flying, and Sliding**, Institute for Mathematics and its Applications (IMA), University of Minnesota, Minneapolis, Minnesota. (Apr. 2009, p. 526)

2–5 **Number Theory and Representation Theory—A conference in honor of Dick Gross' 60th birthday**, Science Center, Harvard University, Cambridge, Massachusetts. (Jun./Jul. 2009, p. 771)

7–11 **AIM Workshop: Low dimensional structures in dynamical systems with variable time lags**, American Institute of Mathematics, Palo Alto,CA. (Nov. 2009, p. 1360)

* 8–9 **2010 Clay Research Conference**, Institut Henri Poincaré, Paris, France.
Description: The Clay Mathematics Institute will hold its annual Research Conference June 8 and 9, 2010, at the Institut Henri Poincaré in Paris.
Information: www.claymath.org.

10–12 **Geometric and Probabilistic Aspects of General Relativity**, University of Strasbourg, Strasbourg, France. (Oct. 2009, p. 1148)

13–18 **48th International Symposium on Functional Equations**, Batz-sur-Mer, France. (Nov. 2009, p. 1360)

* 14–17 **SIAM Conference on Discrete Mathematics (DM10)**, Austin, Texas.
Description: Discrete mathematics is a dynamic field in both theory and applications. Researchers in discrete mathematics have established important connections with mainstream areas of pure and applied mathematics, and as a consequence, research techniques and problems are drawn from a wide range of different fields, including algebra, topology, geometry, probability, analysis and logic. The purpose of this conference is to highlight the major theoretical advances in the field, the development of new tools for discrete mathematics, and the most significant of the new applications of discrete mathematics to problems arising in industry and business. The conference also seeks to bring together participants from the many different environments where discrete mathematics is developed and applied.
Information: http://www.siam.org/meetings/dm10/.

16–23 **Budapest Semesters in Mathematics 25th Anniversary Reunion and Conference**, Budapest, Hungary. (Nov. 2009, p. 1360)

17–19 **Coimbra Meeting on 0-1 Matrix Theory and Related Topics**, Department of Mathematics, University of Coimbra, Portugal. (Jun./Jul. 2009, p. 771)

18–August 15 **Geometry, Topology, and Dynamics of Character Varieties**, Institute for Mathematical Sciences, National University of Singapore, Singapore. (Aug. 2009, p. 864)

21–26 **"Alexandru Myller" Mathematical Seminar Centennial Conference**, "Al. I. Cuza" University of Iaşi, Romania. (Jun./Jul. 2009, p. 771)

26–30 **2010 International Conference on Topology and its Applications**, Nafpaktos, Greece. (Jun./Jul. 2009, p. 771)

28–July 2 **The Józef Marcinkiewicz Centenary Conference (JM 100)**, A. Mickiewicz University, Faculty of Mathematics and Computer Science, Poznańoznań, Poland. (Aug. 2009, p. 864)

* 28–July 3 **Teichmüller Theory and its Interactions in Mathematics and Physics**, Centre de Recerca Matemàtica, Bellaterra, Spain.
Description: This ESF-EMS-ERCOM Conference aims to highlight some of the most important advances in Teichmüller theory. This theory will be considered both from the geometric point of view (Thurston's theory and its ramifications) and from the analytic point of view (the Ahlfors-Bers theory and its ramifications). The relation with physics will also be emphasized.
Topics: Weil-Petersson geometry and other metric structures; mapping class groups and their representation theory; rigidity theory; infinite-dimensional Teichmüller spaces; relations with dynamical systems; relations with number theory and probability theory; invariants of 3- and 4-manifolds; moduli spaces of flat connections; cluster algebras and quantization. In addition to specialized talks, there will be several survey talks given by leading experts in the field. Young researchers are particularly encouraged to participate, and graduate students in the field are also welcome.
Information: http://www.esf.org/conferences/10321.

* 30–July 2 **The 2010 International Conference of Applied and Engineering Mathematics**, Imperial College, London, U.K.
Information: http://www.iaeng.org/WCE2010/ICAEM2010.html.

July 2010

5–9 **11th International Conference on p-adic Functional Analysis**, Universite Blaise Pascal, Les Cezeaux, Aubiere, France. (Oct. 2009, p. 1148)

6–8 **Conference on Industrial and Applied Mathematics**, Bandung Institute of Technology, Bandung, Indonesia (Nov. 2009, p. 1360)

12–August 6 **Statistical Challenges Arising from Genome Resequencing**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1030)

12–15 **SIAM Conference on the Life Sciences (LS10)**, The David L. Lawrence Convention Center, Pittsburgh, Pennsylvania. (Apr. 2009, p. 526)

12–16 **2010 SIAM Annual Meeting (AN10)**, The David L. Lawrence Convention Center, Pittsburgh, Pennsylvania. (Apr. 2009, p. 526)

19–August 13 **Gyrokinetics in Laboratory and Astrophysical Plasmas**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1031)

* 25–31 **The XXI School of Algebra**, Brasília, Brazil.
Description: The XXI School of Algebra, the 21st edition of the biannual Brazilian meeting of Algebraists, will take place at the University of Brasília, from July 25 to 31, 2010.
Information: http://www.algebra.unb.br.

* 26–30 **Analysis on Graphs and its Applications**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom.
Description: This is a follow-up workshop for the 2007 Newton Institute's 6 months program with the same title. As the 2007 program, the workshop will concentrate on three major intertwined areas: Analysis on Discrete Graphs (Discrete Geometric Analysis), Analysis on Fractals, and Analysis on Quantum Graphs, as well as their applications to various areas of mathematics, sciences, and engineering.
Organizing Committee: B. M. Brown (Cardiff, UK), P. Exner (Czech Academy of Sciences), P. Kuchment (Texas A&M), and T. Sunada (Meiji University, Japan).
Information: http://www.newton.ac.uk/programmes/AGA/agaw06.html.

26–30 **6th International Conference on Lévy Processes: Theory and Applications**, Technical University of Dresden, Dresden, Germany. (Apr. 2009, p. 526)

26–August 6 **Winter School on Topics in Noncommutative Geometry**, Departamento de Matematica, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Argentina. (Apr. 2009, p. 526)

August 2010

* 2–6 **AIM Workshop: Differentiable structures on finite sets**, American Institute of Mathematics, Palo Alto, California.
Description: This workshop, sponsored by AIM and the NSF, will focus on recent activity in the study of Lipschitz structures on finite sets. In particular, the workshop will address the question of whether there is a reasonable notion of structures on a finite set involving higher degrees of smoothness.
Information: http://aimath.org/ARCC/workshops/smoothextension.html.

2–6 **Formal Power Series and Algebraic Combinatorics 2010**, San Francisco State University, San Francisco, CA, USA. (Nov. 2009, p. 1360)

* 2–13 **Third Hands-On Research in Complex Systems School**, University of Buea, Buea, Cameroon.
Description: This two-week-long school will provide an interactive experience with hands-on research involving tabletop experiments with real-time computer data acquisition and associated computational modeling. This school is mainly aimed at providing hands-on tools in Complexity Science to Africans.
Information: http://cdsagenda5.ictp.it/full_display.php?email=0&ida=a09184.

* 4–7 **JAIRO CHARRIS SEMINAR 2010: Algebraic Aspects of Darboux Transformations, Quantum Integrable Systems and Supersymmetric Quantum Mechanics**, Universidad Sergio Arboleda, Sede Rodrigo Noguera Laborde, Santa Marta, Colombia.
Description: JAIRO CHARRIS SEMINAR (JCHS) is an IMA annual meeting which is dedicated to Jairo Antonio Charris CastaÒeda (in memoriam). The thematic for JCHS 2010 is Algebraic Aspects of Darboux Transformations, Quantum Integrable Systems and Supersymmetric Quantum Mechanics (see http://ima.usergioarboleda.edu.co/SJCH/JCHS2010.htm).
Scientific committee: Peter Olver, Alexander Turbiner, Niki Kamran, Mikhail Plyushchay, Alberto Grünbaum and Federico Finkel
Deadline: To submit abstracts for talks (50 minutes) and posters is: May 3, 2010. Abstracts (in tex format) should be sent to Primitivo B. Acosta-Humanez (email: primi@ima.usergioarboleda.edu.co), David Blazquez-Sanz (email: david@ima.usergioarboleda.edu.co) or seminario.charris@gmail.com.
Financial assistance: Is available to assist graduate students with travel costs and/or local expenses (see http://ima.usergioarboleda.edu.co/SJCH/JCHS.htm).
Information: http://ima.usergioarboleda.edu.co/SJCH/JCHS2010.htm.

8–11 **Functional Analysis and Operator theory**, Indian Statistical Institute, Bangalore, India. (Aug. 2009, p. 864)

* 11–14 **The Fourth International Conference on Neural, Parallel & Scientific Computations**, ICNPSC-4, Department of Mathematics, Morehouse College, Atlanta, Georgia.
General Topics: Analytical and Computational methods on all aspects of Neural, Parallel, and Scientific Computing.
Deadlines: Submission of article (on or before): April 15, 2010.
Conference Coordinator: M. Sambandham, ICNPSC4, Department of Mathematics Morehouse College, Atlanta, GA 30314; phone: (404) 215-2614, fax: (404) 572-3645.
Information: http://www.dynamicpublishers.com/icnpsc4.htm.

11–December 22 **Mathematical and Statistical Approaches to Climate Modelling and Prediction**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1031)

12–15 **International Conference on Recent Trends in Graph Theory and Combinatorics, ICRTGC-2010**, Cochin, India. (Jun./Jul. 2009, p. 771)

* 13–17 **ICM Satellite Conference on Probability and Stochastic Processes**, Indian Statistical Institute, Bangalore, India.
Description: The International Congress of Mathematicians (ICM) meeting for the year 2010 is scheduled to be held in India at Hyderabad in August. As part of this, a satellite conference is being organized on Probability and Stochastic Processes. The satellite conference will be held in Bangalore, from August 13 to August 17, 2010, in the campus of the Indian Statistical Institute, Bangalore Centre.
Plenary Speakers: S. R. S. Varadhan, Alain-Sol Sznitman, Erwin Bolthausen, Andrea Montanari, Alison Etheridge, Louis Chen, Maury Bramson, Gabor Lugosi.
Topics for Invited Lectures: Are invited for presentation in the following areas: Stochastic Networks, Random Media, Concentration Inequalities, SLE, Random Matrices, SPDE, Rough Path Analysis, Polymer Models, Malliavin Calculus. In addition to the above there will be contributed sessions in all areas of Probability and Stochastic Processes. Speakers can submit titles and abstracts for the same along with the registration process.
Information: http://www.isibang.ac.in/~statmath/icmprobsat/.

14–17 **Satellite Conference of ICM 2010 on Mathematics in Science and Technology**, India Habitat Centre, Lodhi Road, New-Delhi, India. (Nov. 2009, p. 1360)

16–19 **SIAM Conference on Nonlinear Waves and Coherent Structures (NW10)**, Sheraton Society Hill Hotel, Philadelphia, Pennsylvania. (Nov. 2009, p. 1361)

16–December 17 **MSRI Future Scientific Programs: Inverse Problems and Applications**, Mathematical Sciences Research Institute, Berkeley, California. (Aug. 2009, p. 864)

16–December 17 **MSRI Future Scientific Programs: Random Matrix Theory, Interacting Particle Systems and Integrable Systems**, Mathematical Sciences Research Institute, Berkeley, California. (Aug. 2009, p. 864)

16–December 22 **Partial Differential Equations in Kinetic Theories**, Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom. (Sept. 2009, p. 1031)

* 19–20 **MSRI—Connections for Women: Inverse Problems and Applications**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Tanya Christiansen (University of Missouri, Columbia), Alison Malcolm (MIT), Shari Moskow (Drexel), Chrysoula Tsogka (University of Crete), Gunther Uhlmann (University of Washington, chair).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/513/show_workshop.

20–25 **Third International Conference on Boundary Value Problems, Integral Equations and Related Problems**, Beijing and Baoding, Hebei, China. (Aug. 2009, p. 864)

* 23–27 **MSRI—Introductory Workshop on Inverse Problems and Applications**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Margaret Cheney (RPI), Michael Vogelius (Rutgers), Gunther Uhlmann (chair) (University of Washington), Maciej Zworski (Univ. Calif., Berkeley).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/514/show_workshop.

23–27 **International Workshop on Geodesics**, Chern Institute of Mathematics, Nankai University, Tianjin, China. (Jun./Jul. 2009, p. 771)

31–September 4 **Permanents and modeling probability distributions**, American Institute of Mathematics, Palo Alto, California. (Jun./Jul. 2009, p. 771)

September 2010

7–10 **First International Workshop on Differential and Integral Equations with Applications in Biology and Medicine**, Aegean University, Karlovassi, Samos island, Greece. (Oct. 2009, p. 1148)

11–17 **NAFSA 9–The 9th International School on Nonlinear Analysis, Function Spaces and Applications**, Trest Castle, Czech Republic. (Oct. 2009, p. 1148)

* 13–17 **Random Matrix Theory and Its Applications I**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Jinho Baik (University of Michigan), Percy Deift (Courant Institute of Mathematical Sciences), Alexander Its (IUPUI), Pierre van Moerbeke (Universite Catholique de Louvain and Brandeis University), Craig A. Tracy (UC Davis).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/508/show_workshop.

13–December 17 **Modern Trends in Optimization and Its Application**, Institute for Pure and Applied Mathematics (IPAM), UCLA, Los Angeles, CA. (Nov. 2009, p. 1361)

* 20–21 **MSRI—Connections for Women: An Introduction to Random Matrices**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Estelle Basor (American Institute of Mathematics, Palo Alto), Alice Guionnet (ENS, Lyon), Irina Nenciu (UIC, Chicago).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/509/show_workshop.

* 20–24 **10th International Conference on Parametric Optimization and Related Topics (paraoptX)**, Karlsruhe Institute of Technology, Karlsruhe, Germany.
Description: Parametric optimization is a part of mathematical programming and has emerged as an exciting research area in theory, numerics and applications. It investigates the properties of solutions to optimization problems under data perturbations or uncertainty. Many relations to other disciplines of operations research, like stochastic programming, complementarity problems, mixed-integer problems, model-building, numerical methods, multi-objective optimization and optimal control, originate from these properties. paraoptX welcomes papers as well as proposals for special sessions on any area in parametric optimization or related topics. We hope that the conference will continue to help link researchers and practitioners from different areas of mathematical programming from around the world.
Information: http://www.ior.kit.edu/paraoptX.php.

20–October 1 **Berlin Mathematical School Summer School 2010 on Discretization in Geometry and Dynamics**, Technische Universität Berlin, Germany. (Oct. 2009, p. 1148)

October 2010

2–3 **AMS Eastern Section Meeting**, Syracuse University, Syracuse, New York. (Sept. 2009, p. 1032)

9–10 **AMS Western Section Meeting**, University of California, Los Angeles, California. (Sept. 2009, p. 1032)

26–29 **SIAM Conference on Applied Linear Algebra (LA09)**, Embassy Suites Hotel, Monterey Bay-Seaside, California. (Sept. 2009, p. 1032)

29–31 **AMS Central Section Meeting**, Notre Dame University, Notre Dame, Indiana. (Sept. 2009, p. 1032)

November 2010

6–7 **AMS Southeastern Section Meeting**, University of Richmond, Richmond, Virginia. (Sept. 2009, p. 1032)

* 8–12 **MSRI—Inverse Problems: Theory and Applications**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Liliana Borcea (Rice), Carlos Kenig (Univ. Chicago), Maarten de Hoop (Purdue), Peter Kuchment (Texas A&M), Lassi Paivarinta (Univ. Helsinki), Gunther Uhlmann (Univ. Washington)
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/540/show_workshop.

The following new announcements will not be repeated until the criteria in the next to the last paragraph at the bottom of the first page of this section are met.

December 2010

* 6–10 **MSRI—Random Matrix Theory and its Applications II**, Mathematical Sciences Research Institute, Berkeley, California.
Organizers: Alexei Borodin (Caltech), Percy Deift (Courant Institute of Mathematical Sciences), Alice Guionnet (ENS, Lyon), Kenneth McLaughlin (University of Arizona), and Craig A. Tracy (UC Davis).
Information: http://www.msri.org/calendar/workshops/WorkshopInfo/517/show_workshop.

Classified Advertisements

Positions available, items for sale, services available, and more

ALABAMA

UNIVERSITY OF ALABAMA AT BIRMINGHAM
Department of Mathematics

The Department of Mathematics at the University of Alabama at Birmingham (UAB) is soliciting applications for a tenure-track assistant professor position beginning August 15, 2010. Applicants whose research is compatible with the department's strengths in differential equations, differential geometry, dynamical systems, mathematical physics, and topology, including computational aspects of these areas, are encouraged to apply. Those with expertise in geometric or harmonic analysis, inverse problems, or probability are of particular interest in this search. For additional information about the department please visit: http://www.math.uab.edu.

Applicants should have demonstrated the potential to excel in one of the research areas mentioned and in teaching at all levels of instruction. They should also be committed to professional service including departmental service. Postdoc experience is preferred.

Applications should include a curriculum vita with a publication list, a statement of future research plans, a statement on teaching experience and philosophy, and minimally three letters of reference with at least one letter addressing teaching experience and ability. We prefer applications and all other materials be submitted electronically at: http://www.mathjobs.org, although applicants may submit an application including an AMS cover sheet to:

Math Faculty Search
Department of Mathematics
The University of Alabama at Birmingham
Birmingham, AL 35294-1170

The department and university are committed to building a culturally diverse workforce and strongly encourage applications from women and individuals from underrepresented groups. UAB has an active NSF-supported ADVANCE program and a Spouse Relocation Program to assist in the needs of dual career couples. UAB is an Affirmative Action/Equal Employment Opportunity Employer.

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CALIFORNIA

CALIFORNIA STATE UNIVERSITY
Department of Mathematics

The Department of Mathematics at California State University, San Bernardino invites applications for a tenure-track faculty position at the level of Assistant Professor to begin September 2010. Applicants are required to hold a Ph.D. in mathematics or mathematics education. Special consideration will be given to candidates with a demonstrated interest in K-12 mathematics education. For further details on the position and the application procedure, please visit: http://www.math.csusb.edu/position-2010/. Applications received after January 9, 2010, cannot be guaranteed full consideration.

000103

UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Mathematics
FRG Postdoctoral Positions

We invite applications for a special (non-tenure-track) position, effective July 1, 2010. Applicants should have a recent Ph.D., or the equivalent, in algebra or logic or number theory. Preference will be given to applicants in the area of algebraic dynamics. This position is supported in part by the NSF through its Focused Research Group program. NSF requires that applicants be citizens, nationals or permanent residents of the United States, its territories and possessions. The term of this appointment is three years. It has no teaching requirement in the first year, and one course per semester in years 2 and 3. Some additional funds for research travel and other research expenses will be available. The applications must be submitted online via: http://www.|mathjobs.org| and should include the AMS Cover Sheet and supporting documentation (cover letter, resume, publication list, research statement, and possibly a teaching statement). Applicants should ask three people to submit letters of evaluation via: http://mathjobs.org. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at: http://math.

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

The 2009 rate is $110 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional $10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified ads.

Upcoming deadlines for classified advertising are as follows: January 2010 issue–October 28, 2009; February 2010 issue–November 25, 2009; March 2010 issue–December 28, 2009; April 2010 issue–January 28, 2010; May 2010 issue–February 26, 2010; June/july 2010 issue–April 28, 2010.

U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

Situations wanted advertisements from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

Submission: Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send email to classads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 20904. Advertisers will be billed upon publication.

berkeley.edu/employment_academic.html. Refer potential reviewers to the UC Berkeley statement of confidentiality found at: http://apo.chance.|berkeley.edu/evalltr.html|. Applications must be submitted by January 12, 2010. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer. The Department seeks candidates whose research, teaching, or service has prepared them to contribute to our commitment to diversity and inclusion in higher education.

000100

UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Mathematics
Charles B. Morrey Jr. Assistant Professorships

We invite applications for these special (non-tenure-track) positions effective July 1, 2010. The terms of these appointments may range from two to three years. Applicants should have a recent Ph.D., or the equivalent, in an area of pure or applied mathematics. The applications must be submitted online via: http://www.mathjobs.org and should include the AMS Cover Sheet and supporting documentation (cover letter, resume, publication list, research statement, and possibly a teaching statement). Applicants should ask three people to submit letters of evaluations via: http://mathjobs.org. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at: http://math.berkeley.edu/employment_academic.html. Refer potential reviewers to the UC Berkeley statement of confidentiality found at: http://apo.chance.berkeley.edu/evalltr.html. Applications must be submitted by January 12, 2010. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer. The Department seeks candidates whose research, teaching, or service has prepared them to contribute to our commitment to diversity and inclusion in higher education.

000101

UNIVERSITY OF CALIFORNIA, BERKELEY
Department of Mathematics
RTG Postdoctoral Positions

We invite applications for two special (non-tenure-track) positions, effective July 1, 2010. Applicants should have a recent Ph.D., or the equivalent, in pure mathematics. Preference will be given to applicants in the areas of topology, geometry, and operator algebras. These positions are supported in part by the NSF through its Research Training Group program. NSF requires that applicants be citizens, nationals or permanent residents of the United States, its territories and possessions. The term of these appointments is two years, with a third year likely, contingent on funding. They have a reduced teaching load of one course per semester. These appointments carry an additional stipend of $10,000 in each of the first two years for summer research, and up to $2,000 per year for travel and other research-related expenses. The applications must be submitted online via: http://www.mathjobs.org and should include the AMS Cover Sheet and supporting documentation (cover letter, resume, publication list, research statement, and possibly a teaching statement). Applicants should ask three people to submit letters of evaluations via: http://mathjobs.org. All letters of evaluation are subject to Berkeley campus policies on confidentiality of letters of evaluation, a summary of which can be found at: http://math.berkeley.edu/employment_academic.html. Refer potential reviewers to the UC Berkeley statement of confidentiality found at: http://apo.chance.berkeley.edu/evalltr.html. Applications must be submitted by January 12, 2010. Applications submitted after the deadline will not be considered. The University of California is an Equal Opportunity, Affirmative Action Employer. The Department seeks candidates whose research, teaching, or service has prepared them to contribute to our commitment to diversity and inclusion in higher education.

000102

UNIVERSITY OF CALIFORNIA, LOS ANGELES
Department of Mathematics
Faculty Positions Academic Year 2010–2011

The Department of Mathematics, subject to administrative approval, will consider tenure-track/tenure appointments in a wide range of possible fields with emphasis on applied mathematics. We also plan to make temporary and visiting appointments in the following categories 2–5. Depending on the level, candidates must give evidence of potential or demonstrated distinction in scholarship and teaching.

(1) Tenure-Track/Tenured Faculty Positions. Salary is commensurate with level of experience.

(2) E. R. Hedrick Assistant Professorships. Salary is $61,200 and appointments are for three years. The teaching load is four quarter courses per year.

(3) Computational and Applied Mathematics (CAM) Assistant Professorships. Salary is $61,200, and appointments are for three years. The teaching load is normally reduced to two or three quarter courses per year by research funding as available.

(4) Program in Computing (PIC) Assistant Adjunct Professorships. Salary is $65,500. Applicants for these positions must show very strong promise in teaching and research in an area related to computing. The teaching load is four one-quarter programming courses each year and one seminar every two years. Initial appointments are for one year and possibly longer, up to a maximum service of four years.

(5) Assistant Adjunct Professorships and Research Postdocs. Normally appointments are for one year, with the possibility of renewal. Strong research and teaching background required. The salary range is $53,200–$59,500. The teaching load for adjuncts is six quarter courses per year.

If you wish to be considered for any of these positions you must submit an application and supporting documentation electronically via http://www.mathjobs.org.

For fullest consideration, all application materials should be submitted on or before December 9, 2009. Ph.D. is required for all positions.

UCLA and the Department of Mathematics have a strong commitment to the achievement of excellence in teaching and research and diversity among its faculty and staff. The University of California is an Equal Opportunity/Affirmative Action Employer. The University of California asks that applicants complete the Equal Opportunity Employer survey for Letters and Science at the following URL: http://cis.ucla.edu/facultysurvey. Under Federal law, the University of California may employ only individuals who are legally authorized to work in the United States as established by providing documents specified in the Immigration Reform and Control Act of 1986.

000038

CONNECTICUT

YALE UNIVERSITY
J. Willard Gibbs Assistant Professorships in Mathematics 2010-11

The Gibbs Assistant Professorships are intended primarily for men and women who received the Ph.D. degree and show definite promise in research in pure or applied mathematics. Appointments are for three years. The salary will be at least $69,000. Each recipient of a Gibbs Assistant Professorship will be given a moving allowance based on the distance to be moved.

The teaching load for Gibbs Assistant Professors will be kept light, so as to allow ample time for research. This will consist of three one-semester courses per year. Part of the duties may consist of a one-semester course at the graduate level in the general area of the instructor's research. Yale is an Affirmative Action/Equal Opportunity Employer. Qualified women and members of minority groups are encouraged to apply. Submit applications and supporting material through

mathjobs.org by January 1, 2010. Submit inquiries to gibbs.committee@yale.edu. Offers expected to be made in early February 2010.

000069

YALE UNIVERSITY
Assistant Professors Tenure-Track

The Mathematics Department at Yale University intends to make one or more tenure-track assistant professor appointments beginning July 1, 2010. Positions will be open to all fields of mathematics. Evidence of strong promise of leadership in research and excellence in teaching required. Yale is an Affirmative Action/Equal Opportunity Employer. Qualified women and members of minority groups are encouraged to apply.

Applications should be submitted through http:// www.mathjobs.org, inquiries should be submitted to tenuretrack.math@yale.edu. Review of applications will begin on December 15, 2009.

000070

FLORIDA

FLORIDA INTERNATIONAL UNIVERSITY
Department of Mathematics and Statistics

The Department of Mathematics and Statistics at Florida International University invites applications for one tenure-track position. Although the search is primarily at assistant professor level, outstanding candidates would be considered for a more senior position. The field for the position is open. Duties will include mathematical research, teaching, and service. Qualifications include Ph.D. in mathematics and a promising record in research and potential for external funding. FIU is a public university with over 37,000 students, http://www.fiu.edu. To apply, send an application letter, vita, research plan, and at least three letters of reference to: Recruitment Committee (Math), Department of Mathematics and Statistics, Florida International University, Miami, FL 33199. A member of the State University System, FIU is an EE/EO/EA Employer and Institution. For more information, visit the department's website at: http://w3.fiu.edu/~math. Review of applications will start on November 30, 2009, and will continue until the position is filled.

000099

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY
School of Mathematics

The School of Mathematics at Georgia Tech is continuing an ambitious faculty recruitment program begun several years ago. Building on past successes, this recruiting effort is intended to make rapid advances in the scope and quality of our research and graduate education programs. Candidates will be considered at all ranks, with priority given to those candidates who: (1) show the potential to carry out research of exceptional quality at Georgia Tech; (2) complement existing strengths in the School of Mathematics; (3) reinforce bridges to programs in engineering and the physical, computing, and life sciences; (4) have strong potential for external funding; and (5) have a demonstrated commitment to high quality teaching at both the undergraduate and graduate levels. Consistent with these priorities, candidates will be considered in all areas of pure and applied mathematics and statistics. Applications should consist of a curriculum vitae, including a list of publications, summary of future research plans, and at least three letters of reference. Applications should also include evidence of teaching interest and abilities. Candidates for associate and full professor positions should submit a statement outlining their vision for service as a senior faculty member at Georgia Tech. Applications should be submitted directly to http://www.mathjobs.org. If a candidate cannot submit an application electronically, then it may be sent to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, GA, 30332-0160, USA. Review of applications will begin in October 2009, and the roster of candidates being considered will be updated on a continual basis. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

000074

ILLINOIS

NORTHWESTERN UNIVERSITY
Department of Mathematics

Applications are invited for job-ad-2009-2 tenured or tenure-track positions starting September 2010. Priority will be given to exceptionally promising research mathematicians. We invite applications from qualified mathematicians in all fields.

Applications should be made electronically at http://www.mathjobs.org and should include (1) the American Mathematical Society Cover Sheet for Academic Employment, (2) a curriculum vitae, (3) a research statement, (4) a teaching statement, and (5) three letters of recommendation, one of which discusses the candidate's teaching qualifications. Inquiries may be sent to: hiring@math.northwestern.edu.

Applications received by November 1st will be given priority. AA/EOE. Women and minority candidates are especially encouraged to apply.

000062

INDIANA

INDIANA UNIVERSITY BLOOMINGTON
Department of Mathematics
Zorn Research Postdoctoral Fellowships

The Department of Mathematics seeks applications for two Zorn Research Postdoctoral Fellowships beginning in the Fall of 2010. These are three-year, non-tenure-track positions with reduced teaching loads. Outstanding candidates with a recent Ph.D. in any area of pure or applied mathematics are encouraged to apply. Zorn fellows are paired with mentors with whom they have compatible research interests. The Department maintains strong research groups in all of the principal fields of mathematics. Bloomington is located in the forested hills of southern Indiana and offers a rich variety of musical and cultural attractions.

Applicants should submit an AMS cover sheet, a curriculum vitae, a research statement, and a teaching statement using the online service provided by the AMS at http://www.mathjobs.org. If unable to do so, send application materials to the address below. Applicants should arrange for four letters of recommendation, including one evaluating teaching experience. Please ask reference writers to submit their letters electronically through http://www.mathjobs.org. If they are unable to do so, they may also send their letters to the following address: Zorn Postdoctoral Fellowships Search Committee, Department of Mathematics, Indiana University, 831 East 3rd Street, Rawles Hall, Bloomington, IN 47405-7106. Applications should be received by December 15, 2009. Indiana University is an Equal Opportunity/Affirmative Action Employer.

000108

KANSAS

UNIVERSITY OF KANSAS
Department of Mathematics

Applications are invited for a tenure-track assistant professor position in numerical analysis and/or numerical PDEs expected to begin as early as August 18, 2010. Ph.D. or ABD in math or a related field is expected by the start date of the appointment; commitment to excellence in teaching in mathematics; and commitment to excellence in research. Apply online at:

http://jobs.ku.edu, search for position 00003611. Review of applications will begin on November 15, 2009, and will continue until the position is filled. EO/AA Employer.

000091

LOUISIANA

LOUISIANA STATE UNIVERSITY
Department of Mathematics
Anticipated Assistant/Associate Professor
(One or more positions)

Applications are invited for anticipated Assistant or Associate Professor positions in the Department of Mathematics at Louisiana State University. The department will continue to expand its professorial faculty over the next several years. Applications are invited for positions in the areas of geometric analysis, geometry and topology, algebra, analysis, applied mathematics, and combinatorics. Required Qualifications: Ph.D. or an equivalent degree in mathematics or related field. Additional Qualifications Desired: Research excellence as well as commitment to graduate and undergraduate education. Responsibilities: performs research in mathematics of a nature and quality leading eventually to publication of papers in research journals and/or advanced level books; maintains expertise; teaches mathematics at all University levels, in a manner that is keeping with Departmental policy; participates in other educational and professional tasks of the Department and the University. Salary and rank will be commensurate with qualifications and experience. Minorities and women are strongly encouraged to apply. An offer of employment is contingent on a satisfactory pre-employment background check. Application deadline is January 4, 2010, or until a candidate is selected. Apply online at: http://www.lsusystemcareers.lsu.edu. Position #005892 and #008146. LSU System is an Equal Opportunity/Equal Access Employer.

000104

MAINE

COLBY COLLEGE
Department of Mathematics

The Department of Mathematics at Colby College invites applications for two tenure-track positions in mathematics at the assistant professor level, beginning September 1, 2010. For one position, we seek someone with an active research program in number theory or algebra; for the other, someone with an active research program in topology or geometry. Candidates should have a Ph.D. in mathematics. Evidence of exceptional teaching ability is required. The teaching load is five courses annually.

Send letter of application, curriculum vitae, statements on teaching and research, and three letters of recommendation to:

Mathematics Search Chair
Department of Mathematics
Colby College
5830 Mayflower Hill
Waterville, ME 04901

Please indicate in your cover letter the position for which you are applying. We cannot accept applications in electronic form. Review of applications will begin on November 15, 2009, and will continue until the position is filled.

Colby is a highly selective liberal arts college located in central Maine. The College is a three-hour drive from Boston and has easy access to lakes, skiing, the ocean, and other recreational and cultural activities. For more information about the position and the department, visit our website at: http://www.colby.edu/math.

Colby is an Equal Opportunity/Affirmative Action Employer, committed to excellence through diversity, and strongly encourages applications and nominations of persons of color, women, and members of other underrepresented groups. For more information about the College, please visit the Colby website at: http://www.colby.edu.

000090

MARYLAND

JOHNS HOPKINS UNIVERSITY
Department of Mathematics

The Department of Mathematics invites applications for one or more positions at the Associate Professor or Full Professor level beginning fall 2010 or later. Candidates in all areas of pure mathematics are encouraged to apply.

To submit your applications go to: http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site.

Submit the AMS cover sheet, a curriculum vitae, a list of publications, and the names and addresses of three references. Applicants should indicate whether they are applying for an associate professor or a full professor position. The department will assume responsibility to solicit letters of evaluation and will provide evaluators with a copy of the summary of policies on confidentiality of letters of evaluation. If you do not have computer access, you may mail your application to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. Write to: http://www.mathjobs.org/jobs/JHU/cpoole??jhu.edu; email: cpoole@jhu.edu for questions concerning these positions.

Applications received by December 1, 2009 will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

Deadline for Applications: No deadline given.

For more information about the position or institution/company: http://www.mathematics.jhu.edu/new/jobs.htm.

000060

JOHNS HOPKINS UNIVERSITY
Non-Tenure-Track J. J. Sylvester Assistant Professor

Subject to availability of resources and administrative approval, the Department of Mathematics solicits applications for non-tenure-track assistant professor positions beginning fall 2010.

The J. J. Sylvester Assistant Professorship is a three-year position offered to recent Ph.D.'s with outstanding research potential. Candidates in all areas of pure mathematics, including analysis, mathematical physics, geometric analysis, complex and algebraic geometry, number theory, and topology are encouraged to apply. The teaching load is three courses per academic year.

To submit your applications go to http://www.mathjobs.org/jobs/jhu. Applicants are strongly advised to submit their other materials electronically at this site.

If you do not have computer access, you may mail your application to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218. Application should include a vita, at least four letters of recommendation of which one specifically comments on teaching, and a description of current and planned research. Write to cpoole@jhu.edu for questions concerning these positions. Applications received by December 1, 2009, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal Opportunity Employer. Minorities and women candidates are encouraged to apply.

Deadline for Applications: No deadline given.

For more information about the position or institution/company: http://www.mathematics.jhu.edu/new/jobs.htm

000061

MASSACHUSETTS

BOSTON COLLEGE
Department of Mathematics
Tenure-Track Positions

The Department of Mathematics at Boston College invites applications for two tenure-track positions at the level of assistant professor beginning in September 2010, one in number theory or related areas, including algebraic geometry and representation theory; and the second in either geometry/topology or number theory or related areas. In exceptional cases, a higher-level appointment may be considered. The teaching load for each position is three semester courses per year.

Requirements include a Ph.D. or equivalent in mathematics awarded in 2008 or earlier, a record of strong research combined with outstanding research potential, and demonstrated excellence in teaching mathematics.

A completed application should contain a cover letter, a description of research plans, a statement of teaching philosophy, curriculum vitae, and at least four letters of recommendation. One or more of the letters of recommendation should directly comment on the candidate's teaching credentials.

Applications completed no later than December 1, 2009, will be assured our fullest consideration. Please submit all application materials through http://mathjobs.org.

Boston College will start a Ph.D. program in mathematics beginning fall 2010. Applicants may learn more about the department, its faculty, and its programs at http://www.bc.edu/math. Electronic inquiries concerning these positions may be directed to math-search@bc.edu. Boston College is an Affirmative Action/Equal Opportunity Employer. Applications from women, minorities, and individuals with disabilities are encouraged.

000049

BOSTON COLLEGE
Department of Mathematics
Postdoctoral Position

The Department of Mathematics at Boston College invites applications for a postdoctoral position beginning September 2010. This position is intended for a new or recent Ph.D. with outstanding potential in research and excellent teaching. This is a 3-year Visiting Assistant Professor position, and carries a 2-1 annual teaching load. Research interests should lie within geometry and topology or related areas. Candidates should expect to receive their Ph.D. prior to the start of the position and have received the Ph.D. no earlier than spring 2009.

Applications must include a cover letter, description of research plans, curriculum vitae, and four letters of recommendation, with one addressing the candidate's teaching qualifications. Applications received no later than January 1, 2010, will be assured our fullest consideration. Please submit all application materials through http://mathjobs.org.

Boston College will start a Ph.D. program in mathematics beginning fall 2010. Applicants may learn more about the department, its faculty and its programs at http://www.bc.edu/math. Electronic inquiries concerning this position may be directed to postdoc-search@bc.edu. Boston College is an Affirmative Action/Equal Opportunity Employer. Applications from women, minorities, and individuals with disabilities are encouraged.

000050

BOSTON UNIVERSITY
Department of Mathematics and Statistics
Position in Algebraic Geometry and/or Automorphic Representation Theory

The Department of Mathematics and Statistics at Boston University invites applications at the tenure-track Assistant Professor level in Algebraic Geometry and/or Automorphic Representation Theory. The position will begin in September 2010, pending budgetary approval. Strong commitment to research and teaching is essential. Please submit the AMS Application Cover Sheet, CV, research statement, and at least three letters of recommendation, one of which addresses teaching, to: http://mathjobs.org. Alternatively, send all material to AGART Search, Department of Mathematics and Statistics, Boston University, 111 Cummington St., Boston, MA 02215. Application Deadline January 2, 2010. Boston University is an Affirmative Action/Equal Opportunity Employer.

000097

BOSTON UNIVERSITY
Department of Mathematics and Statistics
Position in Stochastic Processes

The Department of Mathematics and Statistics at Boston University invites applications at the tenure-track Assistant Professor level in Stochastic Processes. Areas include all applications, including those in statistics, bioinformatics, physics, and mathematical finance. The position will begin in September 2010, pending budgetary approval. Strong commitment to research and teaching is essential, preferably with interest in interdisciplinary research. Please submit CV, research statement, and at least three letters of recommendation, to: Stochastic Processes Search Committee, Department of Mathematics and Statistics, Boston University, 111 Cummington St., Boston, MA 02215. Application Deadline January 2, 2010. Boston University is an Affirmative Action/Equal Opportunity Employer.

000098

TUFTS UNIVERSITY
Department of Mathematics

Applications are invited for a term-limited Assistant Professorship to begin September 1, 2010. The initial contract will be for one year, renewable for an additional two years. A Ph.D. in Mathematics or a closely related field, evidence of strong teaching, and promise of strong research are required, with a research focus in computational methods for nonlinear inverse problems. The teaching load will be two courses per semester.

The successful candidate will be expected to join current interdisciplinary research efforts focused on developing efficient and accurate mathematical and computational tools for solving large-scale nonlinear inverse problems, such as those that arise in biomedical and geophysical applications. Candidates with a background in computational PDEs are especially encouraged to apply, but candidates with experience in other areas related to nonlinear inverse problems will also be considered.

Applications should include a cover letter, curriculum vitae, research statement and teaching statement, which should all be submitted through http://www.mathjobs.org. In addition, applicants should arrange for three letters of recommendation to be submitted through http://www.mathjobs.org. If a recommender cannot submit online, we will accept signed PDF attachments sent to: Scott.MacLachlan@tufts.edu, or paper letters mailed to CIP Search Committee Chair, Department of Mathematics, Bromfield-Pearson Hall, Tufts University, Medford, MA 02155. Review of applications will begin on Dec. 15, 2009, and will continue until the position is filled. Tufts University is an Affirmative Action/Equal Opportunity Employer. We are committed to increasing the diversity of our faculty. Members of underrepresented groups are strongly encouraged to apply.

000096

TUFTS UNIVERSITY
Department of Mathematics

Applications are invited for a term-limited Assistant Professorship to begin September 1, 2010. The initial contract will be for one year, renewable for an additional two years. A Ph.D. in Mathematics, evidence of strong teaching, and promise of strong research are required, with a research focus on Geometric Group Theory and/or Low-Dimensional Topology.

The successful candidate will be expected to teach two courses per semester, and to contribute to research within the department in the fields of Geometric

Group Theory and Low-Dimensional Topology, and to participate in the weekly Geometric Group Theory and Topology seminar. Areas of research in the department include CAT(0) groups, Mapping Class Groups, and Hyperbolic 3-Manifolds.

Applications should include a cover letter, curriculum vitae, research statement and teaching statement, which should all be submitted through http://www.mathjobs.org. If a recommender cannot submit online, we will accept signed PDF attachments sent to: znitecki@tufts.edu, or paper letters mailed to GGTT Search Committee Chair, Department of Mathematics, Bromfield-Pearson Hall, Tufts University, Medford, MA 02155. Review of applications will begin on Dec. 15, 2009, and will continue until the position is filled. Tufts University is an Affirmative Action/Equal Opportunity Employer. We are committed to increasing the diversity of our faculty. Members of underrepresented groups are strongly encouraged to apply.

000107

NEW HAMPSHIRE

DARTMOUTH COLLEGE
John Wesley Young Research Instructorship

The John Wesley Young Instructorship is a postdoctoral, two- to three-year appointment intended for promising Ph.D. graduates with strong interests in both research and teaching and whose research interests overlap a department member's. Current research areas include applied mathematics, combinatorics, geometry, logic, non-commutative geometry, number theory, operator algebras, probability, set theory, and topology. Instructors teach four ten-week courses distributed over three terms, though one of these terms in residence may be free of teaching. The assignments normally include introductory, advanced undergraduate, and graduate courses. Instructors usually teach at least one course in their own specialty. This appointment is for 26 months with a monthly salary of $4,833 and a possible 12-month renewal. Salary includes two-month research stipend for instructors in residence during two of the three summer months. To be eligible for a 2010–2013 instructorship, candidate must be able to complete all requirements for the Ph.D. degree before September 2010. Applications may be obtained at http://www.math.dartmouth.edu/recruiting/ or http://www.mathjobs.org—Position ID:JWY # 1717. General inquiries can be directed to Annette Luce, Department of Mathematics, Dartmouth College, 6188 Kemeny Hall, Hanover, New Hampshire 03755-3551. At least one referee should comment on applicant's teaching ability; at least two referees should write about applicant's research ability. Applications received by January 5, 2010, receive first consideration; applications will be accepted until position is filled. Dartmouth College is committed to diversity and strongly encourages applications from women and minorities.

000058

NEW JERSEY

RUTGERS UNIVERSITY-NEW BRUNSWICK
Mathematics Department

The Mathematics Department of Rutgers University-New Brunswick invites applications for the following positions which may be available September 2010.

TENURED POSITION: Subject to availability of funding, the Department expects one opening at the level of Associate Professor or Professor. Candidates must have the Ph.D. and show a sustained record of outstanding research accomplishments in pure or applied mathematics, and concern for teaching. The Department has hiring priorities in Differential Geometry and Mathematics of Materials Science, but exceptional candidates in any field of pure or applied mathematics will be considered. The normal annual teaching load for research-active faculty is 2-1, that is, two courses for one semester, plus one course for the other semester. Review of applications begins immediately.

TENURE-TRACK ASSISTANT PROFESSORSHIP: Subject to availability of funding, the Department expects one opening at the level of Tenure-Track Assistant Professor. Candidates must have the Ph.D. and show a strong record of research accomplishments in pure or applied mathematics, and concern for teaching. The Department has hiring priorities in Differential Geometry and Mathematics of Materials Science, but outstanding candidates in any field of pure or applied mathematics will be considered. The normal annual teaching load for research-active faculty is 2-1. Review of applications begins immediately.

HILL ASSISTANT PROFESSORSHIPS and NON-TENURE-TRACK ASSISTANT PROFESSORSHIPS: These are both three-year nonrenewable positions. Subject to availability of funding, the Department may have one or more open positions of these types. The Hill Assistant Professorship carries a reduced teaching load of 2-1 for research; candidates for it should have received the Ph.D., show outstanding promise of research ability in pure or applied mathematics, and have concern for teaching. The Non-Tenure-Track Assistant Professorship carries a teaching load of 2-2; candidates for it should have received the Ph.D., show evidence of superior teaching accomplishments and promise of research ability. Review of applications begins January 1, 2010.

Applicants for the above position(s) should submit a curriculum vitae (including a publication list) and arrange for four letters of reference to be submitted, one of which evaluates teaching.

Applicants should first go to the website: http://www.mathjobs.org/jobs and fill out the AMS Cover Sheet electronically. It is essential to fill out the cover sheet completely, including naming the positions being applied for (TP, TTAP, HILL, NTTAP, respectively) giving the AMS Subject Classification number(s) of area(s) of specialization, and answering the question about how materials are being submitted. The strongly preferred way to submit the CV, references, and any other application materials is online at: http://www.mathjobs.org/jobs. If necessary, however, application materials may instead be mailed to: Search Committee, Dept. of Math-Hill Center, Rutgers University, 110 Frelinghuysen Road, Piscataway, NJ 08854-8019.

Review of applications will begin on the dates indicated above, and will continue until openings are filled. Updates on these positions will appear on the Rutgers Mathematics Department webpage at: http://www.math.rutgers.edu.

Rutgers is an Affirmative Action/Equal Opportunity Employer and encourages applications from women and minority-group members.

000106

OREGON

UNIVERSITY OF OREGON
Department of Mathematics

1. Paul Olum Visiting Assistant Professor (non-tenure related).

This is a full-time two-year position and is not tenurerelated. Minimum qualifications for this postdoctoral position are a Ph.D. in mathematics, statistics, or closely related field, strong evidence of research potential in an area of active interest in the department, and evidence of teaching ability.

2. Visiting Assistant Professor (non-tenure related).

Up to two Visiting Assistant Professorships, depending on funding. If funded, these will be up to three-year full-time positions. Minimum qualifications are a Ph.D. in mathematics, strong evidence of research potential in an area of active interest in the department related to algebra, and evidence of teaching ability.

Please see http://hr.uoregon.edu/jobs/ for a full position announcement. Applicants will please provide a standard AMS cover page, CV and three letters of recommendation. We strongly prefer applications to be submitted online at http://MathJobs.org. Application materials may also be mailed directly to: Postdoc Search Committee, Department of Mathematics, 1222 University of Oregon, Eugene, Oregon, 97403-1222. Deadline: January 15, 2010. Candidates should have the ability to work effectively with

a diverse community. The University of Oregon is an EO/AA/ADA institution committed to cultural diversity.

000089

SOUTH CAROLINA

COLLEGE OF CHARLESTON
Department of Mathematics

Applications are invited for a tenure-track position at the Assistant Professor level beginning August 16, 2010. The Mathematics Department at the College of Charleston when fully staffed has 34 full-time faculty members and offers the B.S. and M.S. degrees in mathematics. Candidates must have a Ph.D. in one of the mathematical sciences, potential for continuing research, and commitment to excellence in teaching. Preference will be given to individuals in the area of analysis and who have the potential to contribute to interdisciplinary offerings. The normal teaching load is nine hours per week, and the salary is competitive. A minimal application will consist of a vita and at least three letters of recommendation which, combined, must address both teaching and research.

All materials should be submitted to the College of Charleston on: http://mathjobs.org.

Additional information about the department and its programs, including the interdisciplinary Discovery Informatics program, is available at: http://math.cofc.edu and http://discovery.cofc.edu.

Review of applications for on-campus interviews will begin as applications are received, and applications will be accepted until the position is filled. The College of Charleston is an Equal Opportunity / Affirmative Action Employer and encourages applications from minority and women candidates.

000093

TEXAS

SOUTHERN METHODIST UNIVERSITY
Rank/Title Assistant Professor
(Position Number 00050290)

Applications are invited for one tenure-track assistant professor position, to begin in the fall semester of 2010. While preference will be given to applicants in computational and applied mathematics, applicants in other related areas are encouraged. Applicants must have a Ph.D., provide evidence of outstanding research, and have a strong commitment to teaching at all levels. The Department of Mathematics offers an active doctoral program in computational and applied mathematics. Applicants can visit http://www.smu.edu/math for more information about the department.

Applicants should send a letter of application with a curriculum vitae, a list of publications, research and teaching statements, and three letters of recommendation to: Faculty Search Committee, Department of Mathematics, Southern Methodist University, P.O. Box 750156, Dallas, TX 75275-0156. The Search Committee can be contacted via e-mail at mathsearch@mail.smu.edu; (Tel: (214) 768-2452; Fax: (214) 768-2355).

To ensure full consideration for the position, the application must be received by December 18, 2009, but the committee will continue to accept applications until the position is filled. The committee will notify applicants of its employment decisions after the position is filled.

SMU, a private university with an engineering school, is situated in a quiet residential section of Dallas. Dallas is home to the University of Texas Southwestern Medical Center and its new Systems Biology Center. SMU will not discriminate on the basis of race, color, religion, national origin, sex, age, disability, or veteran status. SMU is also committed to nondiscrimination on the basis of sexual orientation. Hiring is contingent upon the satisfactory completion of a background check.

000088

TEXAS A&M UNIVERSITY
IAMCS-KAUST Postdoctoral Fellowships

The Institute for Applied Mathematics and Computational Science (IAMCS) at Texas A&M University is pleased to invite applications for its IAMCS-KAUST Postdoctoral Fellowships.

IAMCS is an interdisciplinary research institute at Texas A&M University named in 2008 as one of the four inaugural King Abdullah University of Science and Technology (KAUST) Global Research Partner Centers. Its core members number more than thirty faculty from the fields of mathematics, statistics, computer science, and engineering.

fostering collaboration and interdisciplinary research anchored in the mathematical sciences are at the heart of IAMCS's mission. To that end, IAMCS emphasizes among its activities annual research themes. Current and upcoming themes are mathematical and computational challenges in earth science, material science and engineering, and the life sciences. IAMCS postdoctoral candidates should have demonstrated interest and involvement in interdisciplinary research, and successful candidates will be encouraged to participate in the annual theme activities and to establish research collaborations exploring theme year topics. Moreover, each fellow will be invited to establish collaborations with KAUST faculty, postdocs, and students, as well as all of the KAUST Global Research Partner institutions and individual investigators. This offers an unprecedented opportunity for postdoctoral fellows to join a remarkable network of leading research institutions and eminent scholars assembled through the KAUST GRP program.

KAUST is a new graduate research university developed by the Kingdom of Saudi Arabia at a site along the Red Sea a short distance north of Jeddah. Opened in September 2009, it offers world class, state-of-the-art research and instructional facilities supporting its core research and graduate programs in earth sciences, materials science and engineering, biosciences, and applied mathematics and computational science. A key element in KAUST's development as a premier graduate research university is its Global Research Partnership (GRP) program. The GRP consists of its Academic Excellence Alliance Partners, Research Center Partners, and Individual Research Scholar Partners.

The IAMCS-KAUST Postdoctoral Fellowships at Texas A&M University are two-year appointments with the possibility of extension to a third year. The fellowship stipend is $53K over 12 months plus fringe benefits. Interested individuals should submit their application materials (CV, research statement, and three letters of recommendation) to the email address KAUST@tamu.edu by 15 December 2009. IAMCS intends to select up to four IAMCS-KAUST Fellows.

Texas A&M University is an Equal Opportunity Employer. The university is dedicated to the goal of building a culturally diverse and pluralistic faculty and staff committed to teaching and working in a multicultural environment, and strongly encourages applications from women, minorities, and individuals with disabilities.

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THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Mathematics
Austin, Texas 78712

Expected openings for Fall include: (a) Instructorships, some that have R.H. Bing Faculty Fellowships attached to them, and (b) possibly two or more positions at the tenure-track/tenure level.

(a) Instructorships at The University of Texas at Austin are postdoctoral appointments, renewable for two additional years. It is assumed that applicants for Instructorships will have completed all Ph.D. requirements by August 17, 2010. Other factors being equal, preference will be given to those whose doctorates were conferred in 2009 or 2010. Candidates should show superior research ability and have a strong commitment to teaching. Consideration will be given only to persons whose research interests have some overlap with those of the permanent faculty. Duties consist of teaching undergraduate or graduate courses and conducting independent research. The

projected salary is $45,000 for the nine-month academic year.

Each R.H. Bing Fellow holds an Instructorship in the Mathematics Department, with a teaching load of two courses in one semester and one course in the other. The combined Instructorship-Fellowship stipend for nine-months is $54,000, which is supplemented by a travel allowance of $1,000. Pending satisfactory performance of teaching duties, the Fellowship can be renewed for two additional years. Applicants must show outstanding promise in research. Bing Fellowship applicants will automatically be considered for other departmental openings at the postdoctoral level, so a separate application for such a position is unnecessary.

Those wishing to apply for Instructor positions are asked to send a vita and a brief research summary to the above address c/o Instructor Committee. Transmission of the preceding items via the Internet: http://www.ma.utexas.edu/jobs/application is encouraged.

(b) An applicant for a tenure-track or tenured position must present a record of exceptional achievement in her or his research area and must demonstrate a proficiency at teaching. In addition to the duties indicated above for Instructors, such an appointment will typically entail the supervision of M.A or Ph.D. students. The salary will be commensurate with the level at which the position is filled and the qualifications of the person who fills it.

Those wishing to apply for tenure-track/tenured positions are asked to send a vita and a brief research summary to the above address, c/o Recruiting Committee. Transmission of the preceding items via the Internet: http://www.ma.utexas.edu/jobs/application/TenureTrack is encouraged.

All applications should be supported by four or more letters of recommendation, at least one of which speaks to the applicant's teaching credentials. The screening of applications will begin on November 1, 2009.

Background check will be conducted on the applicant selected. The University of Texas at Austin is an Affirmative Action/Equal Opportunity Employer.

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UTAH

UNIVERSITY Of UTAH
Director of the Center for Science and Mathematics Education

The Colleges of Science and Education seek candidates for Director of the CSME. Candidates should be established scientists or science educators with strong interests and backgrounds in the development and implementation of effective math and science education at the K–12 and undergraduate levels. The Director will have an academic appointment in a department in the College of Science, with a full-time assignment to the Center. The Director's main responsibility is to initiate and sustain Center programs that advance the practice of science education in Utah and enhance the recruitment, retention and training of outstanding and diverse science students and future science teachers.

For more information on the Center, a full description of the position, and guidance on how to apply or nominate a potential applicant, please visit http://www.csme.utah.edu. The University of Utah is an Equal Opportunity/Affirmative Action Employer.

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WISCONSIN

UNIVERSITY OF WISCONSIN-MADISON
Department of Mathematics

The Department of Mathematics is accepting applications for an assistant professor (tenure-track) position beginning August 23, 2010. Applications are invited in all areas of mathematics. Candidates should exhibit evidence of outstanding research potential, normally including significant contributions beyond the doctoral dissertation. A strong commitment to excellence in instruction is also expected. Additional departmental information is available on our website: http://www.math.wisc.edu.

An application packet should include a completed AMS Standard Cover Sheet, a curriculum vitae which includes a publication list, and brief descriptions of research and teaching. Application packets should be submitted electronically to: http://www.mathjobs.org. Applicants should also arrange to have sent, to the above URL address, three to four letters of recommendation, at least one of which must discuss the applicant's teaching experiences, capabilities and potential. To ensure full consideration, application packets must be received by January 2, 2010. Applications will be accepted until the position is filled. The Department of Mathematics is committed to increasing the number of women and minority faculty. The University of Wisconsin is an Affirmative Action, Equal Opportunity Employer and encourages applications from women and minorities. Unless confidentiality is requested in writing, information regarding the applicants must be released upon request. Finalists cannot be guaranteed confidentiality. A background check may be required prior to employment.

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Meetings & Conferences of the AMS

IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the *Notices.* However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See `http://www.ams.org/meetings/`. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

Seoul, South Korea

Ewha Womans University

December 16–20, 2009

Wednesday – Sunday

Meeting #1055

First Joint International Meeting of the AMS and the Korean Mathematical Society.
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: June 2009
Program first available on AMS website: Not applicable
Program issue of electronic *Notices*: Not applicable
Issue of *Abstracts*: Not applicable

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/internmtgs.html`.

Invited Addresses

Young Ju Choi, Pohang University of Science and Technology, *Title to be announced.*

Bumsig Kim, Korea Institute for Advanced Study, *Title to be announced.*

Minhyong Kim, University College London, *Title to be announced.*

Ki-ahm Lee, Seoul National University, *Title to be announced.*

James T. McKernan, Massachusetts Institute of Technology, *Title to be announced.*

Frank Morgan, Williams College, *Title to be announced.*

Hee Oh, Brown University, *Title to be announced.*

Terence Tao, University of California Los Angeles, *Title to be announced.*

Van Vu, Rutgers University, *Title to be announced.*

Special Sessions

Algebraic Combinatorics, **Dongsu Kim**, Korea Advanced Institute of Science & Technology, **Soojin Cho**, Ajou University, and **Bruce Sagan**, Michigan State University.

Algebraic Geometry, **Yongnam Lee**, Sogang University, **Ian Morrison**, Fordham University, and **James McKernan**, Massachusetts Institute of Technology.

Arithmetic of Quadratic Forms, **Myung-Hwan Kim**, Seoul National University, and **Wai Kiu Chan**, Wesleyan University.

Combinatorial Matrix Theory, **Suk-Geun Hwang**, Kyungpook National University, and **Bryan Shader**, University of Wyoming.

Computational Science and Engineering, **Jeehyun Lee**, Yonsei University, and **Max Gunzburger**, Florida State University.

Creativity, Giftedness, and Talent Development in Mathematics, **Kyeong-Hwa Lee**, Seoul National University, and **Bharath Sriraman**, University of Montana.

Cryptography, **Hyang-Sook Lee**, Ewha Womans University, and **Alice Silverberg**, University of California Irvine.

Differential and Integral Geometry, **Young Jin Suh**, Kyungpook National University, **Byung Hak Kim**, Kyung Hee University, **Yongdo Lim**, Kyungpook National University, **Gaoyong Zhang**, Polytechnic University of NYU, and **Jiazu Zhou**, Southwest University.

Ergodic Theory and Dynamical Systems, **Keonhee Lee**, Chungnam National University, **Jeong-Yup Lee**, Korea Institute for Advanced Study, and **Jane Hawkins**, University of North Carolina.

Financial Mathematics, **Hyejin Ku**, York University, **Hyunggeon Koo**, Ajou University, and **Kiseop Lee**, University of Louisville.

Geometric Structures and Geometric Group Theory, **In Kang Kim**, Korea Advanced Institute of Science & Technology, and **Seonhee Lim**, Cornell University.

Geometry of Varieties, Syzygies and Computations, **Sijong Kwak**, Korea Advanced Institute of Science & Technology, **Hyungju Park**, Pohang University of Science and Technology, and **Jerzy Weyman**, Northeastern University.

Harmonic Analysis and Its Applications, **Sunggeum Hong**, Chosun University, and **Andreas Seeger**, University of Wisconsin.

Inverse Problems and Imaging, **Hyeonbae Kang**, Inha University, and **Gunther Uhlmann**, University of Washington.

Knot Theory and Related Topics, **Jae Choon Cha**, Pohang University of Science and Technology, and **Kent Orr**, Indiana University.

Lie Symmetries and Solitons, **Woo-Pyo Hong**, Catholic University of Daegu, **Anjan Biswas**, Delaware State University, and **Chaudry M. Khalique**, North-West University.

Mathematical Analysis in Fluid, Gas Dynamics, and Related Equations, **Minkyu Kwak**, Chonnam National University, **Hyeong-Ohk Bae**, Ajou University, **Seung-Yeal Ha**, Seoul National University, and **Simon Seok Hwang**, LaGrange College.

Mathematical Biology, **Eunok Jung**, Konkuk University, and **Jae-Hun Jung**, SUNY at Buffalo.

Mathematical Logic and Foundation, **Byunghan Kim**, Yonsei University, and **Ivo Herzog**, Ohio State University.

Modular Forms and Related Topics, **Youn-Seo Choi**, Korea Institute for Advanced Study, **YoungJu Choie**, Pohang University of Science and Technology, and **Wen-ching Winnie Li**, Pennsylvania State University.

Noncommutative Ring Theory, **Yang Lee**, Pusan National University, **Nam Kyun Kim**, Hanbat National University, and **Pace P. Nielsen**, Brigham Young University.

Nonlinear Elliptic Partial Differential Equations, **Jaeyoung Byeon**, Pohang University of Science and Technology, and **Zhi-Qiang Wang**, Utah State University.

Nonlinear Partial Differential Equations and Viscosity Solutions, **Ki-ahm Lee**, Seoul National University, and **Inwon Kim**, University of California Los Angeles.

Operator Theory and Operator Algebras, **Il Bong Jung**, Kyungpook National University, **Ja A. Jeong**, Seoul National University, **George Exner**, Bucknell University, and **Ken Dykema**, Texas A&M University.

Operator Theory in Analytic Function Spaces, **Hyung Woon Koo** and **Boo Rim Choe**, Korea University, and **Kehe Zhu**, SUNY at Albany.

Representation Theory, **Jae-Hoon Kwon**, University of Seoul, and **Kyu-Hwan Lee**, University of Connecticut.

Spectral Geometry and Global Analysis, **Jinsung Park**, Korea Institute for Advanced Study, and **Maxim Braverman**, Northeastern University.

Symplectic Geometry and Mirror Symmetry, **Jae-Suk Park**, Yonsei University, **Cheol-Hyun Cho**, Seoul National University, and **Yong-Geun Oh**, University of Wisconsin.

San Francisco, California

Moscone Center West and the San Francisco Marriott

January 13–16, 2010

Wednesday – Saturday

Meeting #1056

Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).

Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2009
Program first available on AMS website: November 1, 2009
Program issue of electronic *Notices*: January 2010
Issue of *Abstracts*: Volume 31, Issue 1

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: Expired
For abstracts: Expired

AMS-MAA Program Updates

Hard Problems, Approximate Solutions: Finding Balance between Math and Family Demands, Thursday, 1:00 p.m.–2:30 p.m., organized by **Kathleen M. O'Hara**, Mathematical Sciences Research Institute. Virginia Wolf said it all in "A Room of One's Own." How do we find time for our own mathematical work amidst intergenerational family demands? The challenges of balancing family life (such as raising children, caring for elderly parents, providing child care for grandchildren, or supporting a partner) with a professional life are myriad.

This panel, the first in a series of panels on this issue, will focus on two approaches to a solution: successful institutional models that allow time for family responsibilities and personal frameworks that allow time for

career goals. Panelists presenting the larger issues of family and work within academia include **Mary Ann Mason** and **Marc Goulden**, University of California, Berkeley, co-authors of the paper "Do Babies Matter? The Effect of Family Formation on the Lifelong Careers of Academic Men and Women"; and **Carol Hollenshead**, former director of the University of Michigan's Center for the Education of Women and co-author of *Developing and Implementing Work Family Policies for Faculty*. **Maura B. Mast**, University of Massachusetts, Boston, and **Judy L. Walker**, University of Nebraska, will provide perspectives on institutional and personal approaches to surviving the family-work crunch. Sponsored by the AMS-ASA-AWM-IMS-MAA-NCTM-SIAM Joint Committee on Women in the Mathematical Sciences.

AMS Program Updates

Conversation on Nonacademic Employment, Friday, 9:30 a.m. to 11:00 a.m., organized by **Samuel M. Rankin III**, AMS. This session will concentrate on how to find nonacademic positions, types of jobs, the interview process, work environments, and advancement opportunities. The discussion will be led by a panel of mathematical scientists working in government and industry and moderated by **James G. Glimm**, SUNY at Stony Brook.

The panel discussion sponsored by the AMS Committee on Science Policy on Friday afternoon includes **Ronald J. Stern**, University of California-Irvine, as moderator. Panelists **Efraim P. Armendariz**, University of Texas-Austin; **Lawrence Craig Evans**, University of California-Berkeley; **Peter D. March**, National Science Foundation; and **Karen Vogtmann**, Cornell University, will discuss the Board of Mathematical Sciences and Applications Report "Evaluation of NSF's Program of Grants and Vertical Integration of Research and Education (VIGRE) in the Mathematical Sciences".

The title of the panel discussion sponsored by the AMS Committee on Education on Saturday morning is **The Common Core State Standards: Will they become our national K—12 curriculum?** The panel will be moderated by **Lawrence Gray**, University of Minnesota. The Common Core State Standards is a major attempt to create a unified set of curriculum standards in math and language arts for grades K–12. It is sponsored by the National Governor's Association, together with several other national organizations, and it has a very short timeline. Find out what it's all about through several brief presentations and Q&A.

MAA Program Updates

Mathematical Poetry Reading, Thursday, 7:00 p.m.–9:00 p.m., organized by Douglas Norton, Villanova University. From the open readings by the Humanistic Mathematics Network in the 1990s to the "Poetry of Love and Mathematics: A Reading" in Washington last year, mathematicians have enjoyed sharing poetry at the Joint Math Meetings. Come to share mathematical poetry of your own composition or simply of your liking in an "open mike" informal setting. Listen, read, talk, share, relax.

Presentations by Teaching Award Recipients on Friday afternoon include **Curtis D. Bennett**, Loyola Marymount University, *Lessons learned in the teaching and learning of mathematics*; **Michael J. Dorff**, Brigham Young University, *What we are doing at BYU to increase the number of students taking mathematics courses and becoming math majors*; and **Allan Rossman**, California Polytechnic State University San Luis Obispo, *Ask good questions*.

Activities of Other Organizations

National Association of Mathematicians

The Claytor-Woodward Lecture will be given by **Abdul-Aziz Yakubu**, Howard University, on *The impact of periodic proportional harvesting policies on TAC-regulated fishery systems*, at 1:00 p.m. on Saturday.

Society of Industrial and Applied Mathematics

The **Invited Address** to be given by **Brenda Dietrich** on Thursday morning is titled *Optimization Inside: The use of mathematical methods in business processes*.

An additional minisymposium will be on **Frontiers in Geomathematics**, organized by **Willi Freeden**, University of Kaiserslautern; **M. Zuhair Nashed**, University of Central Florida; and **Thomas Sonar**, Technical University of Braunschweig, Germany; Wednesday afternoon.

Social Events

North Carolina State University Department of Mathematics Reception for Alumni and Friends, Thursday, 6:00 p.m.–8:00 p.m. All alumni, friends, and participants in North Carolina State University programs (e.g., REU, REU+, REG, IMSM, RTG) are invited to attend and meet old friends and to about hear recent events in the Department of Mathematics. H'ors d'oeuvres and drinks will be provided (see `www.math.ncsu.edu` or contact Hien Tran, `tran@math.ncsu.edu` for more information).

University of Wisconsin-Madison Reception for Alumni and Friends, Thursday, 5:45 p.m.—7:30 p.m. Please come and visit with old and new friends.

Lexington, Kentucky

University of Kentucky

March 27–28, 2010

Saturday – Sunday

Meeting #1057

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: January 2010
Program first available on AMS website: February 11, 2010
Program issue of electronic *Notices*: March 2010
Issue of *Abstracts*: Volume 31, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 8, 2009
For abstracts: February 2, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Percy A. Deift, Courant Institute–New York University, *Title to be announced.*

Irina Mitrea, Worcester Polytechnic Institute, *Recent progress in the area of elliptic boundary value problems on rough domains.*

Bruce Reznick, University of Illinois at Urbana Champaign, *The secret lives of polynomial identities.*

Bernd Ulrich, Purdue University, *Title to be announced.*

Doron Zeilberger, Rutgers University, *3x+1* (Erdős Memorial Lecture).

Special Sessions

Advances in Algebraic Coding Theory (Code: SS 6A), **Heide Gluesing-Luerssen**, University of Kentucky, and **Jon-Lark Kim**, University of Louisville.

Advances in Algebraic Statistics (Code: SS 2A), **Sonja Petrović**, University of Illinois, Chicago, and **Ruriko Yoshida**, University of Kentucky.

Advances in Algebraic and Geometric Combinatorics (Code: SS 14A), **Richard Ehrenborg** and **Margaret A. Readdy**, University of Kentucky.

Analysis and Control of Dispersive Partial Differential Equations (Code: SS 25A), **Michael J. Goldberg** and **Bingyu Zhang**, University of Cincinnati.

Combinatorial Algebra (Code: SS 7A), **Juan C. Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

Commutative Algebra (Code: SS 1A), **Alberto Corso**, University of Kentucky, **Claudia Polini**, University of Notre Dame, and **Bernd Ulrich**, Purdue University.

Complex Analysis and Potential Theory (Code: SS 4A), **James E. Brennan** and **Vladimir Eiderman**, University of Kentucky.

Financial Mathematics and Statistics (Code: SS 22A), **Kiseop Lee**, University of Louisville, and **Jose Figueroa-Lopez**, Department of Statistics, Purdue University.

Function Theory, Harmonic Analysis, and Partial Differential Equations (Code: SS 5A), **Joel Kilty**, Centre College, **Irina Mitrea**, Worcester Polytechnic Institute, and **Katharine Ott**, University of Kentucky.

Geometric Function Theory and Analysis on Metric Spaces (Code: SS 3A), **John L. Lewis**, University of Kentucky, and **Nageswari Shanmugalingam**, University of Cincinnati.

Homotopy Theory and Geometric Aspects of Algebraic Topology (Code: SS 16A), **Serge Ochanine**, University of Kentucky, and **Marian F. Anton**, Centre College.

Interactions between Logic, Topology, and Complex Analysis (Code: SS 23A), **Matt Insall**, Missouri University of Science and Technology, and **Malgorzata Marciniak**, University of Toledo.

Inverse Problems, Riemann-Hilbert Problems, and Nonlinear Dispersive Equations (Code: SS 10A), **Peter A. Perry**, University of Kentucky, and **Peter Topalov**, Northeastern University.

Large Scale Matrix Computation (Code: SS 19A), **Qiang Ye**, University of Kentucky, and **Lothar Reichel**, Kent State University.

Mathematical Economics (Code: SS 21A), **Adib Bagh** and **Robert E. Molzon**, University of Kentucky.

Mathematical Problems in Mechanics and Materials Science (Code: SS 20A), **Michel E. Jabbour** and **Chi-Sing Man**, University of Kentucky, and **Kazumi Tanuma**, Gunma University.

Mathematical String Theory (Code: SS 18A), **Al Shapere**, Department of Physics and Astronomy, University of Kentucky, **Eric Sharpe**, Physics Department, Virginia Polytechnic Institute and State University, and **Mark A. Stern**, Duke University.

Mathematics Outreach (Code: SS 26A), **Carl W. Lee** and **David C. Royster**, University of Kentucky.

Matroid Theory (Code: SS 9A), **Jakayla Robbins**, University of Kentucky, and **Xiangqian Zhou**, Wright State University.

Multivariate and Banach Space Polynomials (Code: SS 15A), **Richard A. Aron**, Kent State University, and **Lawrence A. Harris**, University of Kentucky.

Noncommutative Algebraic Geometry (Code: SS 24A), **Dennis S. Keeler** and **Kimberly Retert**, Miami University.

Partial Differential Equations in Geometry and Variational Problems (Code: SS 8A), **Luca Capogna**, University of Arkansas, and **Changyou Wang**, University of Kentucky.

Recent Progress in Numerical Methods for Partial Differential Equations (Code: SS 12A), **Alan Demlow**, University of Kentucky, and **Xiaobing H. Feng**, University of Tennessee at Knoxville.

Relative Homological Algebra (Code: SS 11A), **Edgar E. Enochs**, University of Kentucky, and **Alina C. Iacob**, Georgia Southern University.

Sharp Spectral Estimates in Analysis, Geometry, and Probability (Code: SS 17A), **Richard S. Laugesen** and **Bartlomiej Siudeja**, University of Illinois.

Spectral and Transport Properties of Schrödinger Operators (Code: SS 13A), **Peter D. Hislop**, University of Kentucky, and **Jeffrey H. Schenker**, Michigan State University.

St. Paul, Minnesota

Macalester College

April 10–11, 2010

Saturday – Sunday

Meeting #1058

Central Section
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: February 2010
Program first available on AMS website: February 25, 2010
Program issue of electronic *Notices*: April 2010
Issue of *Abstracts*: Volume 31, Issue 2

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 22, 2009
For abstracts: February 16, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Charles Doering, University of Michigan, *Title to be announced.*

Matthew James Emerton, Northwestern University, *Title to be announced.*

Vladimir Touraev, Indiana University, *Title to be announced.*

Peter Webb, University of Minnesota, *Title to be announced.*

Special Sessions

Applications of a Geometric Approach to Chaotic Dynamics (Code: SS 16A), **Evelyn Sander**, George Mason University, **Judy Kennedy**, Lamar University, and **James Yorke**, University of Maryland.

Cohomology and Representation Theory of Algebraic Groups and Related Structures (Code: SS 7A), **Christopher Bendel**, University of Wisconsin-Stout, **Bobbe Cooper**, University of Minnesota, and **Terrell Hodge**, Western Michigan University.

Combinatorial Representation Theory (Code: SS 3A), **Tom Halverson**, Macalester College, and **Victor Reiner**, University of Minnesota.

Commutative Ring Theory (Code: SS 5A), **Michael Axtell**, University of St. Thomas, and **Joe Stickles**, Milliken University.

Differential Equations and Applications (Code: SS 15A), **Nicolai Tarfulea**, Purdue University Calumet, and **Catalin Turc**, Case Western Reserve University.

Fractals, Convolution Measures, and Frames (Code: SS 13A), **Keri Kornelson**, University of Oklahoma, and **Karen Shuman**, Grinnell College.

Geometric Flows, Moving Frames and Integrable Systems (Code: SS 8A), **Gloria Mari-Beffa**, University of Wisconsin-Madison, and **Peter Olver**, University of Minnesota.

Hecke Algebras and Deformations in Geometry and Topology (Code: SS 11A), **Matthew Douglass** and **Anne Shepler**, University of North Texas.

Mathematical Developments in Cell and Systems Biology (Code: SS 14A), **Anastasios Matzavinos**, Iowa State University, and **Nicoleta Eugenia Tarfulea**, Purdue University Calumet.

Matrices and Graphs (Code: SS 9A), **Luz M. DeAlba**, Drake University, **Adam Berlinger**, St. Olaf College, **Leslie Hogben**, Iowa State University, and **In-Jae Kim**, Minnesota State University.

Partition Theory and the Combinatorics of Symmetric Functions (Code: SS 6A), **Eric S. Egge**, Carleton College, and **Kristina Garrett**, St. Olaf College.

Pattern Formation in Biological Systems (Code: SS 12A), **Magdalena Skolarska**, University of St. Thomas, and **Chad Topaz**, Macalester College.

Physical Knotting and Linking and its Applications (Code: SS 10A), **Eric Rawden**, University of St. Thomas, **Yuanan Diao**, University of North Carolina at Charlotte, and **Claus Ernst**, Western Kentucky University.

Probabilistic and Extremal Combinatorics (Code: SS 2A), **Ryan Martin** and **Maria Axenovich**, Iowa State University.

Quantum Invariants of 3-manifolds and Modular Categories (Code: SS 1A), **Thang Le**, Georgia Institute of Technology, **Eric Rowell**, Texas A&M University, and **Vladimir Touraev**, Indiana University.

Universal Algebra and Order (Code: SS 4A), **Jeffrey Olson**, Norwich University, **Jeremy Alm**, Illinois College, **Kristi Meyer**, Wisconsin Lutheran College, and **Japheth Wood**, Bard College.

Albuquerque, New Mexico

University of New Mexico

April 17–18, 2010

Saturday – Sunday

Meeting #1059

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: February 2010
Program first available on AMS website: March 4, 2010
Program issue of electronic *Notices*: April 2010
Issue of *Abstracts*: Volume 31, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: December 29, 2009
For abstracts: February 23, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Kenneth Bromberg, University of Utah, *Title to be announced.*

Danny Calegari, California Institute of Technology, *Title to be announced.*

Ioana Dumitriu, University of Washington, *Title to be announced.*

Steffen Rhode, University of Washington, *Title to be announced.*

Special Sessions

Dyadic and Non-Dyadic Harmonic Analysis (Code: SS 2A), **M. Cristina Pereyra**, University of New Mexico, and **Stephanie A. Salomone**, University of Portland.

Financial Mathematics: The Mathematics of Financial Markets and Structures (Code: SS 4A), **Maria Cristina Mariani**, University of Texas at El Paso, **Ionut Florescu**, Stevens Institute of Technology, and **Maria P. Beccar-Varela**, University of Texas at El Paso.

Function Spaces, PDEs and Nonlinear Analysis (Code: SS 10A), **Osvaldo Mendez**, **Behzad Rouhani**, and **Mohamed Amine Khamsi**, University of Texas at El Paso.

Geometric Combinatorics (Code: SS 6A), **Art M. Duval**, University of Texas at El Paso, and **Jeremy Martin**, University of Kansas.

Geometric Structures and PDEs (Code: SS 8A), **Charles Boyer** and **Dimiter Vassilev**, University of New Mexico.

Harmonic Analysis and Partial Differential Equations (Code: SS 5A), **Matthew Blair**, University of New Mexico, and **Hart Smith**, University of Washington.

Positivity in Noncommutative Settings (Code: SS 12A), **Roger Roybal**, California State University Channel Islands, and **Terry Loring**, University of New Mexico.

Selected Topics in Analysis and Numerics for PDEs (Code: SS 11A), **Thomas Hagstrom**, Southern Methodist University, and **Stephen Lau** and **Jens Lorenz**, University of New Mexico.

Strongly-nonlinear Phenomena: Theory and Applications to Nonlinear Optics, Hydrodynamics, Bose–Einstein Condensation and Biology (Code: SS 9A), **Alejandro Aceves**, Southern Methodist University, and **Alexander Korotkevich** and **Pavel Lushnikov**, University of New Mexico.

Subjects in Between Pure and Applied Mathematics (Code: SS 7A), **Hanna Makaruk** and **Robert Owczarek**, Los Alamos National Laboratory.

Topics in Geometric Group Theory (Code: SS 1A), **Matthew Day**, California Institute of Technology, **Daniel Peter Groves**, University of Illinois at Chicago, **Jason Manning**, SUNY at Buffalo, and **Henry Wilton**, University of Texas.

Trends in Commutative Algebra (Code: SS 3A), **Louiza Fouli**, New Mexico State University, and **Janet Vassilev**, University New Mexico.

Newark, New Jersey

New Jersey Institute of Technology

May 22–23, 2010

Saturday – Sunday

Meeting #1060

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: March 2020
Program first available on AMS website: April 8, 2010
Program issue of electronic *Notices*: May 2020
Issue of *Abstracts*: Volume 31, Issue 3

Deadlines

For organizers: November 23, 2009
For consideration of contributed papers in Special Sessions: February 2, 2010
For abstracts: March 30, 2010

The scientific information listed below may be dated. For the latest information, see `www.ams.org/amsmtgs/sectional.html`.

Invited Addresses

Simon Brendle, Stanford University, *Hamilton's Ricci flow and the sphere theorem in geometry.*

Konstantin M. Mischaikow, Rutgers University, *Computational topology applied to the global dynamics of nonlinear systems.*

Ricardo H. Nochetto, University of Maryland, *Curvature driven flows in deformable domains.*

Richard E. Schwartz, Brown University, *Polygonal outer billiards.*

Special Sessions

Expandable Computations, Algorithms, Methodologies and Experiments for Engineering Interpretation (Code: SS 1A), **Mustapha S. Fofana**, Worcester Polytechnic Institute, **Marie D. Dahleh**, Harvard School of Engineering and Applied Sciences Harvard University, and **Kenji Kawashima**, Precision and Intelligence Laboratory Tokyo Institute of Technology.

Groups, Computations, and Applications (Code: SS 2A), **Delaram Kahrobaei**, City University of New York.

Homology Theories for Knots and Skein Modules. (Code: SS 3A), **Mikhail Khovanov**, Columbia University, and **Jozef H. Przytycki** and **Radmila Sazdanovic**, George Washington University.

Invariants of Knots, Links, and 3-Manifolds (Code SS 4A), **Abhijit Champanerkar**, College of Staten Island, CUNY, **Ilya S. Kofman**, College of Staten Island, CUNY, and **Philip J. P. Ording**, Medgar Evers College, CUNY.

Teichmüller Theory, Hyperbolic Geometry, and Complex Dynamics (Code SS 5A), **Zheng Huang**, College of Staten Island, CUNY, and **Ren Guo**, University of Minnesota.

Berkeley, California

University of California Berkeley

June 2–5, 2010

Wednesday – Saturday

Meeting #1061

Eighth Joint International Meeting of the AMS and the Sociedad Matemática Mexicana.
Associate secretary: Susan J. Friedlander
Announcement issue of *Notices*: February 2010
Program first available on AMS website: April 22, 2010
Program issue of electronic *Notices*: June 2010
Issue of *Abstracts*: Volume 31, Issue 3

Deadlines

For organizers: Expired
For consideration of contributed papers in Special Sessions: February 16, 2010
For abstracts: April 13, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/internmtgs.html.

Invited Addresses

Alejandro Adem, University of British Columbia and PIMS, *Title to be announced.*

Peter W-K Li, University of California Irvine, *Title to be announced.*

Ernesto Lupercio, CINVESTAV, *Title to be announced.*

Victor Perez Abreu, CIMAT, *Title to be announced.*

Alberto Verjovsky, IM-UNAM, *Title to be announced.*

Maciej Zworski, University of California Berkeley, *Title to be announced.*

Special Sessions

Algebraic Topology and Related Topics (Code: SS 3A), **Alejandro Adem**, University of British Columbia, **Gunnar E. Carlsson** and **Ralph L. Cohen**, Stanford University, and **Ernesto Lupercio**, CINVESTAV.

Analytic Aspects of Differential Geometry (Code: SS 2A), **Nelia Charalambous**, ITAM, **Lizhen Ji**, University of Michigan, and **Jiaping Wang**, University of Minnesota.

Harmonic Analysis, Microlocal Analysis, and Partial Differential Equations (Code: SS 1A), **Gunther Uhlmann**, University of Washington, and **Salvador Perez Esteva**, UNAM.

Syracuse, New York

Syracuse University

October 2–3, 2010

Saturday – Sunday

Meeting #1062

Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: To be announced
Program first available on AMS website: August 19, 2010
Program issue of electronic *Notices*: October
Issue of *Abstracts*: Volume 31, Issue 4

Deadlines

For organizers: March 2, 2010
For consideration of contributed papers in Special Sessions: June 15, 2010
For abstracts: August 10, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Special Sessions

Difference Equations and Applications (Code SS 2A), **Michael Radin**, Rochester Institute of Technology.

Nonlinear Analysis and Geometry (Code: SS 1A), **Tadeusz Iwaniec**, **Leonid V. Kovalev**, and **Jani Onninen**, Syracuse University.

Several Complex Variables (Code SS 3A), **Dan F. Coman** and **Evgeny A. Poletsky**, Syracuse University.

Los Angeles, California

University of California Los Angeles

October 9–10, 2010

Saturday – Sunday

Meeting #1063

Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: August 2010
Program first available on AMS website: August 26, 2010
Program issue of electronic *Notices*: October 2010
Issue of *Abstracts*: Volume 31, Issue 4

Deadlines

For organizers: March 10, 2010
For consideration of contributed papers in Special Sessions: June 22, 2010
For abstracts: August 17, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Greg Kuperberg, University of California Davis, *Title to be announced.*

Cris Moore, University of New Mexico, *Title to be announced.*

Stanley Osher, University of California Los Angeles, *Title to be announced.*

Terence Tao, University of California Los Angeles, *Title to be announced* (Einstein Public Lecture in Mathematics).

Melanie Wood, Princeton University, *Title to be announced.*

Special Sessions

Large Cardinals and the Continuum (Code: SS 2A), **Matthew Foreman**, University of California Irvine, **Alekos Kechris**, California Institute for Technology, **Itay Neeman**, University of California Los Angeles, and **Martin Zeman**, University of California Irvine.

Topology and Symplectic Geometry (Code: SS 1A), **Robert Brown** and **Ciprian Manolescu**, University of California Los Angeles, and **Stefano Vidussi**, University of California Riverside.

Notre Dame, Indiana

Notre Dame University

October 29–31, 2010

Friday – Sunday

Meeting #1064

Central Section
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: August 2010
Program first available on AMS website: September 16, 2010
Program issue of electronic *Notices*: October 2010
Issue of *Abstracts*: Volume 31, Issue 4

Deadlines

For organizers: February 19, 2010
For consideration of contributed papers in Special Sessions: July 20, 2010
For abstracts: September 7, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Laura DeMarco, University of Illinois at Chicago, *Title to be announced.*

Jordan Ellenberg, University of Wisconsin, *Title to be announced.*

David Fisher, Indiana University, *Title to be announced.*

Jared Wunsch, Northwestern University, *Title to be announced.*

Special Sessions

Commutative Algebra and Its Interactions with Algebraic Geometry (Code: SS 2A), **Claudia Polini**, University of Notre Dame, **Alberto Corso**, University of Kentucky, and **Bernd Ulrich**, Purdue University.

Hilbert Functions in Commutative Algebra and Algebraic Combinatorics (Code: SS 3A), **Fabrizio Zanello**, Michigan Technological University, **Juan Migliore**, University of Notre Dame, and **Uwe Nagel**, University of Kentucky.

Singularities in Algebraic Geometry (Code: SS 1A), **Nero Budur**, University of Notre Dame, and **Lawrence Ein**, University of Illinois at Chicago.

Richmond, Virginia

University of Richmond

November 6–7, 2010

Saturday – Sunday

Meeting #1065

Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: September
Program first available on AMS website: September 23, 2010
Program issue of electronic *Notices*: November
Issue of *Abstracts*: Volume 31, Issue 4

Deadlines

For organizers: March 8, 2010
For consideration of contributed papers in Special Sessions: July 27, 2010
For abstracts: September 14, 2010

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Invited Addresses

Matthew H. Baker, Georgia Institute of Technology, *Title to be announced.*

Michael J. Field, University of Houston, *Title to be announced.*

Sharon R. Lubkin, North Carolina State University, *Title to be announced.*

Stefan Richter, University of Tennessee, Knoxville, *Title to be announced.*

Pucon, Chile

December 15–18, 2010

Wednesday – Saturday
First Joint International Meeting between the AMS and the Sociedad de Matematica de Chile.
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: June 2010
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

New Orleans, Louisiana

New Orleans Marriott and Sheraton New Orleans Hotel

January 5–8, 2011

Wednesday – Saturday
Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: October 2010
Program first available on AMS website: November 1, 2010
Program issue of electronic *Notices*: January 2011
Issue of *Abstracts*: Volume 32, Issue 1

Deadlines

For organizers: April 1, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Statesboro, Georgia

Georgia Southern University

March 12–13, 2011

Saturday – Sunday
Southeastern Section
Associate secretary: Matthew Miller
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 12, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Iowa City, Iowa

University of Iowa

March 18–20, 2011

Friday – Sunday
Central Section
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: July 16, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Worcester, Massachusetts

College of the Holy Cross

April 9–10, 2011

Saturday – Sunday
Eastern Section
Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 9, 2010
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Las Vegas, Nevada

University of Nevada

April 30 – May 1, 2011

Saturday – Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced

For abstracts: To be announced

The scientific information listed below may be dated. For the latest information, see www.ams.org/amsmtgs/sectional.html.

Special Sessions

Geometric PDEs (Code: SS 1A), **Matthew Gursky**, Notre Dame University, and **Emmanuel Hebey**, Universite de Cergy-Pontoise.

Salt Lake City, Utah

University of Utah

October 22–23, 2011

Saturday – Sunday
Western Section
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Boston, Massachusetts

John B. Hynes Veterans Memorial Convention Center, Boston Marriott Hotel, and Boston Sheraton Hotel

January 4–7, 2012

Wednesday – Saturday
Joint Mathematics Meetings, including the 118th Annual Meeting of the AMS, 95th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2011
Program first available on AMS website: November 1, 2011
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 33, Issue 1

Deadlines

For organizers: April 1, 2011
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center and San Diego Marriott Hotel and Marina

January 9–12, 2013

Wednesday – Saturday
Joint Mathematics Meetings, including the 119th Annual Meeting of the AMS, 96th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: October 2012
Program first available on AMS website: November 1, 2012
Program issue of electronic *Notices*: January 2012
Issue of *Abstracts*: Volume 34, Issue 1

Deadlines

For organizers: April 1, 2012
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Baltimore, Maryland

Baltimore Convention Center, Baltimore Hilton, and Marriott Inner Harbor

January 15–18, 2014

Wednesday – Saturday
Joint Mathematics Meetings, including the 120th Annual Meeting of the AMS, 97th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).
Associate secretary: Matthew Miller
Announcement issue of *Notices*: October 2013
Program first available on AMS website: November 1, 2013
Program issue of electronic *Notices*: January 2013
Issue of *Abstracts*: Volume 35, Issue 1

Deadlines

For organizers: April 1, 2013
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

San Antonio, Texas

Henry B. Gonzalez Convention Center and Grand Hyatt San Antonio

January 10–13, 2015

Saturday – Tuesday

Joint Mathematics Meetings, including the 121st Annual Meeting of the AMS, 98th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Steven H. Weintraub
Announcement issue of *Notices*: October 2014
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2015
Issue of *Abstracts*: Volume 36, Issue 1

Deadlines

For organizers: April 1, 2014
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Seattle, Washington

Washington State Convention & Trade Center and the Sheraton Seattle Hotel

January 6–9, 2016

Wednesday – Saturday

Joint Mathematics Meetings, including the 122nd Annual Meeting of the AMS, 99th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Michel L. Lapidus
Announcement issue of *Notices*: October 2015
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2016
Issue of *Abstracts*: Volume 37, Issue 1

Deadlines

For organizers: April 1, 2015
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Atlanta, Georgia

Hyatt Regency Atlanta and Marriott Atlanta Marquis

January 4–7, 2017

Wednesday – Saturday

Joint Mathematics Meetings, including the 123rd Annual Meeting of the AMS, 100th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association of Symbolic Logic, with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

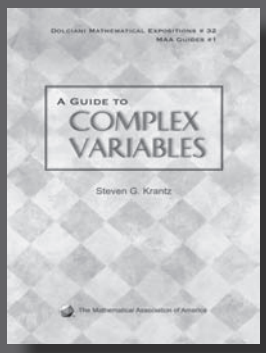
Associate secretary: Georgia Benkart
Announcement issue of *Notices*: October 2016
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: January 2017
Issue of *Abstracts*: Volume 38, Issue 1

Deadlines

For organizers: April 1, 2016
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

From the Mathematical Association of America: **MAA Guides**

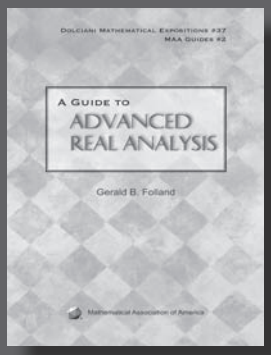
The MAA Guides are perfect for graduate students preparing for qualifying exams, or for faculty who would like an overview of the subject.



A Guide to Complex Variables
Steven G. Krantz

This guide gives the reader a quick and accessible introduction to the key topics in complex variables. It will give the reader a solid grounding in this fundamental area. Many figures and examples illustrate the principal ideas, and the exposition is lively and inviting. An undergraduate wanting to have a first look at the subject, or a graduate student preparing for the qualifying exams will find this book a very useful resource.

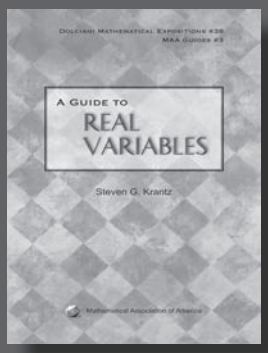
Catalog Code: DOL-32/NT, 204 pp., Hardbound, 2008,
ISBN 9780-88385-338-2 List: $49.95 MAA Member: $39.95



A Guide to Advanced Real Analysis
Gerald B. Folland

This book is an outline of the core material in the standard graduate-level real analysis course. It is intended as a resource for students in such a course as well as others who wish to learn or review the subject. On the abstract level, it covers the theory of measure and integration and the basics of point set topology, functional analysis, and the most important types of function spaces. On the more concrete level, it also deals with the applications of these general theories to analysis on Euclidean space: the Lebesgue integral, Hausdorff measure, convolutions, Fourier series and transforms, and distributions.

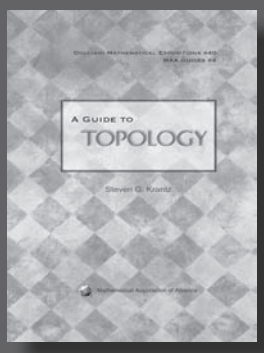
Catalog Code: DOL-37/NT, 120 pp., Hardbound, 2009,
ISBN 9780-88385-343-6 List: $49.95 MAA Member: $39.95



A Guide to Real Variables
Steven G. Krantz

The purpose of *A Guide to Real Variables* is to provide an aid and conceptual support for the student studying for the qualifying exam in real analysis. Beginning with the foundations of the subject, the text moves rapidly but thoroughly through basic topics like completeness, convergence, sequences, series, compactness, topology and the like. This book concentrates on concepts, results, examples, and illustrative figures. The reader may use this text alongside a more traditional tome that provides all the details.

Catalog Code: DOL-38/NT, 164 pp., Hardbound, 2009,
ISBN 978-0-88385-344-3 List: $49.95 MAA Member: $39.95



A Guide to Topology
Steven G. Krantz

An introduction to the subject of basic topology that covers point-set topology, Moore-Smith convergence, and function spaces. It contains many examples and illustrations. The book treats continuity, compactness, the separation axioms, connectedness, completeness, the relative topology, the quotient topology, the product topology, and all the other fundamental ideas of the subject.

Catalog Code: DOL-40/NT, 120 pp., Hardbound, 2009,
ISBN 978-0-88385-346-7 List: $49.95 MAA Member: $39.95

To order, call: 1-800-331-1622 or go online to: www.maa.org

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WHAT IS...

2010 Joint Mathematics Meetings Advance Registration/Housing Form

Name _____
(please write name as you would like it to appear on your badge)

Mailing Address _____

_____

Telephone _____ Fax: _____

In case of emergency (for you) at the meeting, call: Day # _____ Evening #: _____

Email Address _____
Acknowledgment of this registration and any hotel reservations will be sent to the email address given here, unless you check this box: *Send by U.S. Mail* ☐

Affiliation for badge _____ Nonmathematician guest badge name: _____
(company/university) (accompanying registered mathematician; please note charge below)

☐ **I DO NOT want my program and badge to be mailed to me on 12/11/09. (Materials will be mailed to the address listed above unless you check this box.)**

Registration Fees

Membership ✓ all that apply. First row is eligible for JMM member registration fee.
❑ AMS ❑ MAA ❑ ASL ❑ CMS ❑ SIAM
❑ ASA ❑ AWM ❑ NAM ❑ YMN

Joint Meetings	**by Dec 22**	**at mtg**	**Subtotal**
❑ Member AMS, MAA, ASL, CMS, SIAM	US $220	US $288	
❑ Nonmember	US $342	US $444	
❑ Graduate Student	US $ 45	US $ 55	
❑ Undergraduate Student	US $ 35	US $ 45	
❑ High School Student	US $ 5	US $ 10	
❑ Unemployed	US $ 45	US $ 55	
❑ Temporarily Employed	US $177	US $206	
❑ Developing Countries Special Rate	US $ 45	US $ 55	
❑ Emeritus Member of AMS or MAA	US $ 45	US $ 55	
❑ High School Teacher	US $ 45	US $ 55	
❑ Librarian	US $ 45	US $ 55	
❑ Press	US $ 0	US $ 0	
❑ Nonmathematician Guest	US $ 15	US $ 15	
			$ _____

AMS Short Course: *Markov Chains and Mixing Times (1/11–1/12)*

❑ Member of AMS or MAA	US $ 98	US $135	
❑ Nonmember	US $132	US $165	
❑ Student, Unemployed, Emeritus	US $ 46	US $ 67	

The first 80 people who sign up for this course will receive a book (shipped by mid-late December). See details in announcement.
To ensure its receipt please list your home address above. $ _____

MAA Short Course: *Exploring the Great Books of Mathematics. (1/11–1/12)*

❑ Member of MAA or AMS	US $150	US $160	
❑ Nonmember	US $200	US $210	
❑ Student, Unemployed, Emeritus	US $ 75	US $ 85	
			$ _____

AMS Tutorial on Modeling: *An Introduction to Numerical and Statistical Modeling (1/11-1/12)* US $ 25 US $ 25
$ _____

MAA Minicourses (see listing in text)
I would like to attend: ❑ One Minicourse ❑ Two Minicourses
Please enroll me in MAA Minicourse(s) #_____ and/or #_____
In order of preference, my alternatives are: #_____ and/or #_____
Price: US $75 for each minicourse.
(For more than 2 minicourses call or email the MMSB.) $ _____

Employment Center *Please go to http://eims.ams.org to register. For further information contact Steven Ferrucci at emp-info@ams.org.*

Graduate Program Fair
❑ Graduate Program Table US $ 50 N/A
$ _____

Events with Tickets
MER Banquet (1/14) US $53.00 #____Regular #____Veg #____Kosher
NAM Banquet (1/15) US $53.00 #____Regular #____Veg #____Kosher
AMS Banquet (1/16) US $53.00 #____Regular #____Veg #____Kosher
Reception in honor of Martha Siegel (1/16) US $25.00 #____
$ _____

Other Events
❑ Graduate Student/First Time Attendee Reception (1/14) (no charge)

Total for Registrations and Events $ _____

Payment

Registration & Event Total (total from column on left) $ _____
Hotel Deposit (only if paying by check) $ _____

Total Amount To Be Paid **$** _____
(Note: A US $5 processing fee will be charged for each returned check or invalid credit card. Debit cards are not accepted.)

Method of Payment
❑ Check. Make checks payable to the AMS. Checks drawn on foreign banks must be in equivalent foreign currency at current exchange rates.
❑ Credit Card. VISA, MasterCard, AMEX, Discover (no others accepted)

Card number: _____

Exp. date: _____ Zipcode of credit card billing address: _____

Signature: _____

Name on card: _____

❑ Purchase order # _____ (please enclose copy)

Other Information

Mathematical Reviews field of interest # _____

How did you hear about this meeting? Check one: ❑ Colleague(s) ❑ *Notices* ❑ *Focus* ❑ Internet

❑ This is my first Joint Mathematics Meetings.
❑ I am a mathematics department chair.
❑ For planning purposes for the MAA Two-year College Reception, please check if you are a faculty member at a two-year college.
❑ I would like to receive promotions for future JMM meetings.
❑ **Please do not include my name on any promotional mailing list.**
❑ Please ✓ this box if you have a disability requiring special services.

Mail to:

Mathematics Meetings Service Bureau (MMSB)
P. O. Box 6887
Providence, RI 02940-6887 Fax: 401-455-4004
Questions/changes call: 401-455-4143 or 1-800-321-4267 x4143; mmsb@ams.org

Deadlines *Please register by the following dates for:*

To be eligible for the complimentary room drawing:	**Nov. 4, 2009**
For housing reservations, badges/programs mailed:	**Nov. 18, 2009**
For housing changes/cancellations through MMSB:	**Dec. 14, 2009**
For advance registration for the Joint Meetings, Short Courses, MAA Minicourses, Tutorial & Tickets:	**Dec. 22, 2009**
For 50% refund on banquets, cancel by:	**Jan. 4, 2010***
For 50% refund on advance registration, Minicourses & Short Courses, cancel by:	**Jan. 8, 2010***

***no refunds after this date**

Registration for the Joint Meetings is not required for the Short Courses or the Tutorial, but it is required for the Minicourses & Employment Center.

San Francisco Joint Mathematics Meetings Hotel Reservations

Please see the hotel page in the announcement or web for detailed information on each hotel. To ensure accurate assignments, please rank hotels in order of preference by writing 1, 2, 3, etc., in the column on the left and by circling the requested room type and rate. If the rate or the hotel requested is no longer available, you will be assigned a room at a ranked or unranked hotel at a comparable rate. Please call the MMSB for details on suite configurations, sizes, availability, etc. Suite reservations can only be made through the MMSB to receive the convention rate. Reservations at the following hotels must be made through the MMSB to receive the convention rates listed. Reservations made directly with the hotels at the JMM rate will be changed to a higher rate. All rates are subject to a 15.5% sales tax. **Guarantee requirements: First night deposit by check (add to payment on reverse of form) or a credit card guarantee.**

❑ Deposit enclosed (see front of form) ❑ Hold with my credit card Card Number _____ Exp. Date_____ Signature_____

Date and Time of Arrival _____ **Date and Time of Departure**_____

Name of Other Room Occupant _____ **Arrival Date**_____ **Departure Date**_____ **Child (give age(s)**____

Order of choice	Hotel	Single	Double 1 bed	Double 2 beds	Triple 2 beds	Triple 2 beds w/cot	Triple - king or queen w/cot	Quad 2 beds	Quad 2 beds w/cot	Suites Starting rates
	Marriott San Francisco (Hdqtrs)	US $175	US $175	US $175	US $195	N/A	US $195	US $215	N/A	US $349
	Marriott Student Rate	US $140	US $140	US $140	US $160	N/A	US $160	US $180	N/A	N/A
	Intercontinental San Francisco	US $175	US $175	US $175	US $195	N/A	US $215	US $215	N/A	US $269
	Intercontinental Student Rate	US $140	US $140	US $140	US $160	N/A	US $180	US $180	N/A	N/A
	W Hotel San Francisco	US $169	US $169	US $169	US $209	N/A	US $239	US $249	N/A	US $1000
	W Hotel Student Rate	US $140	US $140	US $140	US $180	N/A	US $210	US $220	N/A	N/A
	Serrano Hotel	US $160	US $160	US $160	US $180	N/A	N/A	US $200	N/A	US $259
	Parc 55 Hotel San Francisco	US $152	US $152	US $152	US $172	N/A	US $192	US $192	N/A	US $625
	Parc 55 Student Rate	US $135	US $135	US $135	US $155	N/A	US $175	US $175	N/A	N/A
	Handlery Union Square Hotel	US $146	US $146	US $146	US $156	N/A	N/A	US $166	N/A	US $300
	Handlery Student Rate	US $136	US $136	US $136	US $146	N/A	N/A	US $156	N/A	N/A
	Holiday Inn Civic Center	US $120	US $120	US $120	US $145	US $165	US $165	US $170	US $190	US $299
	Holiday Inn Student Rate	US $110	US $110	US $110	US $135	US $155	US $155	US $160	US $180	N/A
	The Powell Hotel	US $110	US $110	US $110	US $125	N/A	N/A	US $140	N/A	US $250
	Powell Hotel Student Rate	US $99	US $99	US $99	US $114	N/A	N/A	US $129	N/A	N/A
	Hotel Mark Twain	US $99	US $99	US $99	US $109	N/A	N/A	US $119	N/A	US $209
	Hotel Whitcomb	US $99	US $99	US $99	US $109	US $129	US $129	US $119	US $139	US $295

Special Housing Requests:.

❑ I have disabilities as defined by the ADA that require a sleeping room that is accessible to the physically challenged. My needs are: _____

❑ Other requests: _____

❑ I am a member of a hotel frequent-travel club and would like to receive appropriate credit.

The hotel chain and card number are: _____

Email confirmations (no paper) will be sent by the Marriott, the Intercontinental, the Holiday Inn Civic Center, and the Hotel Whicomb. The other hotels will not be sending confirmations.

If you are not making a reservation, please check off one of the following:

❑ I plan to make a reservation at a later date.

❑ I will be making my own reservations at a hotel not listed. Name of hotel: _____

❑ I live in the area or will be staying privately with family or friends.

❑ I plan to share a room with _____, who is making the reservations.

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

Western Section: Michel L. Lapidus, Department of Mathematics, University of California, Surge Bldg., Riverside, CA 92521-0135; e-mail: lapidus@math.ucr.edu; telephone: 951-827-5910.

Central Section: **Susan J. Friedlander**, Department of Mathematics, University of Illinois at Chicago, 851 S. Morgan (M/C 249), Chicago, IL 60607-7045; e-mail: susan@math.nwu.edu; telephone: 312-996-3041. **Georgia Benkart** (after January 31, 2010), University of Wisconsin-Madison, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706-1388; e-mail: benkart@math.wisc.edu; telephone: 608-263-4283.

Eastern Section: **Steven H. Weintraub**, Department of Mathematics, Lehigh University, Bethlehem, PA 18105-3174; e-mail: steve.weintraub@lehigh.edu; telephone: 610-758-3717.

Southeastern Section: **Matthew Miller,** Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

2009 Seoul, Korea Meeting: Georgia Benkart, University of Wisconsin-Madison, Department of Mathematics, 480 Lincoln Drive, Madison, WI 53706-1388; e-mail: benkart@math.wisc.edu; telephone: 608-263-4283.

The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information can be found at** www.ams.org/meetings/.

Meetings:

Important Information Regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 89 in the January 2009 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of LaTeX is necessary to submit an electronic form, although those who use LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in LaTeX. Visit http://www.ams.org/cgi-bin/abstracts/abstract.pl. Questions about abstracts may be sent to abs-info@ams.org. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (see http://www.ams.org/meetings/ for the most up-to-date information on these conferences.)

Co-sponsored conferences:

February 18–22, 2010: AAAS Meeting in San Diego, CA (please see www.aaas.org/meetings for more information).

March 18-21, 2010: First International Conference on Mathematics and Statistics, AUS-ICMS '10, American University of Sharjah, Sharjah, United Arab Emirates (please see http://www.aus.edu/conferences/icms10/ for more information).

June 17-19, 2010: Coimbra Meeting on 0-1 Matrix Theory and Related Topics, University of Coimbra, Portugal (for more information please see http://www.mat.uc.pt/~cmf/01MatrixTheory).

A World *Without* Mathematics ...

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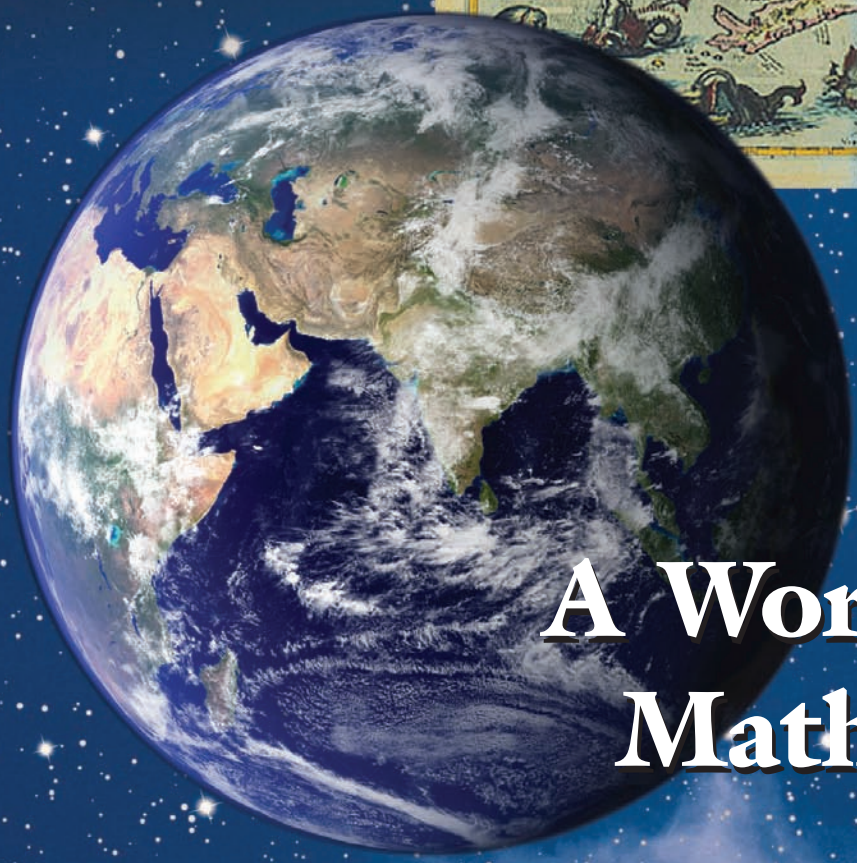

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