AIMath

The Newsletter of the American Institute of Mathematics

Groundbreaking at Morgan Hill

The groundbreaking ceremony for the new home of the American Institute of Mathematics in Morgan Hill, California was held on Thursday, May 31, 2007. Marking the next phase in its move to the Morgan Hill facility, the American Institute of Mathematics celebrated this event with friends and supporters.

Participating in the groundbreaking ceremony were the Honorable Jerry McNerney, 11th Congressional District of California and Mayor Steve Tate of Morgan Hill. Also present was Mr Steve Sorenson, co-founder and President of the AIM Board of Trustees, and Professor Gerald Alexanderson of Santa Clara University and Chairman of the Board of Trustees.

Ron Graham, member of the AIM Advisory Board and Irwin and Joan Jacobs Chair of Computer and Information Science at UC San Diego, hosted the ceremony, and began by sharing the letter of endorsement of AIM from the president of the National Academy of Sciences. Morgan Hill mayor Steve Tate welcomed AIM to the Morgan Hill community and spoke of the mutual benefits that AIM's move to Morgan Hill will bring. AIM Executive Director Brian Conrey conveyed the Institute's excitement at the breadth of opportunities made possible by bringing together a world-class mathematical research community and the enthusiasm of the Morgan Hill residents.

Representative McNerney addressed the gathering of more than 300 people by stressing the universal value of problem-solving skills that mathematical training brings to an increasingly technological society. He also presented congressional certificates to seven Morgan Hill students in recognition for their outstanding performances in MathCounts, a national math competition for middle-school students. Finally, Steve Sorenson recounted the beginnings of AIM, describing it as a model for fostering productive collaboration amongst the research community with the goal of solving important mathematical problems.

Adding to the celebrations was the announcement of a resolution between AIM and the Morgan Hill Unified School District partnering to further the knowledge of the District's students and teachers through new initiatives and programs.

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Groundbreaking for the American Institute of Mathematics in Morgan Hill, California.

From the Director

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Greetings from Palo Alto! It's been a very eventful year for AIM, highlighted by E_8, the groundbreaking and the renewal of our grant as one of the seven NSF-funded mathematics institutes in the U.S. (see www.mathinstitutes.org for information about this group).

The magnitude of the E_8 story last March took us all by surprise. It's true that many people spent several months preparing for its release, but we never imagined the way it would reach people's imaginations. In the end the story was covered by about 200 TV stations, more than 1000 newspapers, and I don't know how much radio. My personal favorites: getting interviewed on NPR's *All Things Considered,* the Tuesday of the week the story broke when three TV stations with camera crews were at AIM at the same time, one of them doing a live broadcast from AIM, and the story in the Spokane (Tacoma) newspaper about Peter Trapa's mom and what it was like to raise a genius!

The Groundbreaking ceremony in Morgan Hill was absolutely amazing! I don't know what else to say about it, except that we really appreciate Congressman Jerry McNerney's keynote speech. The mathematics community is very fortunate that McNerney, who is only the second U.S. Congressman ever to hold a Ph.D. in mathematics, is willing to share his time with us.

The NSF renewal was a big step. The AIM staff all agree that it feels like AIM is entering a new phase, somehow playing a bigger role in the mathematics community. Our workshop model seems to have caught on, at least with many mathematicians, and we often hear that "more workshops" should be done in this style. It has taken the full five years of the first grant for our workshops to evolve to a state that we are reasonably happy with. I would say that one of the key things that has helped us the most in this process was the idea that our workshops generally consist of two lectures in the mornings and some form of group work in the afternoons.

A new initiative that is part of our next five year plan is the introduction of Structured Quartet Research Ensembles, or SQuaREs - don't you just love that acronym? - which are groups of 4 to 8 mathematicians who meet at AIM for one to two weeks per year for a period of one to three years. These are almost like mini-FRGs (FRG stands for Focused Research Groups, and is one of NSF's best initiatives in the last decade). The plan is to ramp up over the course of the next five years from 5 to 30 SQuaREs per year.

I would like to take this opportunity to thank Rachel Kuske for her service to AIM over this last year and to congratulate her on her new position as Chair of Mathematics at the University of British Columbia. And I would like to welcome Leslie Hogben into the position vacated by Rachel. We are absolutely delighted to have Leslie on board!

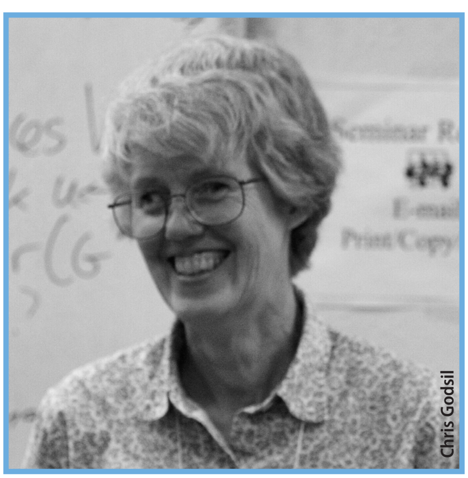
(Continued on page 11)

J. Brian Conrey

New AIM Appointment

The American Institute of Mathematics is pleased to announce the appointment of Leslie Hogben as the Associate Director for Program Diversity.

Leslie Hogben is a professor of mathematics at Iowa State University. She received her Ph.D. in 1978 from Yale University. Originally working in non-associative algebra, she shifted her research focus to linear algebra, especially combinatorial matrix theory. She particularly enjoys doing research with graduate and undergraduate students.



Hogben is an associate editor of *Linear Algebra and Its Applications*, editor of *Handbook of Linear Algebra*, and the Assistant Secretary/Treasurer of the International Linear Algebra Society.

Leslie Hogben,
Associate Director for Program Diversity

Groundbreaking at Morgan Hill

(Continued from page 1)

AIM's "castle" is inspired by the majestic Moorish Alhambra palace in Granada, Spain, and there are plans to host the first of its focused research workshops in Fall, 2009. The 167,000 sq.ft. facility will incorporate a large, open meeting area, seminar rooms, a dining hall, and accommodation for visitors to the Institute. In addition, it will house the AIM library comprising a comprehensive mathematical working library, AIM's unique reprint collection, as well as other special collections.

ABOVE: Morgan Hill Mayor Steve Tate BELOW: Congressman Jerry McNerney and Kiley Foster receiving her congressional award.

ABOVE: AIM Trustee Chair Jerry Alexanderson (right) and Frank Farris. BELOW: Congressman Jerry McNerney & congressional awardees.

ABOVE: Executive Director Brian Conrey BELOW: AIM President Steven Sorenson and Dr. Allan Noshino, Secretary, Board of Education

Introducing AIM's New Fellow

During a phone interview, Yi Ni, a Princeton graduate and this year's AIM Five-Year Fellow, seemed hesitant to name a favorite mathematician or teacher. In middle school, he was mostly inspired by books.

"It was after college," he said, "that I found that the life of a mathematician is not boring. Mathematicians are just ordinary people, not nerds, mysterious, or genius. So I thought I could be one, too."

Ni has since gone on to earn his Ph.D. in mathematics. His graduate work in topology also garnered him this year's Five-Year Fellowship, the tenth ever awarded. The Fellowship supports one recent Ph.D. graduate, allowing him or her to focus on research for five years.

Ni plans to use his tenure expanding his original research. Specifically, his Ph.D. work dealt with low-dimensional topology. "When you study topology, sometimes you need tools from other fields of analysis," Ni said. "In my thesis work, I tried to extract some topological information from algebraic information."

Ni first became interested in mathematics while a student in China. He received a B.S. and M.S. from Peking University before coming to the United States to study.

"The mathematics in the US is much better than mathematics in China," Ni said. "Here, you get to know a lot of advanced fields in mathematics."

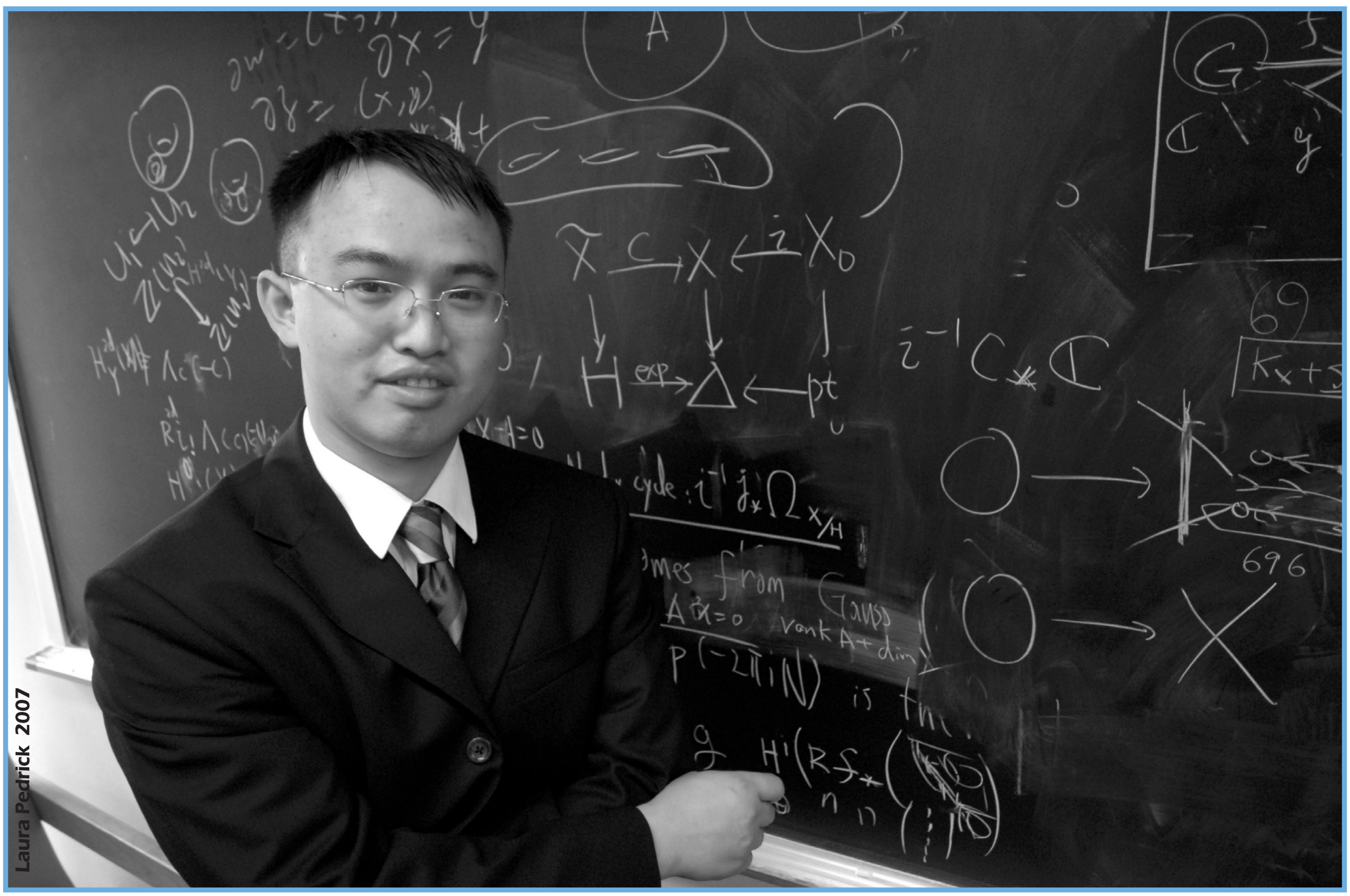
Ni's graduate work is significant. "It partly solves some conjectures in the field," he said, "and leads to interesting corollaries."

Ni plans on researching with Peter Ozsváth at Columbia for a year before switching to M.I.T. "I will study similar situations as my thesis work," Ni said, "but with different questions, and in different directions. I will study my original field, but from a different angle."

At M.I.T., Ni hopes to work with new colleagues. "I expect to learn more mathematics, and work with some junior and senior mathematicians there," he said.

"It will be a very exciting experience for me."

-Lily Beauvilliers



Laura Pedrick 2007

Math Mardi Gras: the tradition continues

Math Mardi Gras, 2007.

AIM hosted its second annual, highly successful, Math Mardi Gras, on March 25, 2007 at the Morgan Hill Community Center. This day of family math activities and friendly competitions attracted over three hundred members of the Morgan Hill community. Students from grades 2 through 12 demonstrated their math skills, learned a new skill, and engaged in various competitions.

The main room of the Community Center was a bustle of activity with Math Jeopardy continuously running at one end of the room, competitions of SET, Sudoku, and Rubik's cube were in the middle, and challenging math booths around the perimeter. Students in various age groups lined up to face their peers in a fast paced, buzzer-hitting game of Math Jeopardy, emceed by the entertaining Dave Holmstrom, a 6th grade MathCounts coach. A highlight of the Math Jeopardy competition was a round in which AIM director Brian Conrey took on his former MathCounts students. They were only able to beat him at one question —maybe next year! About a dozen students ranging in grades from 6 through 9 tried their hand at the Rubik's cube competition, with the fastest able to solve it in under one minute–a dramatic improvement over last year!

SET, a visual matching game, proved to be a marvelous equalizer, with a 4th grader barely beating out a 9th grader for 2nd place. Kids appreciated the opportunity to team up with their parents in the ever-popular Sudoku competition, although this year's final Sudoku round turned out to be quite a challenging one. The various competitions were emceed by Rich Gamboa.

True to the Mardi Gras theme, participants were able to go to different carnival-style booths to earn colorful or black ("expert") Mardi Gras beads. However, rather than tossing a ring, students engaged in various math problems, such as calculating baseball statistics or figuring out the odds of a simple lottery. "Know Your Squares" was a very popular booth, as was "Mind Benders" where math puzzles were offered. Each booth was run by student workers in grades 6-12. These students spent many hours prior to the festival, producing their booth and practicing their presentations under the watchful eyes of adult mentors Alysa Freitas, Jessica Yip, and Lori Mains.

New this year was the addition of a separate room just for 2nd and 3rd graders. Parents and students alike reported that they enjoyed the calmer atmosphere and chance to be with peers of the same age. A popular new booth for this age group was "Measure Up!" where students worked to measure familiar items to the nearest millimeter. This room also featured a special black bead table. Participants who earned a set of colorful beads at a specific booth

SET: a marvellous equalizer.

in the room could ask for the "expert" question, bring it to the black bead table, have their answer checked, and receive the coveted black beads.

One of the most crowded tables, however, had no beads associated with it. A special guest, Dr Hidefumi Katsuura, a professor from San Jose State University, delighted young and old alike with his intricate wooden puzzles. Students also had a hands-on opportunity to understand the relationship between tetrahedra, pyramids, and cubes by building them out of cardstock.

The day culminated with the crowning of the Math Mardi Gras king and queen in each age group (*i.e.* those students who had earned the most beads from the carnival booths). Contestants in the final round of SET were barely able to finish their final round before the audience when a fire alarm rang, evacuating the building. Talk about going out with a bang!

An exciting round of Math Jeopardy hosted by MathCounts coach David Holmstrom.

Workshop Snapshot

Deputy Director Steven Krantz provides a summary of all AIM workshops. The full text of all workshops can be found at ***www.aimath.org/~skrantz/Blurbs***

Rational Curves on Algebraic Varieties *(May 2007)*
Organized by Brendan Hassett and Sándor Kovács

A simple example of a variety is the solution to two polynomials $z_3^2 + z_1^3 = 0$ and $z_2 = z_3^2$ in C^3. This will be a complex curve with a cusp at the origin.

Algebraic geometers are interested in classifying varieties, and in determining when two varieties–with apparently different equations–are the same. An interesting and useful invariant that can be used to address some of these questions is the idea of a "rational curve" in the variety. Here a rational curve is a curve that can be parametrized using rational algebraic functions.

(continued on www.aimath.org/~skrantz/Blurbs/rational.html)

Finding & Keeping Graduate Students in the Mathematical Sciences
Organized by Abbe Herzig, Amy Cohen-Corwin, and David Manderscheid

Current data from the Joint Data Committee of the American Mathematical Society and other professional societies in mathematics and statistics show that, of Ph.D.s in the mathematical sciences awarded to U.S. citizens or permanent residents, fewer than 30% go to women and fewer than 7% to African-Americans, Latino-Americans, and Native Americans combined. These figures indicate that the under-represented populations constitute a huge untapped resource for growth.

(continued on www.aimath.org/~skrantz/Blurbs/attracting.html)

Buildings and Combinatorial Representation Theory *(March 2007)*
Organized by Michael Kapovich, Arun Ram, and Monica Vazirani

One of the focuses of this workshop is group representations. A group representation hands you a new object for which the group is the set of symmetries. A class of groups that has been studied particularly effectively is those groups that can be perceived as a space tiled with mirrors that are arranged in a very symmetric manner. Simple group elements act as reflections in those mirrors.

(continued on www.aimath.org/~skrantz/Blurbs/building.html)

The Tate Conjecture *(July 2007)*
Organized by Dinakar Ramakrishnan and Wayne Raskind

Number theorists and algebraic geometers study algebraic varieties. For us *variety* is the common zero set of a collection of polynomials having coefficients either in the rational numbers $\mathbf{Q}$ or in a finite field like $\mathbf{Z}_p$ (the integers modulo p for p a prime). One can put natural geometric conditions (such as transversal crossing, or no folding) on a variety V so that there are no singularities–the variety is smooth.

(continued on www.aimath.org/~skrantz/Blurbs/tate.html)

Call for Proposals

AIM, the American Institute of Mathematics, sponsors week-long activities in all areas of the mathematical sciences with an emphasis on focused collaborative research.

Workshop Program

AIM invites proposals for its focused workshop program. AIM's workshops are distinguished by their specific mathematical goals. This may involve making progress on a significant unsolved problem or examining the convergence of two distinct areas of mathematics. Workshops are small in size, up to 32 people, to allow for close collaboration among the participants.

SQuaREs Program

AIM also invites proposals for a new program called SQuaREs, Structured Quartet Research Ensembles. More long-term in nature, this program brings together groups of four to eight researchers for 1-2 weeks of focused work on a specific research problem in consecutive years.

More details are available at:

http://www.aimath.org/research/

AIM seeks to promote diversity in the research mathematics community. We encourage proposals which include significant participation of women, underrepresented minorities, junior scientists, and researchers from primarily undergraduate institutions.

Organizer's Perspective

*An account of the "Problems in Geometric Group Theory" workshop at AIM, April 23-27, 2007, by organizer **Rick Scott**, Santa Clara University.*

During the week of April 23-27, 2007, AIM held a workshop entitled "Problems in Geometric Group Theory." Unlike the typical AIM workshop which concentrates efforts of leading mathematicians on a single focused problem, the purpose of this workshop was to discuss ALL of the problems in geometric group theory at once. The field of geometric group theory has grown rapidly in recent years, expanding into many other areas of mathematics. This broad emphasis has the potential to lead to surprising and meaningful connections among different subdisciplines, but it also makes it difficult for interested graduate students or post-docs to learn and keep up with the state of the art. This AIM workshop was part of a larger project to bring together recognized experts to decide upon, organize, and maintain a list of the most fundamental unsolved problems in the field.

The organizers for the workshop were Mladen Bestvina, Tadeusz Januszkiewicz, and myself. For the past ten years, Bestvina has been accumulating and maintaining a list of open problems in Geometric Group Theory. This list was initially posted on his website (with periodic updates), and has become a valuable resource for people working in the area. With the expansion of the field, many new questions have arisen, and many of the old questions have been answered, partially answered, or reformulated. In an effort to involve the larger community in updating the list, Bestvina asked about 20 leading experts to compile lists of their own in various sub-areas. These drafts would then be assembled as a book modeled on, for example, Kirby's list in Low Dimensional Topology (http://math.berkeley.edu/~kirby).

The primary purpose of the AIM workshop was to bring together these experts to discuss the problems, organize the drafts, and make sure there were no omissions among subtopics. Being a fairly young subdiscipline and less "well-trodden" than many of its elder siblings, geometric group theory has very broad appeal, but it is also fairly difficult to navigate. We hoped that discussions about which open questions were most important might serve as both a catalyst and an excuse to have a more general conversation about the frontier of the subject and which directions were worthy of future efforts.

In the process of planning the AIM workshop, we realized that having an effective way to maintain and update the final problem list (post-publication) would be a great way to keep the subject alive and relevant. So we decided to create, in addition to the book, a web-based version of the list modeled on Wikipedia. This "wiki" will be a public-editable website that lists the problems together with background information, progress to date, public discussion, and a mechanism to suggest new problems. A preliminary version of the wiki was set-up prior to the workshop for uploading and discussing drafts, and one of the sessions at the workshop was devoted to a discussion of the wiki. (During this session, it was agreed that the wiki should "go public" at the same time the book goes to press.)

The format we decided upon for the workshop itself was to break into 3-4 groups in the mornings (a deviation from the typical AIM model with lectures in the morning, and smaller group work in the afternoon), then come back together in the afternoons for group reports and further discussion. Each group was assigned one of the subtopics and relevant draft(s) for that subtopic. Group members were asked to come up with 5-10 of the most important questions for that topic, and to report back to the larger group in the afternoon.

Overall, this format worked very well. The actual group activities in the morning depended on the status of the relevant drafts. For detailed or lengthy drafts, the focus was more on prioritizing the lists (in fact some of the proposed

(Continued on page 12)

"In fact some of the proposed open questions were even solved or had proofs outlined during these discussions."

The Teacher's Circle -an AIM initiative

Tatiana Shubin of San Jose State University describes the Teacher's Circle Program from the perspective of a founding organizer.

Imagine the following situation. For twelve years you are forced to acquire skills in using some tools that become more and more intricate, complicated and finally utterly unwieldy – like some gardening tools - trowels, shovels, rakes, hoes, all the way to combines. You practice using them in a gym, with a patch of soil about 1 foot by 1 foot in size and about 1 inch deep, and you are NEVER EVER allowed to get to a real garden and use your tools and skills there. Would you love and cherish your tools? Would you strive to learn and perfect your skills? Preposterous as it sounds, this is exactly what our K-12 math education currently is. Kids are forced to learn algorithms and techniques without ever being allowed to apply them to a situation for which these algorithms and techniques were invented. We believe that this is a main cause of the present crisis in math education, and the only way out of it is by opening the doors of a real and beautiful garden and letting our students do their best in cultivating it. This is what problem solving is about: give the students an interesting and challenging problem and let them use their mental powers to battle it. We math teachers are by their side with helpful tools that will allow them to conquer the beast.

Kids are naturally curious, they love being challenged and they avidly learn things whose usefulness they have ascertained by their own experience. We have witnessed this time and again in the San Jose Math Circle (SJMC) *(see article on page 10)* that we have been running since 1998. However, the number of kids directly affected by the math circles is very limited. Is there a way to overcome this limitation?

It took a master middle school teacher to come up with the idea of a math circle for teachers. Mary Fay-Zenk had been a superb middle school math teacher for more than 20 years and she now serves as the Vice Principal of Miller Middle School. For many years she has been advocating enrichment, specifically problem-solving classes, for all middle schools in her district. She has also encouraged scores of her students to attend the SJMC and has seen the resulting intellectual growth. It was her idea to organize The Teacher's Circle where middle school teachers would practice problem solving and discuss ways to incorporate it into their classrooms. In January 2005, several mathematicians and teachers came together to begin the 18-month process of careful planning the first Teacher's Circle, which was held in August, 2006.

The purpose of The Teacher's Circle is to equip educators with an effective problem-solving approach to teaching mathematics. This style of learning is based on the Math Circle's environment that has proven to be successful for students around the world. Therefore, the Teacher's Circle model immerses a group of middle school math teachers in engaging mathematics and exposes them to a dynamic style of classroom presentation. Participants come away with a variety of resources, lesson modules, and a renewed sense of appreciation for the fascinating world of mathematics.

The Teacher's Circle program started with a summer workshop sponsored by the American Institute of Mathematics (AIM) with some support from the Mathematical Sciences Research Institute. It was held at AIM in Palo Alto during the week of August 14–18, 2006 with more than twenty local middle school mathematics teachers and administrators in attendance. There were also four external observers from St. Louis, MO, Chicago, IL, and Charlotte, NC, three of whom were professional mathematicians.

Workshop Activities

The daily schedule revolved around active problem-solving sessions, led by one of the five instructors for the week (Tom Davis, Tatiana Shubin, Sam Vandervelde, Paul Zeitz, and Joshua Zucker). During these sessions, a variety of problem solving techniques was presented in the context of problems in the areas of number theory, Euclidean and combinatorial geometry, elements of topology, the fourth dimension, symmetry and visualization in algebra, and probability. Less formal hour-long sessions were held in the evenings after dinner.

One of our goals was to demonstrate that problem solving is an effective mechanism for learning, since we believe that it provides the strongest motivation for studying mathematics. We also wanted to free teachers from the fear of tackling difficult problems: that failing to solve a problem in a very short time is a positive rather than negative thing. By thinking hard about a problem for a long time, students of any age learn material at a deeper level. The more often this occurs, the better they are able to absorb new and more complicated concepts.

This notion seems to have been successfully conveyed. "I hope to introduce many of the problems I learned during the week to get my students to think more deeply about problems rather than just calculating an answer," said one participant. This sentiment was echoed by all, along with a commitment to adjust their teaching style to include more open-ended problems for their students, provide more group problem solving time, replace repeated drills with good problems that require patience, and illustrate different methods for approaching a problem.

Collaboration is Essential

A recurring theme in our teachers' responses was that of collaborative learning. Teachers appreciated the collaboration that they experienced at the workshop and how this teamwork enhanced their own learning. They perceived this as the true essence of a math circle, and they are ready to implement more collaboration in their classrooms. Some of their responses were, "I will allow more thinking and collaboration time," and, "I hope that I will be able to integrate more 'student circle' opportunities for kids to be talking to each other while tackling problems."

Teachers also pointed out the positive effect of experiencing different teaching styles from the group leaders. They admitted that even though the instructions were fast-paced and covered many topics, leaving them behind at times, this experience, in itself, was valuable for them. One teacher wrote, "Some of the problem solving was way over my head. Even so, I learned—if only to understand what my students' experience was when lost or overwhelmed."

Another commented, "Some of the topics required us to struggle, but it was a good reminder of how our students might feel, so even that had value."

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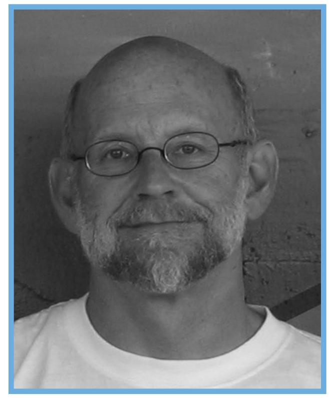
Working groups during the Teacher's Circle Workshop at AIM.

"It is our hope that AIM will serve as the national center for the Teacher's Circles, and that the number of such circles will grow rapidly and steadily."

San Jose Math Circle

Tom Davis

The American Institute of Mathematics participates in a variety of outreach programs, both in the Bay Area and the Morgan Hill community. The San Jose Math Circle was one of AIM's first joint initiatives.



Tom Davis,
co-founder of the San Jose Math Circle.

I first learned about mathematical circles about ten years ago at a presentation at UC Berkeley by Zvezdelina Stankova. As a young girl she had been involved in such circles in Bulgaria and as a high school student won a gold medal in the International Mathematical Olympiad (IMO) for the Bulgarian team. Zvezdelina eventually earned a PhD from Harvard as well as a teaching certificate to teach in high schools. She soon became discouraged by the mathematical education system in the secondary schools in the US. In particular, she noted the imbalance of opportunities between the weakest and the strongest students. And she pointed to mathematical circles as a way to reach and encourage the best students: the ones who were most likely to make a difference in the advancement of science and mathematics.

Mathematical circles bring together interested young people to work on challenging problems-which are distinct from routine exercises. Zvezdelina proposed starting some circles in the United States modeled after the ones she had experienced as a child. As a direct result of that presentation plus a lot of work by volunteers, the first two math circles were formed, one at UC Berkeley, the other at San Jose State University (SJSU).

Zvezdelina became the main organizer for the Berkeley circle, and a team of four people: Tatiana Shubin and David Hayes of SJSU, Brian Conrey of AIM, and the author were co-organizers of the San Jose circle. Both the Berkeley and the San Jose circles have been active since 1998 and we are looking forward to our tenth year beginning in the fall of 2007. Since then, circles have also been organized by Paul Zeitz at the University of San Francisco and Sam Vandervelde at Stanford.

One of the most important differences with a math club is that math circles are hosted by a series of different leaders. In recent years, the San Jose Math Circle (SJMC) has hosted twenty-two meetings annually, and were led by 14 different mathematicians. This has two advantages: the students are exposed to a variety of approaches and the leaders do not "burn-out."

For the first few years, the most difficult part for us in San Jose was recruiting students, since there was no history and it was difficult to spread the word among middle and high school teachers. Now that the SJMC has been running for years, it is advertised by word-of-mouth both by the students who attend and by their teachers. And while, initially, the circles were attended primarily by high school students, the majority of students now come from middle school which is good because we are reaching them at a younger age.

The parents of the San Jose students have been extremely supportive as well. In addition to being some of our best recruiters for students, they generously provide refreshments for the students during the break. We encourage the parents to attend the circles with their children, but we have one rule: the parents stay at the back of the room and do not participate-the circles are for the students. It's clear that the parents get a lot out of the circles, too. At the end of each session I find myself answering almost as many math questions from interested parents as from students.

At San Jose the circles are held approximately three times per month on Wednesday evenings and approximately once per month the circle is replaced by a Bay Area Mathematical Adventures (BAMA) presentation which is usually a talk with a larger audience. On average, every year there are about 30 meetings of the San Jose circle and BAMA together.

The San Jose Math Circle:
www.geometer.org/sjcircle

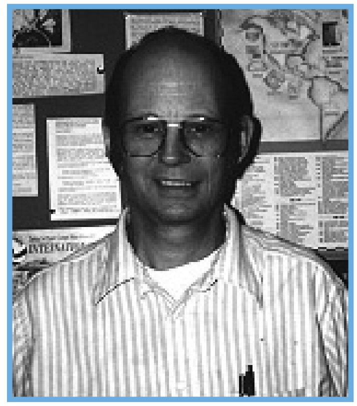
BAMA:
Bay Area Mathematical Adventures
www.mathematicaladventures.org

The Teacher's Circle:
www.theteacherscircle.org

Bay Area Mathematical Adventures

Peter Ross

The American Institute of Mathematics is proud to be a sponsor of the Bay Area Mathematical Adventures from BAMA's beginnings.



Peter Ross,
Santa Clara University

The Bay Area Mathematical Adventures (BAMA) is a series of free public talks by outstanding mathematicians. Initially conceived as a way of sharing the excitement of mathematics with interested high school students, BAMA's events also attract many younger students along with their parents and teachers, and members of the general public who just like mathematics.

Every year, six or so evening talks are sponsored by BAMA, alternating between the campuses of Santa Clara University and San Jose State University. The enthusiastic audiences range in size from 50 to more than 200, and the mathematical topics are very diverse, with the biggest draws appearing to be number theory, combinatorics, and recreational mathematics.

The idea for BAMA originated with Tatiana Shubin of San Jose State and Peter Ross of Santa Clara University when attending Zvedza Stankova's talk about Math Circles at the American Institute of Mathematics (AIM) in Palo Alto in 1998. With support from AIM, they convinced their department chairs to support a program of talks by renowned mathematicians who would present current, challenging problems to high school students.

The BAMA talk series grew alongside the San Jose Math Circle, and together the two programs offer frequent and varied mathematical experiences for the young people in the South Bay area. In fact, BAMA interleaves its talks with the San Jose Math Circle meetings, scheduling their adventures in the weeks during the school year when the Circle doesn't meet.

Over the years the talks have had some amusing, unusual, and even dramatic, moments.

Some Highlights

- Ron Graham's talk that initiated the BAMA series was entitled "Juggling Permutations of the Integers", and featured a half-hour, on-stage, juggling workshop at its conclusion.
- The one and only John Horton Conway spoke on "Some Very Interesting Sequences." His abstract was: "One of the interesting sequences is 1, 11, 21, 1211,111221,312211,13112221, 1113213211, ... "

From the Director *(Continued from page 2)*

The Teacher's Circle represents a large committment by AIM to see its successful implementation on a national scale. The model we envision is a two-year program that is launched with a group of 25 middle school math teachers from a given locale that spend an intensive week doing math under the guidance of three mathematician leaders.

This week is followed by monthly meetings for the next two years punctuated by a weekend meeting for the whole group at the end of the first year.

Here is an example of a problem the teachers worked on during this summers' AIM program; note that, like much of mathematics, it seems impossible at first, but yields, with sufficient thought, reflection, and hard work, a beautiful answer: ``The numbers from 1 to 100 are written on the board. You select two numbers, cross them off the list, and add to the end of the list the sum plus the product of the two selected numbers. Now you have a new list and you repeat the process. Repeat as often as you can. What is the end result of doing this?"

AIM is currently seeking $5 million dollars to launch 100 such Teacher's Circles over the next 10 years.

-J. Brian Conrey

SQuaREs: AIM's new Program

AIM is proud to announce SQuaREs —Structured Quartet Research Ensembles—a program that will foster long-term collaborative efforts on major research initiatives. Teams of four to 8 researchers will gather at AIM for a week or two at various times over a period of up to three years with the goal of making major inroads into some of the most important questions that now challenge mathematicians.

The SQuaREs Program complements AIM's week-long focussed collaborative workshops allowing smaller groups to continue their collaboration over an extended period. Both collaborations arising from AIM workshops as well as those formed independently are encouraged to apply.

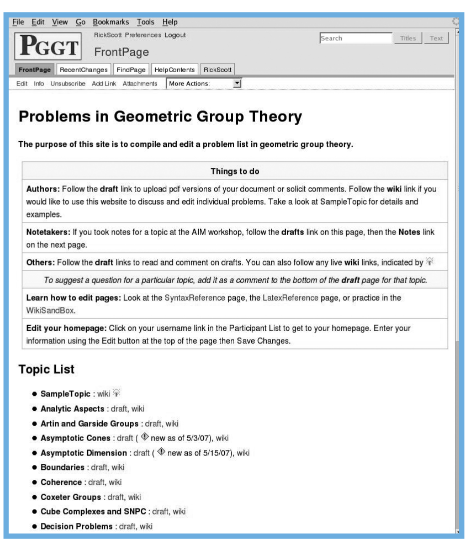
AIM will provide both research facilities and financial support for each SQuaRE group. We solicit SQuaREs in all areas of pure and applied mathematics. Preference is given to groups which contain a mix of junior and senior researchers, and to groups which have not previously collaborated.

Organizer's Perspective

(Continued from page 7)

open questions were even solved or had proofs outlined during these discussions). For sketchier drafts, new questions were proposed and discussed. In all groups, the participants were very active in the discussions, and the authors received excellent suggestions for future drafts.

The afternoon sessions also had broad participation with energetic discussion and speculation. Designated note-takers led off the session by listing the most important questions arising from the morning groups. The ensuing discussions served both to inform the larger group as well as to allow experts from other areas to comment and make further suggestions.



Page from the "Problems in Geometric Group Theory" wiki.

Although the premise for the Geometric Group Theory workshop was different from the typical AIM workshop, two aspects of the AIM model made the Institute an excellent venue. First, bringing together the best people in a given field of mathematics, and second, forcing them to have active discussions rather than just present and listen to lectures.

Call for SQuaREs Proposals

The American Institute of Mathematics (AIM) is committed to developing productive collaborations among mathematical scientists. The SQuaREs Program supports long-term, major research initiatives for small collaborative teams.

Research facilities and financial support are provided for groups of 4-8 researchers to meet for periods of 1-2 weeks at AIM throughout a three-year period. The goal of this program is to make major inroads into some of the most important questions currently challenging mathematics.

AIM seeks proposals for SQuaREs to begin in Summer, 2008 or later. We solicit SQuaREs in all areas of pure and applied mathematics. Instructions and an application form are available on the AIM web-site

www.aimath.org/research/squares.html.

Proposal deadlines are November 1 and May 1.

Preference is given to groups which contain a mix of junior and senior researchers, and to groups which have not previously collaborated. SQuaREs typically meet during weeks when there are no workshops at AIM.

E_8 makes the News

On July 23, 2003 AIM hosted a workshop called "Atlas of Lie Groups" organized by Jeffrey Adams, Dan Barbasch, John Stembridge, Peter Trapa, and David Vogan. Four years and four AIM workshops later the team, now 18-strong, announced that they had calculated all of the Kazhdan-Lustzig-Vogan polynomials for the split real form of the largest exceptional group E_8. This monumental achievement was publicly announced by AIM and the Atlas team on March 21, 2007. To our great delight, the rest of the world was interested! Following the announcement, a week of mayhem ensued which featured dozens of television, radio, newspaper, and magazine interviews of the Atlas team as well as of AIM staff. On Tuesday March 22, there was a live broadcast from AIM of a segment of the San Francisco CBS evening news!

It is fair to say that this publicity has energized the Atlas team in their quest to be able to compute the unitary dual of any Lie Group.

It has been AIM's mission from the beginning to support teams of researchers working over an extended period of time to make important advances. Prior to E_8, the solution of the Perfect Graph conjecture, initiated by AIM and solved by Maria Chudnovsky, Neil Robertson, Paul Seymour, and Robin Thomas was AIM's first major success with this model of research. AIM also played a role in the Goldston, Pintz, Yildirim work on small gaps between primes and on the Madsen - Weiss solution of the Mumford conjecture, both long term efforts by teams that yielded major advances.

American Institute of Mathematics

360 Portage Avenue
Palo Alto, California
94306-2244

www.aimath.org
Phone: (650) 845-2071
Fax: (650) 845-2974

J. Brian Conrey — *Executive Director* — conrey@aimath.org

Steven G. Krantz — *Deputy Director* — skrantz@aimath.org

Leslie Hogben — *Associate Director for Program Diversity* — hogben@aimath.org

David W. Farmer — *Director of Programming* — farmer@aimath.org

Ellen Heffelfinger — *Librarian* — heffel@aimath.org

The Teacher's Circle (Continued from page 9)

The Many Benefits of the Teacher's Circle

Among the aspects of the workshop that participants found to be particularly valuable they mentioned the variety of educators present (middle school teachers, college professors, etc.), the opportunity to work with other teachers that allowed them to weigh and solidify ideas, the time to explore and work on mathematics with a partner or small group, the developing network of teachers with whom they are now able to share ideas, the discovery of new materials and resources, and the compatibility of 'hard' mathematics with a middle school curriculum.

At school, mathematics is often taught as an unrelated collection of facts. At the workshop, teachers were able to see a more coherent picture. Our hope was that our activities and discussions will encourage teachers to begin revealing this interconnectedness of ideas and underlying mathematical structure to their students. We were pleased to read in the final evaluations that teachers said that they would begin "discussing a given topic from as many angles as possible."

The workshop clearly showed that one of the greatest deficiencies in professional development for middle school teachers is the lack of solid mathematical content. All the participating teachers thoroughly enjoyed and valued the mathematics that was offered. Evidently, teachers are starving for mathematics, and math circles for teachers may help to alleviate this problem.

The Teacher's Circle Continues

The summer workshop launched the beginning of The Teacher's Circle's year-long program. An equally important component of the program consisted of seven follow-up meetings, which occurred once a month throughout the school year. Every month from September to April (except December), The Teacher's Circle organized an evening event for middle school math teachers interested in exploring accessible, exciting topics in mathematics and learning about problem-solving approaches to teaching math. We also spent some time discussing what had and hadn't worked in classes and brainstorming about possible problem-solving approaches that could be used for topics that were coming up in the teachers' curriculum. These meetings have been very popular: most of the teachers who participated in the summer program also attended these sessions and even brought colleagues who have since become new members of The Teacher's Circle.

Spreading the Word

We hope that the Teacher's Circle described above will serve as a model for similar circles around the country. To that end, in June 2007, AIM ran a workshop, "How to Run a Teacher's Math Circle." Its participants came as seven teams, each from different cities around the country – Salt Lake City, Tucson, Lincoln, St. Louis, South Bend, Boston, and Charlotte. Each team consisted of middle school teachers, research mathematicians, and school administrators from the district. These teams were selected from among a pool of applicants on the merit of their strong potential for starting teacher's math circles in their own communities. During the mornings of the week-long workshop, participants were able to sample the essence of the Teacher's Circle model by participating in mathematical discussions and working solving related problems. The afternoons had participants working on developing detailed plans of how they would start, run, and sustain their own circles. The workshop organizers, along with AIM's Brian Conrey and David Farmer, assisted the teams by sharing their own experiences in areas including recruitment of teachers and mathematicians, fundraising, finding a venue, and the like.

AIM also invited a panel of local business leaders and prominent fundraisers who provided much relevant advice, stressing the fact that there is a growing awareness of the absolute necessity to drastically change mathematical instruction in all schools, and, particularly, middle schools. This was very encouraging for all, including the organizers, as we feel that the Bay Area needs more Teacher's Circles.

On the last day of the workshop, each team presented their program, complete with the vision and the details of its implementation. There is a firm basis to believe that during the next school year our Teacher's Circle will be joined by several sister circles. It is our hope that AIM will serve as the national center for the Teacher's Circles, and that the number of such circles will grow rapidly and steadily.

The American Institute of Mathematics

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for its continued support of our vision.

In Memoriam

Deborah Tepper Haimo was born in Odessa, Ukraine, raised in Israel, and came to the United States when she was 11 years old. She was an undergraduate at Radcliffe College and a graduate student at Harvard. At the latter institution she studied with Hassler Whitney. She wrote her thesis, "Integral equations associated with Hankel transforms", under the direction of David Widder.

Haimo taught at Washington University in St. Louis and Southern Illinois University before she was hired by the fledgeling University of Missouri in St. Louis Mathematics Department. She twice served as Chair there, and helped to build the department to its current position of strength.

Haimo was a founding member of the Aim Advisory Board. She also served as a member of the Board of Trustees of Radcliffe College and also on the Board of Overseers of Harvard University. She was noted for her service to the profession and for the professional encouragement and nurturing of women mathematicians, and was in 1997 awarded the Yueh-Gin Gung and Dr. Charles Y. Hu Award of the MAA for Distinguished Service.

Haimo, and her late husband Franklin, are also remembered for the important Deborah and Franklin Tepper Haimo Award of the MAA for the recognition of distinguished teaching service.

Haimo died at the age of 85. She is survived by four daughters.

Atle Selberg had a profound influence on twentieth century mathematics. Winner of the Fields Medal in 1950, Selberg contributed major ideas to analysis and number theory.

His most important contribution is the Selberg Trace Formula, a fundamental tool in harmonic analysis on Lie Groups, which is especially useful in the study of automorphic forms.

The Fields Medal was awarded to Selberg for his elementary proof of the Prime Number Theorem. He also invented the Selberg Sieve and developed the general theory of sieves. He made many contributions to the theory of the Riemann zeta-function. He was the first to prove that the Riemann zeta-function has a positive proportion of its zeros on the critical line and laid the groundwork for the proof that the logarithm of the Riemann zeta-function is normally distributed on the critical line. And the Rankin-Selberg convolution, a method for creating new L-functions out of old, opened the door to a grander theory of L-functions.

In 1944 in a Norwegian College Teachers journal, Selberg published a paper on what is now called Selberg's Integral, a fundamental identity in random matrix theory.

Selberg also proved his rigidity theorem, that lattices in Lie groups of rank larger than two cannot be continuously deformed.

Selberg was part of the permanent faculty at the Institute for Advanced Study, having joined that faculty in 1949. Selberg had extended visits to Aim in 1999 and 2001, and was an avid participant in the lunchtime game of bocce .

The Reprint Collection at AIM

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* **single authors** *

* **OR** *

* **collections** *

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The Reprint Library is one of AIM's most prized collections. More than 100,000 reprints can be found on AIM's bookshelves assembled into the "Collected Works" of more than 5000 mathematicians. These volumes of "collected works" are housed in black, 3-ring binders; the author's name is displayed on the spine, with the individual reprints placed in separate plastic protectors inside, much as an individual might sort a reprint collection in his or her private office.

These binders make for a nice browsing experience for AIM visitors. One can see the natural progression of ideas through an author's sequential publications. Our reprint holdings can be found on our web-site: **http://www.aimath.org/library.**

AIM plans to build the most comprehensive reprint library in the world, and is constantly looking to enhance its collection. Please consider sending us reprints of your papers and updating your collections folder as you write new papers. Also, we would warmly welcome the donation of entire reprint collections to our library.

A small portion of the AIM Reprint Library.

Joint Math Meetings in San Diego

Each January, more than 4000 mathematicians gather at the annual meeting of the American Mathematical Society and the Mathematical Association of America. In 2008, the Joint Meetings will be held in San Diego, California. AIM uses this opportunity to spread the word about its activities and to generate interest in ARCC's workshops.

Brian Conrey, Steven Krantz, Leslie Hogben, and David Farmer can be found at the AIM booth in the exhibit area, and are happy to talk with people about AIM and its programs.

AIM also joins in hosting the Mathematics Institute Open House reception. This event is open to all conference participants and provides another venue to learn about each institute's programs and to meet with institute members. Please join us at the Institutes' Reception, 5:30 - 8:00 p.m., Sunday, January 6 in San Diego.

Please join us at the Mathematical Institutes' Open House Reception

Sunday, January 6, 2008
5:30 P.M. - 8:00 P.M.

American Institute of Mathematics
Research Conference Center

The AIM Research Conference Center (ARCC) hosts week-long focused workshops in all areas of the mathematical sciences. ARCC focused workshops are distinguished by their emphasis on a specific mathematical goal, such as making progress on a significant unsolved problem or examining the convergence of two distinct areas of mathematics. Workshops are small in size, up to 32 people, to allow for close collaboration among the participants.

Call for Proposals

Proposals are sought for workshops which will take place in 2008 - 2009.

Proposals require:
- a list of organizers
- a list of potential participants
- a description of the workshop goals
- an outline of how these goals will be met

Proposals will be accepted until November 1, 2007.

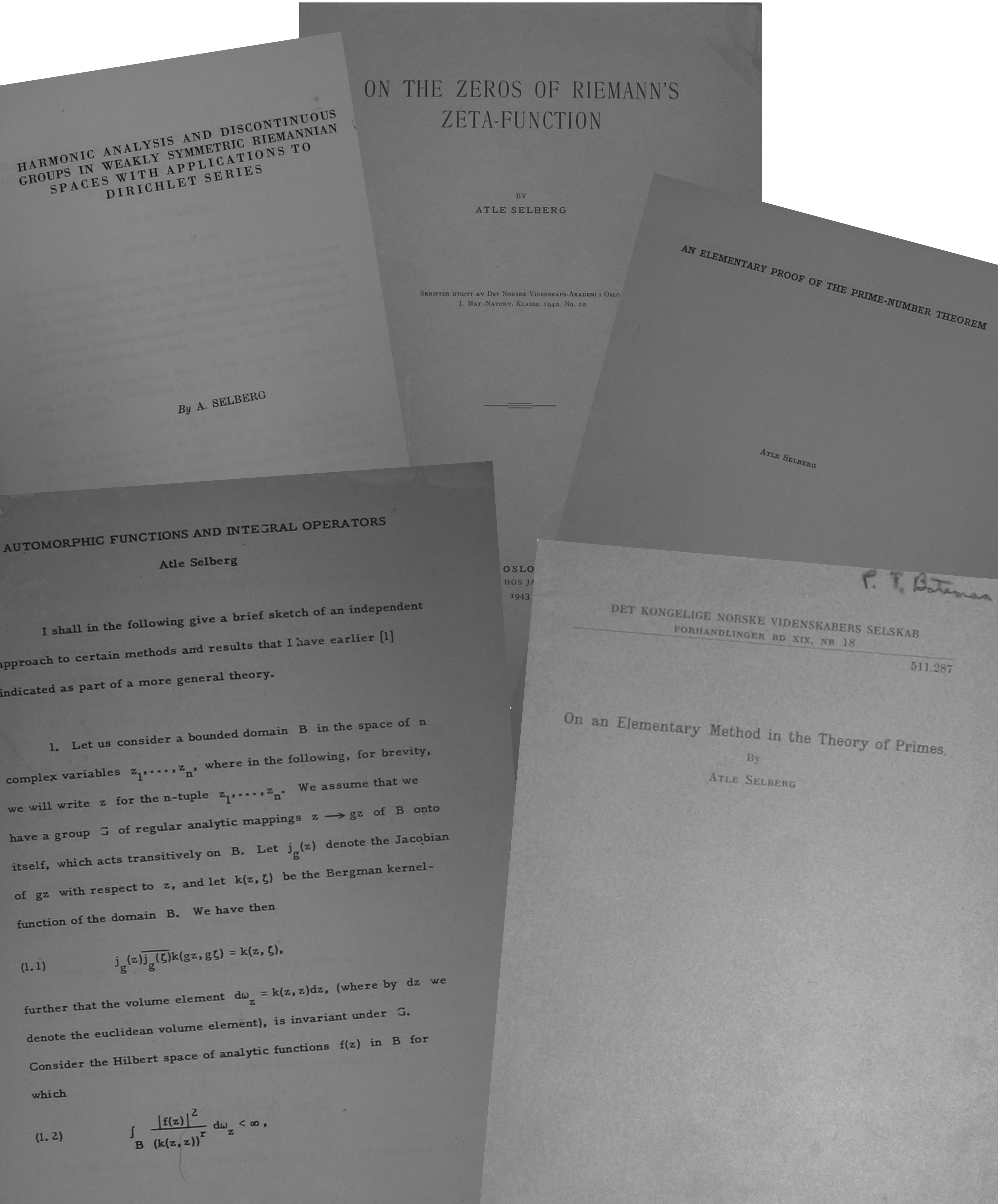
Workshops will be held at AIM in Palo Alto. More details and an online application are available at:
http://www.aimath.org/research

ARCC seeks to promote diversity in the research mathematics community. We encourage proposals which include significant participation of women, underrepresented minorities, junior mathematicians, and researchers from primarily undergraduate institutions.

The future home of ARCC in Morgan Hill, California

Major funding for ARCC is provided by a grant from the National Science Foundation.

Selections from the Selberg Reprint Collection



HARMONIC ANALYSIS AND DISCONTINUOUS GROUPS IN WEAKLY SYMMETRIC RIEMANNIAN SPACES WITH APPLICATIONS TO DIRICHLET SERIES

By A. SELBERG

ON THE ZEROS OF RIEMANN'S ZETA-FUNCTION

BY

ATLE SELBERG

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ATLE SELBERG

AUTOMORPHIC FUNCTIONS AND INTEGRAL OPERATORS

Atle Selberg

I shall in the following give a brief sketch of an independent approach to certain methods and results that I have earlier [1] indicated as part of a more general theory.

1. Let us consider a bounded domain B in the space of n complex variables $z_1, \dots, z_n$, where in the following, for brevity, we will write z for the n-tuple $z_1, \dots, z_n$. We assume that we have a group G of regular analytic mappings $z \longrightarrow gz$ of B onto itself, which acts transitively on B. Let $j_g(z)$ denote the Jacobian of gz with respect to z, and let $k(z, \zeta)$ be the Bergman kernel-function of the domain B. We have then

(1.1) $$j_g(z)\overline{j_g(\zeta)}k(gz, g\zeta) = k(z, \zeta),$$

further that the volume element $d\omega_z = k(z,z)dz$, (where by dz we denote the euclidean volume element), is invariant under G. Consider the Hilbert space of analytic functions f(z) in B for which

(1.2) $$\int_B \frac{|f(z)|^2}{(k(z,z))^r} d\omega_z < \infty,$$

P. T. Bateman

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On an Elementary Method in the Theory of Primes.

By

ATLE SELBERG