

The American Institute of Mathematics

The last twenty years have seen a sharp increase in the number of mathematics institutes worldwide. They vary greatly in size, structure, and tradition, but there is nothing quite like the American Institute of Mathematics (AIM). Established as a non-profit organization in 1994, AIM is almost entirely funded through the personal donations of one man, John Fry. Today AIM has established itself as a small center for visiting mathematicians and an organizer of high-profile conferences. Plans are under way to establish conference facilities and a library just south of California's Silicon Valley on property which Fry bought for the purpose. Though AIM lost out in the recent competition for mathematics institute funding from the NSF¹, it is proceeding with plans for a "distributed institute", which combines talent and resources from nine universities around the country.

John Fry's family owned a successful chain of supermarkets in California. After the family sold that chain, Fry and his two brothers started another one consisting of stores selling electronics equipment. There are now about twenty Fry's Electronics stores, mostly in the western states. They sell not only off-the-shelf items like computer software and CD players but also all the component parts one would need to build, say, a supercomputer. Many of the Fry's Electronics stores are decorated according to various themes—one is West-

¹See "Recompetition of NSF-Funded Mathematics Institutes", *Notices*, January 1997, pages 33-36. A brief update appeared in "NSF-Funded Institutes Recompensation", *Notices*, January 1999, page 54.

Photographs courtesy of Brian Conrey/AIM.

ern, one is made to look like a Mayan temple, one draws images from *Alice in Wonderland*.

While an undergraduate mathematics major at Santa Clara University in the 1970s, Fry considered graduate school but opted instead to pursue a career in business. His love of mathematics and its history persisted, and he became an avid collector of rare mathematics books. When in the early 1990s Fry had the idea of establishing a world-class mathematics library, he had a natural connection in Gerald Alexanderson of Santa Clara University, whom Fry knew from his collegiate years. The library idea eventually grew into a plan for a mathematics institute. Fry also tapped a former classmate from Santa Clara, J. Brian Conrey, who is currently on a five-year leave from Oklahoma State University, to serve as director of AIM. Both Alexanderson and Conrey have been prominent in the U.S. mathematical community. Alexanderson has been part of the leadership of the Mathematical Association of America for many years and in January of this year finished a term as MAA president. Conrey gained prominence for his accomplishments as department chair at Oklahoma State.

The idea for AIM first took root in 1993, but it was not until the summer of 1996 that the Institute drew widespread attention. At the Seattle Mathfest that August, AIM, with partial support from the NSF and the National Security Agency, sponsored a symposium called "In Celebration of the Centenary of the Prime Number Theorem: A Symposium on the Riemann Hypothesis". The symposium's kickoff event, a rare lecture by 1950 Fields Medalist Atle Selberg, drew an audience about five hundred strong. The symposium at-

tracted world experts in mathematics and theoretical physics and sparked press coverage in the Seattle newspapers and national publications.

Around that same time, an attempt to establish AIM at Stanford University fell through. Conrey came on board in the fall of 1997, and in February of last year AIM set up shop in its current headquarters, a 10,000-square-foot space in the same building as a Fry's Electronics store in downtown Palo Alto; the space is donated by Fry. There are two seminar rooms and fourteen offices for visiting mathematicians, whose numbers at any one time might range from one or two to half a dozen. In the summer of 1998, for example, the offices were filled with number theorists, including Peter Sarnak of Princeton University, Henryk Iwaniec and William Duke of Rutgers University, Steve Gonek of the University of Rochester, Chris Hall of IBM, and Gabriel Berger of Boston College. AIM paid the researchers' salaries while they were in residence. Conrey, who is himself a number theorist and took part in the research, said the group worked incessantly and wrote a number of papers.

AIM's emphasis on number theory and its sponsorship of the symposium on the Riemann Hypothesis have fueled perceptions that the Institute is focused on a somewhat naive attempt to crack the Riemann Hypothesis by setting the world's experts to work on it. In fact, AIM has supported research in other areas of mathematics, such as topology (the Poincaré conjecture), analysis and partial differential equations (the Lagrangian Plateau problem and the 3-dimensional Euler equation), and algebraic K-theory (the Bloch-Kato conjecture). On the other hand, it is true that AIM's basic mode of operation is to bring together high-powered teams of mathematicians focused on specific research projects, pay them well, and expect results. "Fry appreciates the intellectual intensity of this endeavor, and he wants to support it," Conrey said. While Fry "would love to have a team of researchers funded by AIM solve a big problem," Conrey explained, Fry also values incremental progress. When papers are written by researchers supported by AIM, "he can see a direct effect from the money that is put into it." Asked whether this is a sufficient reward, Conrey replied, "For Fry, it is."

AIM's proposal for the NSF institute competition outlined a plan for a "distributed institute" made up of small research groups at eight universities: California Institute of Technology, Oklahoma State University, Princeton University, Rice University, University of California (San Diego), University of Maryland, University of Washington, and Washington University in St. Louis. Each university would establish a small group working on a specific research problem and arrange reductions in the teaching, advising, and committee responsi-

bilities of the senior researchers. AIM would pay salaries of senior visitors, and NSF would chip in support for younger researchers, post-docs, and graduate students. There were also plans to bring undergraduates, high school students, and teachers into the fold through appropriate research experiences. A project centered at Caltech under Barry Simon would create an online mathematics encyclopedia to be used by mathematicians. The proposal requested \$13.3 million from NSF, with \$12.0 million coming from AIM and \$7.3 million from the universities. The proposal was turned down for a couple of reasons, chief among them the perception that AIM simply added a layer of bureaucracy between the NSF

and the mathematics departments of the affiliated universities. In addition, some referees thought the financial commitment from Fry was not clearly stated.

Despite the lack of NSF funding for the proposal, the system of AIM affiliates is in place. Conrey said that AIM plans to submit proposals to the NSF for smaller projects; in fact, AIM has already submitted one such proposal prepared jointly with Stanford University, which has now joined as an AIM affiliate. AIM is currently supporting one of the projects which was described in the institute proposal and which is centered at Princeton Uni-

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J. Brian Conrey, AIM director.

versity. Led by Princeton faculty Charles Fefferman, Demetrios Christodoulou, Sergiu Klainerman, and Yakov Sinai, the project also includes Alexander Shnirelman of Tel Aviv University, Peter Constantin of the University of Chicago, and Diego Cordoba of the Institute for Advanced Study. The project focuses on investigation of singularities in the 3-dimensional Euler equations. AIM has also funded smaller research projects at Oklahoma State and Rice and is proceeding with the online

encyclopedia. In addition to the symposium on the Riemann Hypothesis, two other AIM-supported conferences have been held: one was a followup to the symposium and was held at the Schrödinger Institute in Vienna in September 1998, and the other was held in 1997 at Stanford University to honor the achievements of Lars Ahlfors, who died in 1996. In keeping with Fry's original dream, AIM is building a mathematics library, with current books and periodicals for use by mathematicians and rare books available to scholars in the history of mathematics.

Plans are being developed for the establishment of an AIM facility on a 200-acre property in Morgan Hill, about twenty miles south of San Jose. The county has bought much of the surrounding area for parkland and has been putting in walking and equestrian trails. AIM's idea is to create in this bucolic setting a conference center similar to the

well-known one at Oberwolfach in the Black Forest in Germany. The AIM property has several buildings, including one which comprises 40,000 square feet over two floors and looks out over a valley. This building will likely house the dining facilities and the library. There is also an octagonal building that would be well suited as a lecture hall. Housing for visitors would have to be purchased on adjoining lots or constructed.

The director and a half-time librarian are currently the only AIM employees. Conrey, who receives a six-figure salary from AIM, lives in a house in Morgan Hill owned by Fry. The Board of Trustees of AIM comprises Alexanderson, Fry, and Stephen Sorenson, a director at Fry's Electronics. Scientific advice is provided by the AIM Research Board (see sidebar). The affiliates are overseen by an Operating Board, which, in addition to Sorenson and Conrey, consists of representatives from the affiliate institutions. The AIM Advisory Board, which has been in place since 1994 and which is currently chaired by Keith Devlin of St. Mary's College, provides broad advice on general matters but does not take part in the day-to-day functioning of the Institute. The AIM Library Board is chaired by R. Keith Dennis of Cornell University. AIM does not solicit applications from visitors or proposals to fund research projects or conferences, but rather relies on ideas funneled through the Research Board or the Operating Board. Final decisions about what to fund are made by the Board of Trustees.

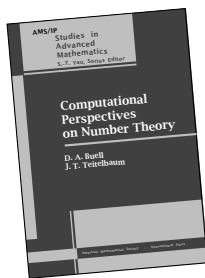
According to Conrey, AIM does not have a set budget, but in the past year it has spent about \$300,000, all of it donated by Fry. Recently, Sorenson secured a donation from Applied Materials Corporation. Conrey intends to do more fundraising for AIM in Silicon Valley. "To make this work, we can't just rely on Fry's money," he remarked. "I would like to have a broad base of support in Silicon Valley." The valley, he said, "is unlike anywhere else in the world. People just get excited about mathematics and technology. People here see the value of mathematics research." To raise its visibility among the general public, AIM is hosting a series of public lectures by well-known mathematicians. For example, in 1996 AIM sponsored such a lecture by Peter Hilton on computational complexity, and on March 24 of this year Andrew Wiles delivered one that was cosponsored by AIM and Stanford University and that was entitled "Fermat's Legacy".

During the meeting in Seattle where the symposium on the Riemann Hypothesis was held, AIM organized a roundtable discussion to



AIM property in Morgan Hill, CA.

Number Theory



Computational Perspectives on Number Theory Proceedings of a Conference in Honor of A. O. L. Atkin

D. A. Buell, *Center for Computing Sciences, Bowie, MD*, and

J. T. Teitelbaum, *University of*

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This volume contains papers presented at the conference "Computational Perspectives on Number Theory" held at the University of Illinois at Chicago in honor of the retirement of A. O. L. Atkin. In keeping with Atkin's interests and work, the papers cover a range of topics, including algebraic number theory, p -adic modular forms and modular curves. Many of the papers reflect Atkin's particular interest in computational and algorithmic questions.

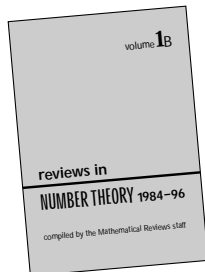
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collect ideas about things it could do. One of the suggestions put forward was that AIM should find the best postdoc in mathematics and fund that person for five years. "So, AIM did it," Conrey said simply. Kannan Soundararajan, a former student of Sarnak who had written twelve papers by the time he finished his doctorate in 1998, is receiving a five-year AIM fellowship consisting of \$48,000 per year, plus \$4,000 for travel and incidentals. Soundararajan spent the first year of the fellowship teaching part-time at Princeton. Conrey said he expects Soundararajan will spend some time at the AIM headquarters in Palo Alto, "but he doesn't have to be anywhere in particular." Soundararajan "is a unique individual," Conrey remarked. "There are a few postdocs who could really benefit from this, and he is one of them." Conrey said that AIM may award such fellowships once every couple of years. No application or nomination procedure is yet in place, so AIM will rely on its boards for suggestions.

The fellowship to Soundararajan demonstrates how private funding can bring the flexibility to capitalize on opportunities. On the other hand, some observers worry that this same flexibility means that the funding for AIM could dry up quickly, should Fry lose interest. Conrey for one is not worried about this prospect. He is looking far into the future as he moves ahead with plans for the Morgan Hill facility, with its library and conference center, and for solidifying AIM's standing as an important center for mathematics research. "The main goal," he said, "is that, twenty years from now, AIM should be here, doing good things."

—Allyn Jackson



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