Fall 2002

EMISSARY

Mathematical Sciences Research Institute

www.msri.org

Notes from the Director

Michael Singer

After having served as Deputy Director last year, I have moved on to become Acting Director while David Eisenbud is on partial leave. David is alive and well and doing mathematics on the third floor as a member of the year-long Commutative Algebra program. In addition, he is still involved in fund raising and continues to offer a helping hand and advice (only when asked!).

Bob Megginson has come on board as Deputy Director. Bob has a long association with MSRI, having served as Chair of our Human Resources Advisory Committee and as a member of the Board of Trustees. He definitely knows the ropes and has been great at dealing with the thousands of things that cross the Deputy Director's desk. He has been a terrrific source of ideas and has saved me from myself more than once.

We are just at the start of a one-semester program in Quantum Computing and a year-long program in Commutative Algebra. Both began with workshops that were truly introductions (and invitations) to their fields. Do check out some of the talks on our web site.

(continued on page 2)

Arlie Petters Receives First Blackwell–Tapia Prize

Bob Megginson

The first David H. Blackwell – Richard A. Tapia Prize has been awarded to Arlie O. Petters, William and Sue Gross Associate Professor in the Department of Mathematics at Duke University. This prize, established this year by MSRI and Cornell University, will be presented every other year to a mathematical scientist who has contributed significantly to his or her field of expertise, and who has served as a role model for mathematical scientists and students from under-represented minority groups or contributed in other significant ways to the addressing of the problem of the under-representation of minorities in mathematics.

Petters emigrated from Belize to the United States in 1979 and became an American citizen in 1990. After receiving Bachelor's and Master's degrees in mathematics and physics from Hunter College at CUNY, he was awarded a Bell Laboratories Cooperative Research Fellowship to continue his graduate studies. He did his doctoral work in mathematics at MIT and Princeton, receiving his Ph.D. from MIT in 1991 under the direction of Bertram Kostant (MIT) and David Spergel (Princeton). His thesis title was *Singularities in Gravitational Microlensing*. After five years on the mathematics faculty of Princeton, he accepted the William and Sue Gross Chair at Duke, and became Duke's first tenured African American in mathematics.

(continued on page 3)

Contents

Notes from the Director

(continued from page 1)

Next semester a program in Semiclassical Analysis will share the building with the second half of the Commutative Algebra year. Besides several program-related workshops, we will host this academic year the workshops: Recent Progress in Random Matrix Theory, Semidefinite Programming (our Hot Topics workshop), Event Risk (at the Alliance Capital Conference Center in New York City), The Feynman Integral Along with Related Topics and Applications and The History of Algebra in the Nineteenth and Twentieth Centuries. We will also be hosting a Conference in Honor of David Blackwell and Richard A. Tapia and awarding the first Blackwell–Tapia Prize to Arlie O. Petters (see front page).

We are always looking for good ideas for programs and workshops. Information about proposing them is on our website, but you can also just call and chat with David or Bob or me about your ideas.

Celebrating 20 Years of Programs

In the Fall of 1982, MSRI hosted its first two programs: Nonlinear Partial Differential Equations and Mathematical Statistics. Since then we have hosted 55 semester and year long programs, all listed on the back of our new MSRI T-shirt (below) or you can find them together with links to streaming video of lectures at http://www.msri.org/calendar/pastprograms-old.html. To celebrate this anniversary, we've organized several events this fall. As I write this in early October, we have just begun the CINEMATH film festival, jointly sponsored by the Pacific Film Archive.

The back of our 20-year T-shirt, designed by Liana King. The front shows our logo. To order, go to www.msri.org and click on the T-shirt photo at the bottom.

Films in this series are introduced by Dave Bayer, Keith Devlin, Ron Graham and Bob Osserman and were chosen to provide an in-depth view of how math has been presented in the movies as structure, metaphor, and story. To see a list of the films you can go to http://www.msri.org/20thanniversary/cinemath.html. Another event in our celebration will be a panel discussion "The Honors Class: Hilbert's Problems in Perspective". Moderated by David Hoffman, the panel includes Benjamin Yandell, author of the *The Honors Class: Hilbert's Problems and their Solvers*, Constance Reid, author of *Hilbert*, Michael Atiyah and Paul Cohen. Our celebration culminates with a reception and public talk by Michael Atiyah entitled "Geometry and Physics: from Plato to Hawking" on October 26. All our anniversary events are listed at http://www.msri.org/20thanniversary/.

Jim Sotiros has put together an illustrated chronology of the early days (page 12). If you have reminiscences or pictures from the first few years of MSRI please let me know. I'd like to publish some more of these in future issues.

MSRI Spiffs Up Its Logo!

To commemorate our anniverary we have also refined our logo. We have had so many versions of the old logo and now seemed like a good time to standardize it and clean it up. The new logo appears on the front of the MSRI T-shirt.

MSRI
Mathematical Sciences Research Institute

Building Addition

Things are moving along with our plans to replace our lecture hall and add more features to our building. Although we will not change the office capacity of the building, we will expand the library, open up the atrium, add a real kitchen, a common room, some small conference rooms, and most importantly, an upgraded and expanded lecture hall. See pages 7–10 for details.

The present building is a wonderful place, but these changes have been needed for a long time. I could tell you about the obvious science-facilitating benefits of meeting and lecture rooms, but just remember: a real kitchen means we have the opportunity of having someone prepare lunches on site every day and maybe even fresh baked goodies for tea.

Our New Address

The road we share with the Space Sciences Labs now has a name: Gauss Way. The University originally wanted to name the road after the star Albireo, whose components shine blue and gold (try and guess the official colors of UC Berkeley!). David suggested

that we honor Carl Friedrich Gauss instead. With the help of the space scientists, who were delighted that we suggested the name of one of their favorite astronomers, we carried the day.

We immediately started lobbying the City of Oakland to give us a number whose significance matches that of our street name. Gauss's first contribution to mathematics was to show, when he was nineteen, that one can construct a regular 17-gon with straightedge and compass. This problem was known to the Greeks over 2000 years before Gauss, but no progress had been made on it prior to Gauss's solution. Until this point Gauss had not decided between philology or mathematics, but with this result he finally made the right choice.

I have just heard that Oakland has granted our wish. Let me be the first to invite you to visit us at 17 Gauss Way.

The View from the Top

A few weeks ago I gave one of my new calling cards to someone who did not know of my august position in life. He took one look and got all excited. "Acting Director!", he said. "We need to talk. I hope you can help me, I've always been interested in acting."

Petters Receives Blackwell–Tapia Prize

(continued from page 1)

Petters's scientific work is in mathematical physics. His current research interests include the development of a rigorous mathematical theory of light deflection in gravitational fields and the investigation of the observational consequences of the theorems in such a theory. His many awards and honors include Duke's Bass Chair in Recognition of Excellence in Research and Teaching, a National Science Foundation Faculty Early Career Award, an Alfred P. Sloan Research Fellowship, and induction into the Hall of Fame of Hunter College of the City University of New York.

A popular and effective advisor and mentor of undergraduates, Petters was presented the 1996 Service Award of the Princetonians of Color Network. He is a frequent guest speaker at events for minority students at all levels from elementary through graduate school, and the excitement with which he describes his work is infectious. As a co-organizer for the Seventh Conference for African American Researchers in the Mathematical Sciences, held at Duke in 2001, he has helped bring together minority professionals with graduate students to foster mentoring relationships and provide the students with evidence that others from backgrounds like their own are succeeding in mathematics-based fields.

The Blackwell–Tapia Prize was established by MSRI and Cornell in honor of David Blackwell and Richard Tapia, distinguished mathematical scientists who have been inspirations to more than a generation of African American and Hispanic American students and professionals in the mathematical sciences. Blackwell was the seventh African American to obtain a Ph.D. in Mathematics, receiving it in 1941 from the University of Illinois for his thesis on *Some Properties of Markoff Chains*, written under Joseph Doob. After holding positions at the Institute for Advanced Study, Southern University, Clark College (now Clark-Atlanta University), and Howard University, where he chaired the Mathematics Department (1947–1954), Blackwell came to Berkeley's Department of Statistics in 1954. He remained at Berkeley for the rest of his career, serving as chair of Statistics 1957-1961. His eighty papers contain many original and important contributions to the mathematical sciences, with the Rao–Blackwell Theorem probably being the one most familiar to students of statistics from their earliest introduction to the field.

Blackwell's many honors include election to the National Academy of Sciences in 1965 as its first African American member, as well as election to the American Academy of Arts and Sciences. He is also an honorary member of the Royal Statistical Society, and has served as President of the Institute of Mathematical Statistics and Vice President of the American Statistical Association, the International Statistical Institute, and the American Mathematical Society. Though now Professor Emeritus, he remains active in his field as well as in issues affecting the representation of minorities in the mathematical sciences, and serves on MSRI's Human Resources Advisory Commitee.

Richard Tapia is the son of immigrants from Mexico who spent his precollege years in the Los Angeles Public School System before attending Harbor Junior College. He then continued on to UCLA, where he received his B.A. and M.A. in Mathematics before obtaining his Ph.D. there in 1967 for his thesis on *A Generalization of Newton's Method with an Application to the Euler–Lagrange Equation*. After positions at UCLA and the University of Wisconsin, he moved to Rice University in 1970 where he chaired the Mathematics Department 1978-1983 and, since 1991, has been Noah Harding Professor of Computational and Applied Mathematics. He has published over eighty papers and given numerous invited addresses on a wide-ranging collection of topics.

A partial listing of Tapia's awards and honors includes election to the National Academy of Engineering in 1992 as its first native-born Hispanic American member, appointment to the National Science Board in 1996 and selection for a U.S. Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring that same year, the 1997 Lifetime Mentor Award from the AAAS, the 1999 Giants in Science Award from the Quality Education for Minorities Network, and, just to prove that mathematicians really can have a very broad range of outside interests, a world record set by him and his twin brother in 1968 for elapsed time for fuel dragsters. To hear more about that last achievement, be sure to attend his invited hour talk on *The Mathematics of Drag Racing* at the 2003 Baltimore Joint Mathematics Meetings.

The Blackwell–Tapia Prize was presented to Petters at a conference in honor of Blackwell and Tapia held at MSRI on November 1-2, 2002, with both Blackwell and Tapia in attendance. The prize and conference organizing committee consisted of Carlos Castillo-Chávez, David Eisenbud, Fern Y. Hunt, William A. Massey (co-chair), Robert Megginson (ex officio), Juan Meza (co-chair), and Michael Singer (ex officio).

An Innovative Way of Training Junior Mathematicians for Research in Blood Flow

Stanley Berger, Giovanni Galdi and Anne Robertson

From time immemorial blood has been the subject of myth and fable, a symbol of identity in family and in nation, indeed, a symbol of life itself. Throughout history, it has engaged the physician, the biologist, and even the occasional uncategorizable genius such as Leonardo da Vinci. It was more recently, chiefly in the last half of the twentieth century, that applied mathematicians, as well as specialists in fluid and solid mechanics, have joined this assembly, each group bringing to bear the strengths of their disciplines, but also, not surprisingly, a certain narrow focus. Thus, while their contributions were great, they were somewhat disjoint, in some part because we have long known more about blood than about the vessels through which it flows.

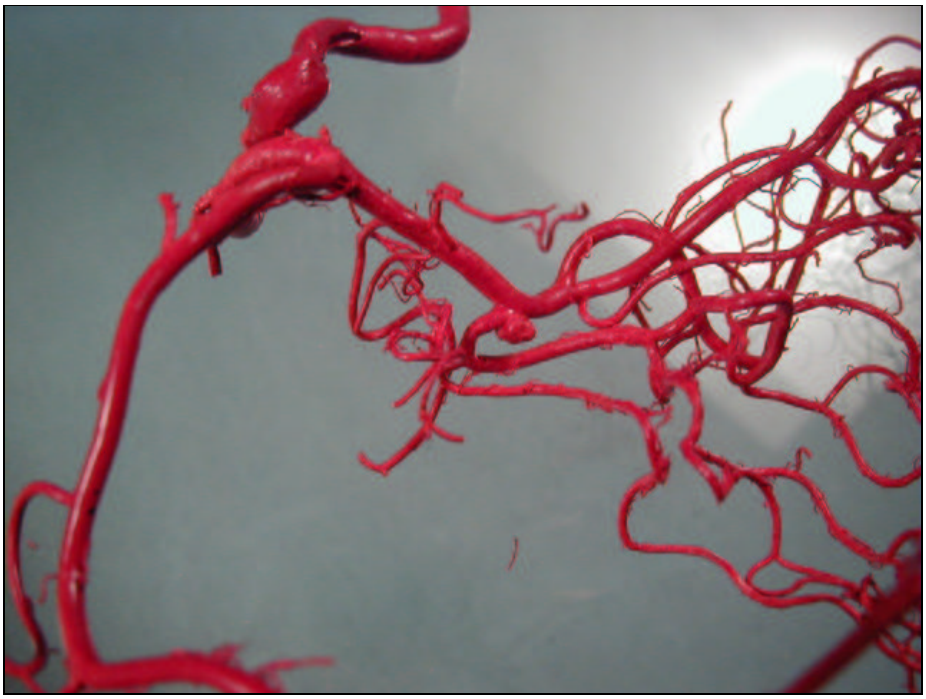
At this beginning of a new century, using powerful analytical and computational tools, we are poised to make significant new advances in our understanding of blood flow. The training of a new generation of scholars to carry the brunt of this effort requires that we take stock of what has already been done, but, equally, take the opportunity to construct a consistent, rational structure, using whenever applicable the techniques and tools of continuum mechanics, unifying research on the vessel wall and the flow of blood.

Initially, blood flow research covered a broad range of subjects, but soon began to specialize in narrowly focused fields of research with little interaction. This isolation is now seen as a drawback, given the perspective and insights that other disciplines may provide. The importance of collaborations across disciplines while maintaining a depth in individual fields is now recognized. However, productive cross-disciplinary interactions between specialists demand that researchers have an appreciation of the challenges and advances in other fields and a knowledge of the vocabulary needed to engage in dialogue across professional boundaries.

The *International School on Biomathematics, Bioengineering and Clinical Aspects of Blood Flow*, held from July 23 to August 10, 2002 at MSRI, was designed to address this challenge, by exposing specialized junior researchers to advances in blood flow research from numerous perspectives. To do this successfully, it was necessary to take a novel approach to organizing the school. Specifically, junior researchers were taught the required fundamentals and were exposed to recent advances in blood flow research in cross-disciplinary areas, including bioengineering, medicine, numerical analysis and continuum mechanics. To this end, the main lecturers of the school were chosen among internationally renowned surgeons, mathematicians and engineers.

Because of their diverse backgrounds and expertise, it was essential that the main speakers and organizing committee met well before the beginning of the school, to coordinate their lectures and provide a coherent picture in the main lectures. With this goal in mind, a special session was arranged at the international conference *Contemporary Challenges in Applied Fluid Dynamics* held in Capo Miseno, Italy, from May 31 to June 5, 2001. This conference was organized by Remigio Russo, Giulio Starita and Paolo Maremonti of the University of Naples II, Italy. Six out of seven members of the organizing committee participated in the special session, which included two days of lectures (including short lectures by students), a round table discussion of plans for the summer school and a meeting of the scientific committee. It was considered a great success by the participating faculty and students, including participants working outside the field of bioengineering.

Another challenge was to handle the diverse scientific backgrounds among the junior participants. As expected, most participants were graduate and postgraduate mathematicians with little knowledge of continuum mechanics. To overcome this problem, an optional introductory tutorial session of the summer school was designed to provide a common background and vocabulary necessary for the latter main lectures. This session was composed of two short courses covering fundamental graduate level continuum mechanics (fluid mechanics and solid mechanics) given by Vincenzo Coscia (University of Ferrara, Italy) and a course by Riccardo Sacco (Politecnico di Milano, Italy) on mathematics and numerical methods.



Cast from a section of human cerebral arterial system, displaying a cerebral aneurysm within the complex architecture of the arterial system (courtesy C. Kerber, UCSD).

Several workshop students, about to get their blood flowing in a fast-paced walk along the hill trails behind MSRI. Behind them is Deputy Director Bob Megginson.

To ensure that the participating students had the opportunity to acquire the fundamentals necessary for the subsequent main courses, the lecturers provided detailed notes, assigned optional homework and held office hours.

The second week and part of the third week were mainly taken by five short courses given by seven faculty with expertise ranging from neurosurgery to applied mathematics. These courses were chosen to cover both fundamental subjects (biofluid dynamics, anatomy and physiology, mechanical behavior of blood and the arterial wall, mathematical modeling and numerical simulation of the vascular system) as well as emerging subject areas such as applications of MEMS (micro-electromechanical systems) and nanotechnology to biological problems. The majority of the faculty provided detailed notes for the students.

The remaining part of the second week and most of the third week consisted of a series of seven invited lectures (one and a half hours each) by internationally distinguished senior researchers. These invited lectures treated state-of-the-art themes and presented important open questions in the field.

The human circulatory system is significantly more complex than typical engineered fluid systems, because of the elaborate branching vascular network, the heterogenous multiphase makeup of blood, the composite character of the arterial walls, and the nature of the geometry and structure of arteries, which evolve in response to mechanical loads, diseases and aging. As a result, idealizations necessary and ubiquitous to scientific and mathematical studies can sometimes oversimplify analysis of the human circulatory system to the point of irrelevance to clinicians. It is essential that those immersed in the field of blood flow work closely with clinicians to evaluate their models and take advantage of the clinicians' wealth of first hand knowledge. Main lecturer Howard Yonas, a neurosurgeon at the U. of Pittsburgh, contributed to the school with lectures on the cerebral circulatory system, including a discussion of current open challenges in clinical treatment of cerebral vascular diseases such as aneurysms and arteriovenous malformations as well as atherosclerosis of the carotid arteries. Harvey Borovetz (U. of Pittsburgh) discussed the physiology of the heart and a variety of specialized applied subjects including artificial heart technology and blood substitutes.

It is not possible, even with current computational power, to perform a complete unsteady three-dimensional analysis of large sections of the circulatory system. Typically either a small section of the vasculature, such as a single bifurcation, is analyzed using the full governing equations, or large sections of the vasculature are studied using 1-D or lumped parameter approximations of the full equations. In his main course, Biofluid dynamics, Stanley A. Berger (U. of California, Berkeley) focused on the formulation of Womersley's pioneering 1-D models that laid the foundation for most of the current work on 1-D models of the circulatory system. Dr. Berger went on to elucidate the implications of these models for unsteady flow in arteries.

Recently, progress has been made in coupling these local and global models in order to capture the multi-scale nature of blood flow: local flow behavior is influenced by and in turn influences the flow in the whole system. Main lecturer Alfio Quarteroni (Politecnico di Milano and U. of Lausanne) covered fundamental mathe-

Anne Robertson (left), Heather Van Dyke, Stanley Berger and Giovanni Galdi.

matical and numerical issues pertaining to modeling of the vascular system, and more specialized topics such as recent contributions from his group on multi-scale modeling of the circulatory system.

In the early days of bioengineering, soft biological tissue was typically modeled as a linear material. As the field matured, more sophisticated constitutive models have been assimilated. Characterisics such as nonlinearity, viscoelasticity and anisotropy are now commonly included in analysis of soft tissue such as heart valves, as well as in studies of diseases such as cerebral and abdominal aortic aneurysms. Anne M. Robertson (U. of Pittsburgh) addressed the subject of the arterial wall in a series of main lectures covering the structure and function of arteries, nonlinear elasticity as related to arteries, and recent applications to modeling the initiation and development of cerebral aneurysms. In an invited talk, "In-vivo estimations, ex-vivo simulations and in-silico fabrications", David A. Vorp (U. of Pittsburgh) discussed subjects including recent experimental and theoretical work developing constitutive models for abdominal aortic aneurysm tissue in human patients.

Charles Peskin (Courant Institute of Mathematical Sciences) presented an invited lecture describing the *immersed boundary method* he developed as well as results he has obtained modeling the heart as a fiber-reinforced fluid. In a second lecture, he discussed an electric circuit analog to model the transition of the prenatal to postnatal circulation and the use of this model for studying heart pathologies.

In the majority of studies of blood flow in large arteries, the role of individual blood cells is believed to play a minor role and blood is treated as a homogeneous fluid. The bulk fluid is then modeled as either Newtonian, or in some studies as a generalized Newtonian fluid to capture the shear thinning properties it displays. Adelia Sequeira (Instituto Superior Técnico of Lisbon), a main lecturer for the school, reviewed non-Newtonian constitutive models used for blood including some recent models that have viscoelastic properties as well as shear thinning. She discussed the well-posedness of these models with particular focus on the viscoelastic models.

Over the last two decades, our perception of the role of the cells lining the lumen of the circulatory system, (endothelial cells), has transformed. In-vitro and in-vivo studies have shown that these cells are extremely responsive and sensitive to mechanical loading, for example arising from blood flow through the artery. It is now recognized that endothelial cells play an essential role in regulation of vessel diameter and arterial wall remodeling and a major role in vascular diseases such as atherosclerosis. Significant open questions remain regarding the molecular mechanisms by which these mechanical forces are transformed to chemical signals. Invited lecturer, John Frangos (La Jolla Bioengineering Institute) addressed these subjects in his talk, "Cellular Responses to Temporal Gradients in Fluid Shear Stress".

Improvements in both clinical imaging modalities such as MR angiography as well as increases in readily available computational power have made it possible to seriously work towards the goal of developing computational fluid dynamic tools for patient-specific studies. Ultimately, these computational tools will be used by surgeons to explore treatment for individual patients prior to surgery. Three invited speakers addressed this important field. Ömer Savas (U. of California, Berkeley) discussed results from recent experimental studies in exact-replica phantoms of atherosclerotic carotid bifurcations as well as associated numerical studies. David Saloner (U. of California, San Francisco) presented a lecture on imaging of vascular disease including recent work applied to carotid bifurcations and cerebral aneurysms. Thomas F. Budinger (U. of California, Berkeley, Head of the Center for Functional Imaging, Lawrence Berkeley National Laboratory) presented a more general but related lecture on biomedical imaging and blood flow.

Building on the immense amount of work in the field of microelectronics and MEMS, the field of BioMEMS (Biomedical Micro Electro Mechanical Systems) took off in the late 1990s. Dorian Liepmann (U. of California, Berkeley) gave two main lectures in which he discussed current research in this field including biochemical "labs-on-a-chip", microsurgical tools, and smart drug delivery. Luke P. Lee (U. of California, Berkeley) followed this with two main lectures on related subjects including recent work in biophotonics and biomedical polymer opto-electro- mechanical systems for nano- and microscale medicine.

AfterMath: Tax-Wise Giving

Gift and estate planning can have a lot to do with self-expression and the desire to leave a legacy. Many mathematicians leave a substantial legacy in their research and life's work, and to their families. Others also leave a legacy through strategic philanthropic support of organizations important to them. MSRI may be one of these for you.

The purpose of estate planning is to assure that the disposition of your assets at death is not left to the "one size fits all" rules of state law, and to minimize the cost and burden on your loved ones of dealing with your final affairs. Proper tax planning can increase the amount of your estate available to your beneficiaries — and that tax planning can include charitable giving to non-profit organizations like MSRI.

MSRI has gift and estate planning questionnaires to help with your estate planning questions, and can also work with you one-on-one to help you find answers that will form the basis of your estate plan. A great place to start is to simply contact MSRI for a questionnaire and your attorney to create a will or Living Trust. We would appreciate your including the Mathematical Sciences Research Institute in your plans, or to add the Institute as the beneficiary of your IRA or retirement plan. Those who do so become members of the MSRI Gauss Society.

If you have questions or would like more information, please contact Director of Development Jim Sotiros at 510-643-6056 or JSotiros@msri.org. If you have already included MSRI in your estate plan, let Jim know so he can include you in the Gauss Society.

AfterMath is not intended as tax advice. Individual financial circumstances require specific professional guidance. Please contact your legal and financial advisors to see how these general issues apply to you.

MSRI Launches Building Campaign

MSRI is getting ready to expand and improve its home, and is raising funds to turn these plans into reality. On this and subsequent pages you can see how the new space will be used and what our new lecture hall will look like. Doug Lind, Chair of the present Building Committee, describes the process that led to the plans you see here and how the expansion will improve the present building.

Building is not cheap, so MSRI announced on October 25 at a joint meeting of the Academic Sponsors and Trustees a fund raising effort to raise the necessary $7.3 million.

MSRI's director, David Eisenbud, has been devoting many hours to pre-campaign planning. "Our early efforts have borne great fruit: $6.5 million has been committed to this project thus far."

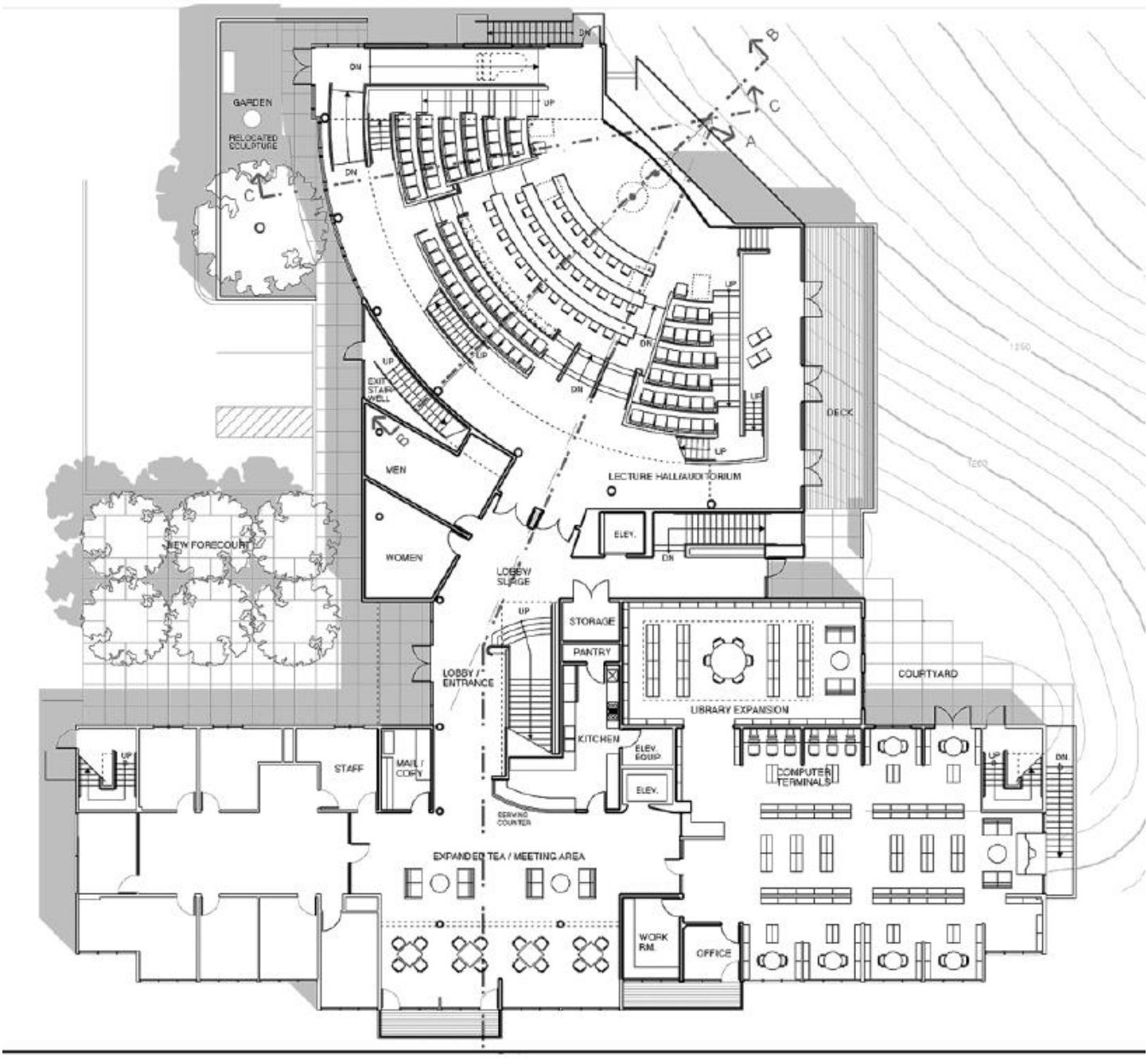
The building campaign actually began a few years ago with an extraordinarily generous $500,000 commitment from Shiing-Shen Chern, MSRI's Founding Director. This was followed very quickly by a $2.5 million challenge grant from MSRI trustee Jim Simons and his wife Marilyn. This grant matches cash contributions made to MSRI on a 1:1 basis up to the $2.5 million total.

Success has also come from foundations across the country. The prestigious Kresge Foundation has awarded $650,000 and a challenge: the funds will only be available if the campaign reaches its goal. The East Bay's Wayne and Gladys Valley Foundation has made a strong statement of support awarding $500,000 for the project.

The MSRI building campaign is chaired by trustees Jim Simons and Roger Strauch. MSRI Trustee David Hodges is Vice Chairman, and committee members include former Board of Trustees Chairman Elwyn Berlekamp, Trustee David Forney, former Trustee Ron Stern, Trustee Doug Lind, and Board Chairman Robert Bryant. David Eisenbud, Michael Singer, Bob Megginson, Gisela Fränken and Jim Sotiros serve on the committee ex officio.

MSRI's friends who are interested in supporting this cause are encouraged to contact the Institute's Development Director, Jim Sotiros, at 510-643-6056 or JSotiros@msri.org. Contributions can be made directly from the Campaign web page at www.msri.org.

Architect Bill Glass's sketch of the enlarged MSRI building in its surroundings.



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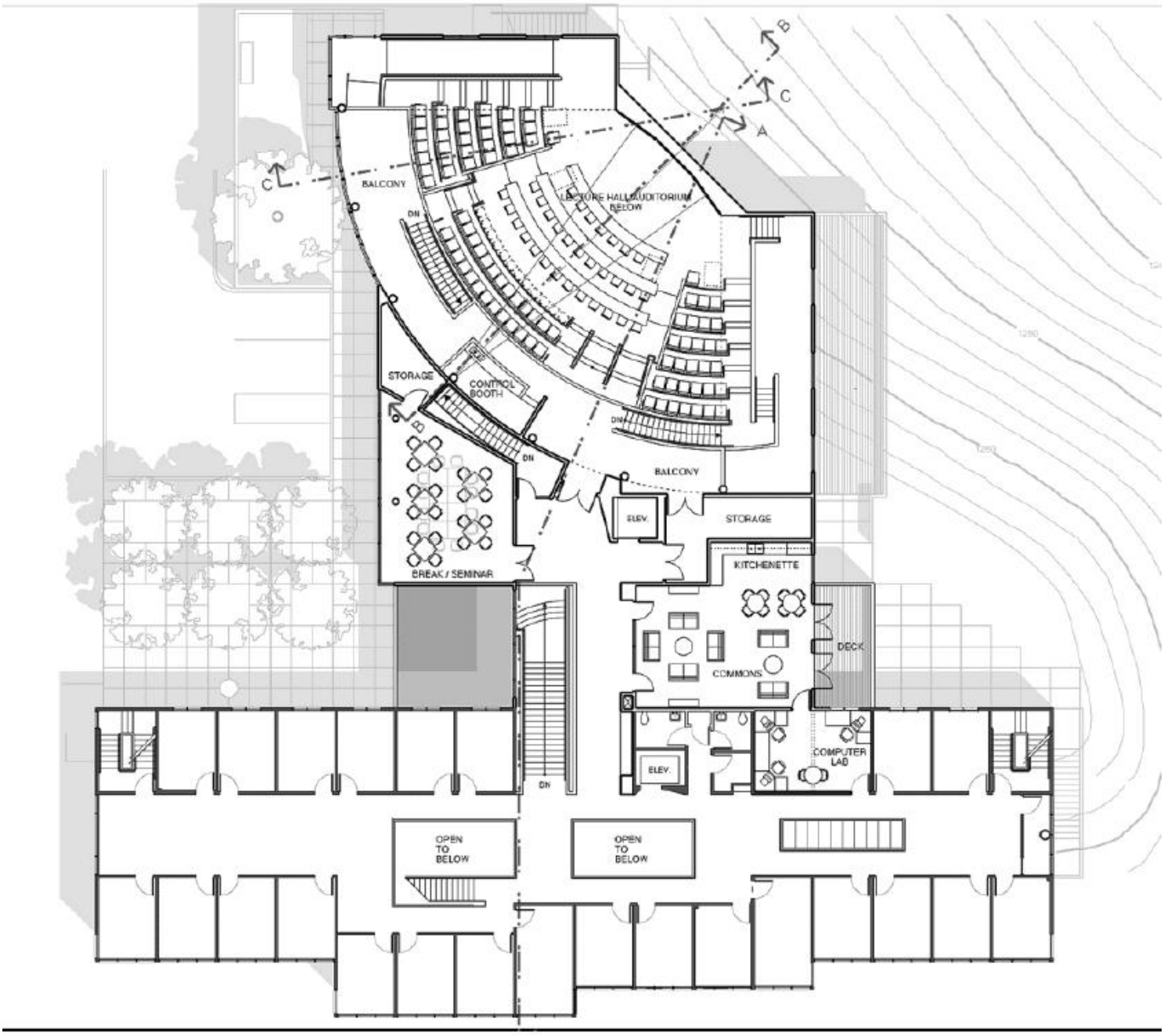
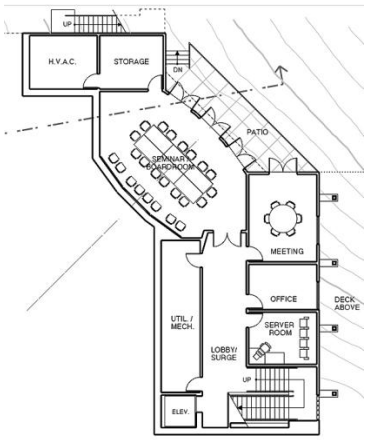
First floor plan of the building with the addition. The currently built area is shown by the red outline on the left. Besides the new auditorium and lecture hall, which is the centerpiece of the addition and occupies two floors, several modifications are made on this level: the library will expand to occupy part of the old lecture hall; the present atrium will become more open and contiguous to a professional kitchen suitable for catering; a large deck facing south will provide a stunning view of the wooded slopes, the city of Oakland and the south San Francisco Bay.



The second level (above) will have a new common room with a kitchenette for individual use, a large seminar room, some storage space, and a new computer lab in place of two offices that lose their windows; these two offices are regained elsewhere, leaving the total occupancy by researchers unchanged. The third level of the current building remains essentially the same and is not shown. A new floor (right) is created below the new auditorium, thanks to the steep hill slope. It will have a boardroom, a small meeting room, more storage space and a server room.



Designing the Expansion Plan

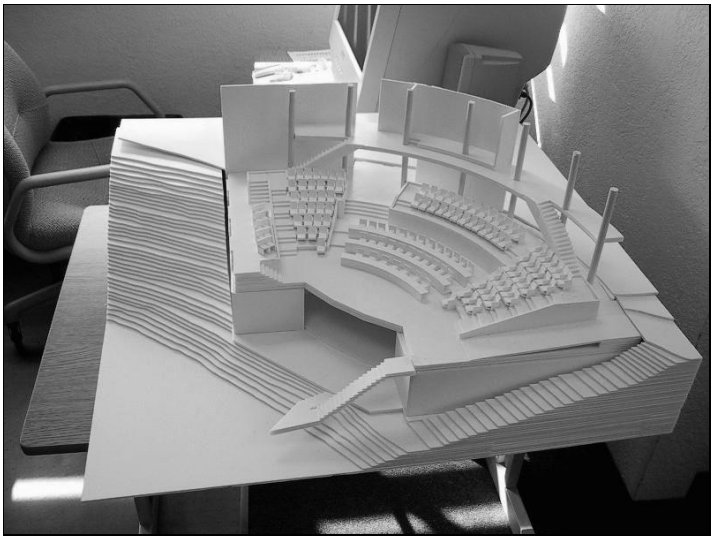
Doug Lind

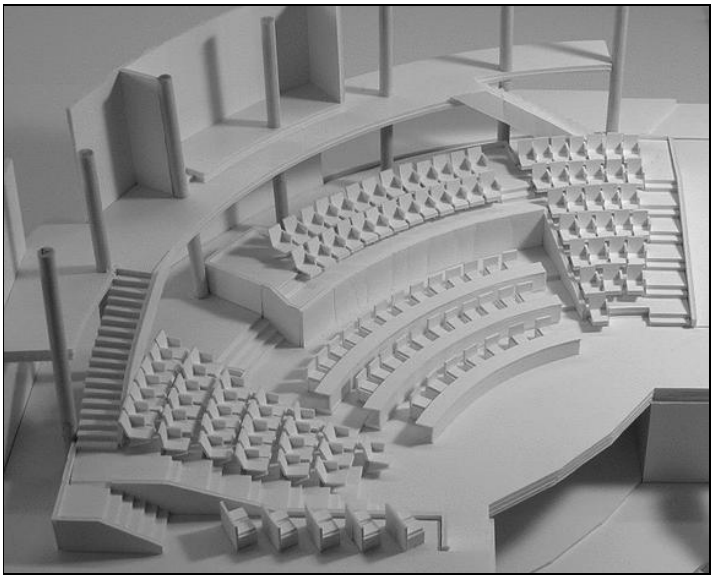
Over the past few years the inadequacies of the current MSRI building for supporting a world-class institute became increasingly clear. The lecture hall is cramped and lacks tiered seating for clear views, and its recording facilities to make lectures available on the internet are confined to a jumble of equipment at the back of the hall. The library has run out of space. There are no seminar rooms where small groups can work. The atrium entrance is no substitute for the common room present in many successful institutes. The kitchen does not meet the standards that the university requires to serve regular lunches and other meals. Storage space has long since been used up. Heating and ventilation leave much to be desired in summer- and wintertime.

To meet this challenge, in the summer of 2000 David Eisenbud and Dusa McDuff (then chair of the Board of Trustees) appointed a Building Committee, charged with developing a concrete plan for improvement and expansion of the current building. Members of this committee, besides myself, are Richard Brualdi (Wisconsin) , David Eisenbud (MSRI), Gisela Franken (MSRI), David Hoffman (MSRI), Dusa McDuff (Stony Brook), Bob Megginson (Michigan), Cal Moore (UC Berkeley), Jim Sotiros (MSRI), and Carol Wood (Wesleyan). The Building Committee worked very closely with Bill Glass, architect of the original MSRI building, and received substantial help from MSRI's Silvio Levy, Michael Singer and David Zetland.

The committee set a target of having a complete plan ready for the meeting of the Trustees in March, 2001. Starting with an initial draft plan from Bill Glass, based on earlier work in 1993 for Bill Thurston, the committee met for three formal meetings, for two informal ones, and held a number of conference telephone calls. The plans went through five revisions to refine and improve them, based on years of experience with how MSRI functions. Bill Glass's models helped enormously in visualizing the arrangement of components.

The new lecture hall takes advantage of the natural slope to the east of the current building to provide tiered seating. (The slope is shown by steps on the model shown on the right.) The main innovation is a special section of seating in front for holding the regular seminars that are the usual mainstay of the programs. A control booth at the back is used for recording lectures and managing computer displays. The old lecture hall is used for the library expansion. By using compact shelving, the plan doubles the capacity of the current library. On the second floor of the expansion, a new common room with kitchenette is located between the lecture hall and the current building, including an outside deck opening to the south. A new seminar room across the hall from the common room will have projection facilities to accommodate overflow crowds from the lecture hall. The common room blocks the windows of two current offices, and these have been re-deployed as a computer lab, freeing up some offices currently used for this.





Model of the new lecture hall, made by Architect Bill Glass. Above: Hall shown in its mountainside environment. Below: The cozy "sub-hall" will be used for small seminars; the overall room seats 145.

At the center of the first floor is a professional kitchen, with pantry and a serving counter opening on to the atrium. This replaces the current kitchen and eating area, which will be removed to double the window space looking to the west. Underneath the new lecture hall is a combination seminar/meeting room opening onto an outside deck. This area also includes a smaller seminar room, a room for computer servers and equipment, and additional storage space. As part of the expansion project, the ventilation and heating systems will be upgraded.

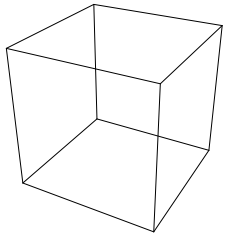
The Building Committee feels this plan solves all the major problems with the current structure, and will provide MSRI with a truly world class facility. As one committee member remarked, the final plans made everyone involved feel "unreasonably happy"!

Douglas Lind (University of Washington) is the chair of the MSRI's Committee for Academic Sponsors, an ex-officio member of the Board of Trustees and the chair of the Board's Building Committee.

Puzzles Column

Joe P. Buhler and Elwyn R. Berlekamp

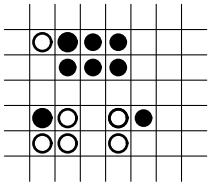
1. A 12 inch length of wire is to be cut into pieces that are used to construct the frame (i.e., the edges) of a cube with 1-inch sides. What is the smallest possible number of pieces into which the wire must be cut?



Source: This is a problem in a new MAA book *The Inquisitive Problem Solver*, by Paul Vaderlind, Richard Guy, and Loren Larson; the book contains an entertaining collection of problems from Sweden that are aimed at a general audience.

2. The new combinatorial game "Clobber" is played by two players, white and black, on a rectangular `m` by `n` checkerboard. In the initial position, all squares are occupied by a stone, with white stones on the white squares and black stones on the black squares. A player moves by picking up one of their stones and clobbering an opponent's stone on an adjacent square (horizontally or vertically). The clobbered stone is removed from the board and replaced by the stone that was moved. The game ends when one player, on their turn, is unable to move, and then that player loses.

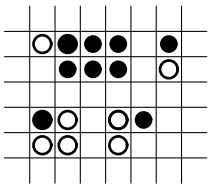
Near the end of a game of Clobber, the following position arises:



Question 1: If Black goes first, who can win?

Question 2: If White goes first, who can win?

What are the answers to the same questions for the following position?



Source: Clobber was invented in 2001 in Halifax by Richard Nowakowski, J. P. Grossman and Michael Albert. The first competitive clobber tournament was held at Dagstuhl, Germany, in February 2002. Much more information about the game can be found on the web site www.gustavus.edu/~wolfe/games/clobber/.

3. Find the area of the convex octagon that can be inscribed in a circle and that has four consecutive sides of length 3 and the remaining four consecutive sides of length 2.

Source: The 1978 William Lowell Putnam Exam (and *Proofs Without Words II*, by Roger Nelsen, MAA, 2000).

4. A warden meets with 23 prisoners as they arrive. He explains the prison rules, and then allows them to meet each other, talk, and have a strategy session. The prisoners are then taken to their solitary cells, and no further communication between the prisoners is possible.

In the prison there is a "switch room" containing two electrical switches (not connected to anything), each with two positions. From time to time the warden chooses a prisoner and takes him to the switch room; after observing the switches the prisoner is required to choose one switch and reverse its state. (The prisoners know nothing about the initial state of the switches.) The prisoner is then returned to solitary confinement. The only constraint on the warden's behavior is that each prisoner must be taken to the switch room infinitely often, i.e., any individual prisoner knows that he will sooner or later be taken to the switch room, and after that sooner or later taken to the switch room again, etc.

At any time, a prisoner can announce to the warden that "By now, all of us have visited the switch room." If this is a true statement, the prisoners are all freed. If it is false, the prisoners are all executed. Clearly, no prisoner will make this statement unless they are absolutely sure that it is true.

Devise a strategy for the prisoners which will guarantee their release.

Source: This problem has apparently been circulating for a while, and appeared on IBM's puzzle web site "Ponder This" at www.research.ibm.com/ponder/. Each month, a puzzle is posted on that site, and a solution (together with a list of people who solved it) is posted at the end of the month. The prisoners problem was the July, 2002 challenge.

The Cha Scholars

MSRI is the fortunate recipient of a grant from the C. M. Capital Foundation and the Cha family to establish the Cha Scholars program. This program, jointly directed by MSRI's Founding Director Shiing-Shen Chern and current Director David Eisenbud, will assist MSRI in bringing the world's top people in a given program to the Institute. The Cha Scholars are selected from mathematics scholars living in or who are citizens of China, Hong Kong, or Taiwan.

The first Cha Scholar is Dr. Yongwei Yao. Dr. Yao is a graduate of the Northeast Normal University in the People's Republic of China and received his Ph.D. from the University of Kansas in June 2002, under the direction of Craig Huneke. At present he is a Postdoctoral Fellow at MSRI and participating in the special year in Commutative Algebra.

In the Beginning

Jim Sotiros

Since the Fall of 2002 marks the 20th anniversary of the first programs held at MSRI, it seems like a good time to look at some vignettes from our early history:

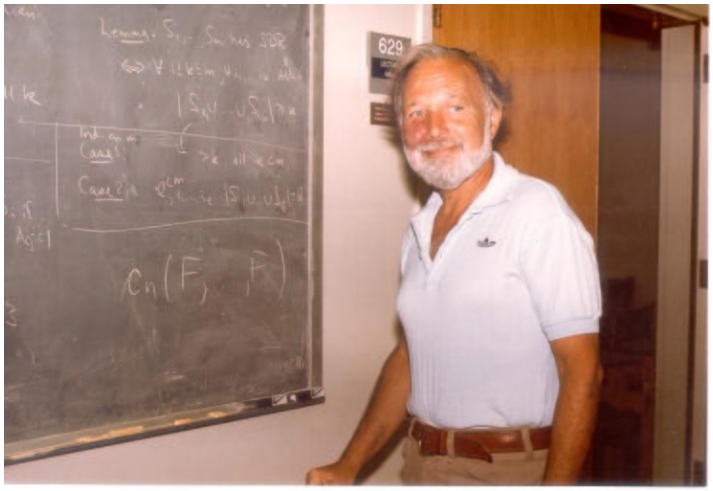
Early 1960s: At an advisory meeting of an advisory committee at the NSF, scientists from diverse disciplines were asked "What, in your discipline, could make for a quantum leap in achievement?" Committee member Irving Kaplansky replied: "For mathematics, found two new Institutes for Advanced Study — one in the Midwest, and one on the West Coast."

March 1978: The Director of the NSF, Dr. Richard C. Atkinson, forwarded material to the NSB (National Science Board) regarding the need for supplementing the foundation's project research grant mechanism for the mathematical sciences by a research institute. Quoting from Atkinson's memo to the NSB: "*American research in mathematics is today in a golden age. But there is within the mathematical community a general consensus that, in order to maintain and even further stimulate the unequalled pace of research of the past dozen years, another mathematical sciences research institute, similar but not identical to the famous Institute for Advanced Study, should be established. Over the past three years, this concept has been discussed during meetings of the mathematical sciences professional organizations.*

Letters from and conversations with many American mathematicians show agreement with the need for continued stimulation of mathematical research and with the concept of a research institute as an efficient and effective method of providing such stimulation.

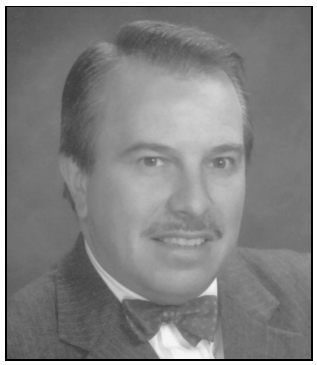
RESOLVED that the national Science board approves the establishment of a Mathematical Sciences Research Institute; further, the Board approves of a Project Announcement and the general plans for the establishment of the Institute."

1978: In response to the NSF Project Solicitation "A Mathematics Sciences Research Institute", three UC Berkeley mathematics professors, Shiing-Shen Chern, Calvin Moore and I. M. Singer began planning and preparation for a Berkeley proposal. The closing date for the proposal is August 1, 1979.



I. M. (Iz) Singer at 2223 Fulton Street.

S.-S. Chern



Calvin (Cal) Moore

July 10, 1979: At the outset Chern, Moore and Singer made a fundamental decision that the Institute should be organized as an entity separate from the University of California. On this date they established a nonprofit California corporation — MSRI, Inc. — that would submit a proposal and operate the Institute if the proposal was successful. The Articles of Incorporation state "The specific and primary purposes are to preserve and strengthen the intellectual vigor of the nation's effort in the mathematical sciences by stimulating mathematical research in diverse problem areas among mathematical scientists."

July 30, 1979: The NSF Proposal for MSRI requesting $9,096,873 over 84 months beginning 7/1/1980 Is submitted. The Principal Investigators are Shiing S. Chern, Calvin C. Moore, and Isadore M. Singer.

January 16, 1980: Options for housing the proposed institute are considered: Either sharing space in an existing building (on or off-campus), or leasing a University building to be constructed.

January 30, 1981: Chancellor Ira M. Heyman presents University President David Saxon with a proposal for a facility to house the proposed Mathematical Sciences Research Institute.

March 10, 1981: NSF Site Visit takes place.

May 15, 1981: UC Regents approve agreement with MSRI to construct and finance Institue building on UC Berkeley campus.

June 2, 1981: NSF officially announces that they will fund two mathematical institutes: MSRI in Berkeley and IMA in Minneapolis.

January 21, 1982: UC announces architectural design competition to design a mathematics institute.

September 1982: MSRI begins full scientific operation at the UC Extension Building at 2223 Fulton Street (see next page).

August 1983: There are now 60 titles in the MSRI preprint series.

January 28, 1984: MSRI ground breaking for the new building. Occupancy projected for November 1984. (or Janaury 21, 1984 according to the SF Chronicle). Remarks by UC Berkeley chancellor Ira M. Heyman and Alvin Thaler of NSF. Guests can access the event only from Grizzly Peak Boulevard because Centennial Drive is closed due to a slide. Future plans are made for a small apartment building or buildings for short-term visitors.

Groundbreaking for the permanent building (January 28, 1984). On the foreground are S.-S. Chern and Irving Kaplansky (Kap), who became MSRI's second Director. Onlookers include, from left to right: Martin Kruskal, Robert Osserman (partly hidden by someone unidentified), Hyman Bass, Reese Harvey, I. M. Singer, Daniel Quillen and Al Thaler. This photo from Kaplansky's archives can be seen in *More Mathematical People*, edited by Donald J. Albers, Gerald L. Alexanderson and Constance Reid, Boston, Harcourt-Brace-Jovanovich, 1990.

April 1, 1985: MSRI moves from Fulton Street to its new home, nestled in the hills above the UC Berkeley campus.

Our first home (1982–1985), on Fulton Street

Interior view of permanent building during construction. This side now houses the administration on the ground floor, and member and computing offices on the top two floors.

Academic Sponsors

From the beginning, MSRI was conceived as a cooperative endeavor of and for the mathematical community. Early on, a small group of mostly West Coast universities became "Academic Sponsors", meaning they contributed financially to MSRI and had a role in its scientific guidance. Gradually this group expanded to include many more universities, including most major universities in the US. For the benefits of academic sponsorship and the list of current Academic Sponsors (now 68), see http://msri.org/governance/sponsors/academicsponsors.html.

The following institutions have become Academic Sponsors since March 2002:

Columbia University, 4/12/02
Brandeis University, 5/13/02
Pennsylvania State University, 6/6/02
The University of Toledo, 9/23/02
University of Iowa, 10/17/02

Jackie Blue: 18+ Years and Going Strong

Bob Megginson

The story of MSRI's twenty years would not be complete without a chapter on our longest serving staff member, Housing and Visa Officer Jackie Blue. Jackie started with MSRI on April 6, 1984, and has worked for every Director and Deputy Director we've had.

The thousands who have been placed by Jackie into short- and long-term accommodations in a challenging housing market can testify to her remarkable success at solving tough problems on short notice. Part of his secret comes from the personal relationships she has built over the years with the many landlords who provide housing for MSRI visitors. The people in this network form an important part of the MSRI family, and Jackie never lets us forget that. Jackie's background before coming to MSRI was in social work and special education. She says she still feels at times like a schoolteacher watching the progress of her students, as she sees the postdocs she met in her early days here return as rising stars and then leaders in their fields who attract the next generation of young mathematicians into MSRI programs who will need Jackie's services. The files she maintains on current and past members now contain not only visa documents and housing records, but also holiday letters and pictures of children sent over the years by MSRI visitors who remember her as a special friend.

One might think that the demands placed on MSRI's housing officer would not have changed much over time, since the number of members in residence at any one time is about the same now as it was in the early years. However, the membership trend has been toward more people visiting for shorter periods, and the demands placed on Jackie by the need to find housing for many people staying for one or two months have grown greatly. One regret she has is that she feels she has less time to spend just being generally helpful to those who have special requirements in the challenging new environment they find in Berkeley. Even so, she still puts a high priority on matching people with housing that meets their individual needs, and is remarkably successful at doing exactly that.

When faced with a particularly challenging placement, such as an incoming Deputy Director who turns up a month early with a cat and a dog, Jackie recites to herself a special mantra: *Somehow, it always works out*. And because of Jackie's skills, experience, and concern for the people who rely on her, somehow it always does.

The MSRI Building

Bill Glass

The University of California provided the successful proposal to host the Mathematical Sciences Research Institute in the early 1980s. A part of the proposal was to construct a new building to house the Institute. The site proposed was in the hills above the main campus, just uphill from the Lawrence Hall of Science and south of the Space Sciences Laboratory. The site captures panoramic views of the San Francisco Bay and the East Bay Hills.

The Institute originally occupied a portion of a building at the west edge of the main campus while the University began the process of building the new facilities. Calvin Moore, then Deputy Director, headed the effort on the part of the Institute to define the Institute's building program and see the process through to the completed building. The University and the Institute undertook a design-build competition, matching architects and contractors to provide design and construction proposals to fulfill the Institute's requirements.

Drawing on the model of the Institute for Advanced Study at Princeton University, the program provided to competitors for the MSRI building included a library, commons areas, a lecture hall and seminar room, administrative offices, and 54 private offices for the members of the institute. The budget was set at $1.9 million, then raised to $2.2 million when the University and the Institute were not satisfied with the original results of the competition.

Our team did not feel that we could satisfy the program requirements at the lower budget, and did not submit a proposal during the first go-around. When the budget was raised and the program reissued, our team (our predecessor firm Shen/Glass Architects and S. J. Amoroso Construction) submitted the successful design.

A principal goal of the Institute for the new building was to encourage interaction among its members. This was expressed in the program by the requirement for a series of "small commons" spaces distributed throughout the building to serve as meeting and discussion areas. Our response was to establish a "social network" by arranging all circulation, both horizontal and vertical, within an atrium and distribute the small commons spaces within this circulation system. At the heart of this atrium is the main lobby space, designed to host the Institute's daily teas and taking advantage of the spectacular Bay view.

The design also reflected the Institute's desire that the building not have an institutional character by proposing to build the project with wood siding, lending the building a residential scale and making it more, as one competition juror stated, "like a big house". At a time when Post-Modernism was all the rage in the architectural profession, the design was also unapologetically modern in its form, while remaining sympathetic to the tradition of building in the Bay Region through its selection of materials, use of scale, and approach to detail.

Bill Glass is the principal of the architectural firm Glass and Associates, founded in Oakland as Shen/Glass Architects in 1979. This firm designed the present MSRI building and is responsible for the building addition designs on pages 7–10.

Forthcoming Workshops

Most of these workshops are offered under the auspices of one of the current programs (see Director's Notes starting on page 1). For more information about the programs and workshops, see http://www.msri.org/calendar.

February 3 to February 7, 2003: *Commutative Algebra: Interactions with Homological Algebra and Representation Theory.*, organized by Luchezar Avramov (chair), Ragnar Buchweitz, and John Greenlees.

March 13 to March 15, 2003: *Computational Commutative Algebra*, organized by Serkan Hosten, Craig Huneke, Bernd Sturmfels (chair), and Irena Swanson.

March 29 to April 3, 2003 at the Banff International Research Station: *Commutative Algebra and Geometry*, organized by Mark Green, Juergen Herzog, and Bernd Sturmfels (chair).

April 7 to April 11, 2003: *Semiclassical Methods in Physics and Chemistry*, organized by R. Littlejohn, W. H. Miller, and M. Zworski.

April 21 to April 25, 2003: *The History of Algebra in the Nineteenth and Twentieth Centuries*, organized by Jeremy J. Gray and Karen Hunger Parshall.

May 5 to May 9, 2003: *Mathematical Semi-Classical Analysis*, organized by J. Sjostrand, S. Zelditch, and M. Zworski.

MSRI Book Series

Two new books are out!

More Games of No Chance, edited by Richard Nowakowski, vol. 42

Generic Polynomials: Constructive Aspects of the Inverse Galois Problem, by Christian U. Jensen, Arne Ledet and Noriko Yui, vol. 45

The next few titles will be:

Galois Groups and Fundamental Groups, edited by Leila Schneps, vol. 41

Algorithmic Number Theory, edited by Joe Buhler and Peter Stevenhagen

Modern Signal Processing, edited by Dan Rockmore and Dennis Healy Jr.

See http://www.msri.org/publications/books for details on published books and the full text of *More Games of No Chance*.

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Current and Recent Workshops

Most recent first. For information see http://www.msri.org/calendar.

December 13 to 17, 2002: *Algorithms in Quantum Information Processing*.

December 9 to 12, 2002: *The Feynman Integral Along with Related Topics and Applications*, organized by Sergio Albeverio, Cecile DeWitt-Morette, Gerald W. Johnson, Louis H. Kauffman, and Michel L. Lapidus (chair).

December 2 to 6, 2002: *Commutative Algebra: Local and Birational Theory*, organized by Craig Huneke (chair), Paul Roberts, Karen Smith, and Bernd Ulrich.

November 6 to 8, 2002 at the Alliance Capital Conference Center, New York: *Event Risk*, organized by Marco Avellaneda, Sanjiv Das, Lisa Goldberg, David Hoffman, Francis Longstaff, Mark Rubinstein, Michael Singer, and Domingo Tavella.

November 4 to 8, 2002: *Quantum Information and Error Correction*, organized by Richard Jozsa (chair).

October 21 to 25, 2002 at IPAM, Los Angeles: *Models of Quantum Computing*, organized by David Di Vincenzo and Peter Shor.

October 7 to 11, 2002: *Semidefinite Programming and Applications*, organized by Dimitris Bertsimas, Stephen Boyd, Laurent El Ghaoui (chair), and Bernd Sturmfels.

September 23 to 27, 2002: *Recent Progress in Random Matrix Theory and Its Applications*, organized by Estelle Basor (co-chair), Alexander Its, Persi Diaconis, and Craig Tracy (co-chair).

September 23 to 27, 2002, at the Banff Centre in Alberta, Canada: *Quantum Algorithms and Complexity*, organized by Umesh Vazirani (chair).

September 9 to 13, 2002: *Introductory Workshop in Commutative Algebra*, organized by Luchezar Avramov, Mark Green, Craig Huneke, Karen E. Smith and Bernd Sturmfels.

August 26 to 30, 2002: *Introductory Workshop in Quantum Computation*.

June 3 to 7, 2002: *Finsler Geometry*, organized by David Bao, Robert Bryant, S.-S. Chern, and Zhongmin Shen.

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The following publishers generously contribute to the Institute library with donations or significant discounts. Their recent titles are on display at the entry to our library.

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Come to the MSRI reception at the January 2003 AMS meeting in Baltimore!
Wed, January 15, 2003
Baltimore Convention Center
5:30pm to 7:30pm

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