



Math Times

University of Illinois at Urbana-Champaign

Spring 1996

Letter from the Chair

Dear Friends:

This is the last year of my term as department chair. I have asked LAS Dean Jesse Delia to initiate a search for a new chair to step into the position by August. After a sabbatical leave next year, I will return to a research and teaching position in the department in fall 1997. I hope that I can even find time for a game of chess now and then.

These past four years have been exciting times for the mathematics department and for mathematics nationally. I will touch on just a few of the highlights of these years.

Probably the most exciting mathematical event was the completion of the proof of Fermat's Last Theorem by Andrew Wiles. This generated a lot of activity in our department with seminars and courses devoted to the background necessary for understanding the proof. This activity is ongoing with Nigel Boston leading the effort.

The crisis atmosphere generated initially by the plan to close the mathematics graduate program at the University of Rochester and then its subsequent restoration sent

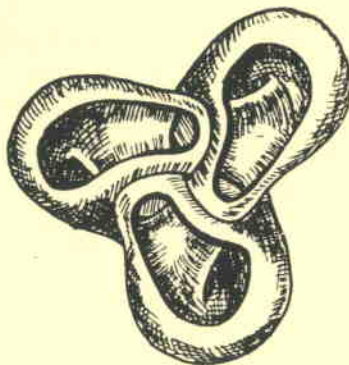
a warning message to mathematicians in academic circles at all levels.

Mathematicians provide instruction that is fundamental to all of science. We must work to see that our scientific contributions and our service to the students in other disciplines is recognized and valued by students and faculty. It is important that we continue to deliver the highest quality of education and are recognized for our efforts.

One of the ways our department has been doing this is by promoting interdisciplinary activities. The committee on Mathematics and Its Applications has invited distinguished speakers in its Mathematics in Science and Society series. David Mumford,

Harvard University, gave the initial lectures last year. This spring Sir Roger Penrose, Oxford University, gave a provocative set of talks to standing room only crowds of mathematicians and many others from the university community. The committee also sponsors weekly talks by members of different campus departments.

Our department has become a national leader in the calculus reform movement because of the efforts of Professors **J. Jerry Uhl** and **Horacio Porta**. The Calculus & Mathematica program, started by Uhl and Porta in our department, has gained national attention and is the most widely used alternative method of teaching calculus. The ongoing evolution of this computer-based method of teaching calculus into a Distance Education Program (DEP) may be one of the most exciting changes in decades in the teaching of mathematics. The DEP currently reaches out to rural and inner city high schools to provide interactive calculus instruction in real time monitored by an instructor here in Altgeld Hall. The program is expanding and we predict it will be the basis for



widely diverse instruction in remote locations in the future.

The difficult job market continues to concern us and especially our graduating students. One important direction we have taken is to encourage students to take a broad range of courses to prepare for a variety of careers. We have made new options available in the Master's Degree programs that emphasize computational aspects which have a broad range of applicability.

As a natural consequence of the limited number of available positions nation-wide, we have received many applications from highly qualified new and recent Ph.D.s and have been able to hire some of these brilliant, young mathematicians. Their enthusiasm revitalizes the department; the faculty hired within the last four years are already having a positive impact on the future of the department.

There may be some major challenges to be faced by the new chair and the entire department, but the future of mathematics at the University of Illinois looks good.

The next department chair is not known as I write this. The search committee, **Maarten Bergvelt**, **Nigel Boston**, **Donald Burkholder**, **Adolf Hildebrand**, **Lou van den Dries**, and **Jang-Mei Wu**, with Lawrence Hubert of the Department of Psychology as chair, is just beginning its work and should make a recommendation to the dean sometime this summer. We will keep you informed.

All the best to all of you,

Jerry Janusz

Book on Ribenboim

A book about Professor Paulo Ribenboim of Queen's University in Canada, who was a visiting associate professor in our department from 1959-1962 and has been a frequent visitor since, has been published. It gives his biography and lists many of his achievements. He has many friends at UIUC.

Besides his research in number theory, Ribenboim is well known for his excellence as a teacher and guide of young mathematicians, and his enthusiasm for mathematics. About one of his papers he said "it was great fun to write."

He has retired but is still working. Recently he wrote "during all these years numbers and structures populated the brain, engaged in a continuous and devilish dance. Non polluting, strictly non applicable, politically correct. And happy."

Mathematics is, of all the arts and sciences, the most austere and remote.

G. H. Hardy

News From Overseas

Alumnus Joey Balmaceda, who received his Ph.D. in 1991 with advisor **Michio Suzuki**, sends word from Quezon City, Philippines, that last year he was named one of the country's Outstanding Young Scientists for his work in mathematics.

M. Greenwood 1915-1996

Word has been received of the death of Marshall Greenwood, February 8, 1996, in San Diego, CA. A self taught number theorist who was a long time friend of the UIUC mathematics department, Mr. Greenwood published and distributed a mathematical newsletter and corresponded regularly with several members of the department. Although he lived on a veteran's pension, Mr. Greenwood gave a sizeable donation to the department.

Last year at the age of 80, with Professor **Nigel Boston**, Mr. Greenwood was the co-author of an article on quadratic expressions representing prime numbers which was published in the *American Mathematical Monthly*.

He also established the M.L. Greenwood Prize for UIUC undergraduate students which is given each year for the best undergraduate paper on a mathematical subject. To enter, students can pick up a list of possible project topics from Boston or Professor **Elliot Weinberg**, or propose a topic of their own choosing.

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Penrose Speaks

Sir Roger Penrose, the Rouse Ball Professor of Mathematics at Oxford University, gave two exciting talks March 26 and 27 in the department's ongoing series, Mathematics in Science and Society. His lectures were so popular that the Altgeld lecture hall was filled and many had to stand to hear him.

The first talk was *Shadows of the Mind, a Search for the Missing Science of Consciousness*, and the second was titled *Do We Need a New Geometry for Physics?*

Roger Penrose received his Ph.D. from Cambridge University with a dissertation on algebraic geometry. He continued his research and teaching at universities in the United Kingdom and the United States, among them Princeton, Cornell, Chicago, University of California at Berkeley and London before he was named Rouse Ball professor at Oxford.

He has explored in depth a range of topics in mathematics and physics, including relativity theory, quantum mechanics, astrophysics, cosmology, possible and impossible geometrical shapes and how the brain works. With Stephen Hawking, he extended our understanding of black holes and the big bang theory of the origins of the universe. His work with geometric puzzles shed light on the nature of quasi-crystals. In 1972 he was elected to the Royal Society. He shared with Stephen Hawking the Royal Astronomical Society's Eddington medal in 1975 and the Wolf Foundation Prize in Physics in 1988.

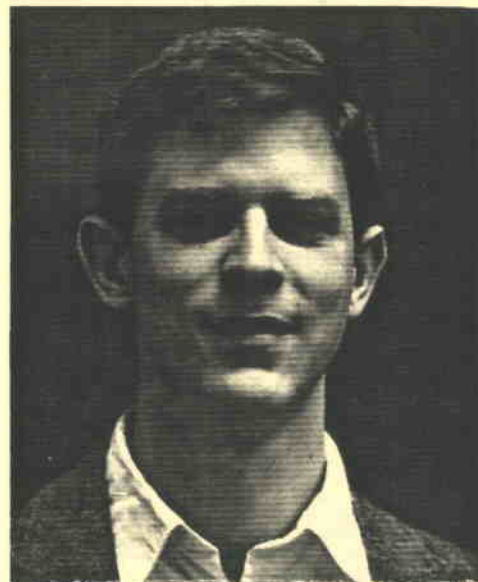
Mathematics in Science and Society is a lecture series devoted to interdisciplinary aspects of

Richard Sowers Arrives

Although he has spent most of his life on the east and west coasts, Assistant Professor **Richard Sowers**, who joined the department at the start of the spring semester, is no stranger to the midwest. He spent the last year and a half at Northwestern University in Evanston on a National Science Foundation Postdoctoral Fellowship. He says, "Urbana is a nice place. The small town feeling is like Lebanon, Pennsylvania, where I grew up."

Born in Maryland, Sowers went to high school in Los Angeles. After he received his B.S. from Drexel University in Philadelphia and his M.S. from the University of Maryland in College Park in electrical engineering, he changed to applied mathematics. He received his Ph.D. in 1991, also from Maryland. The title of his dissertation is "New Asymptotic Results for Stochastic Partial Differential Equations," and his adviser was M.I. Friedlin.

Last summer at the 1995 Seminar on Stochastic Processes in Gainesville, Florida, he was one of the main speakers. In the winter



Richard Sowers

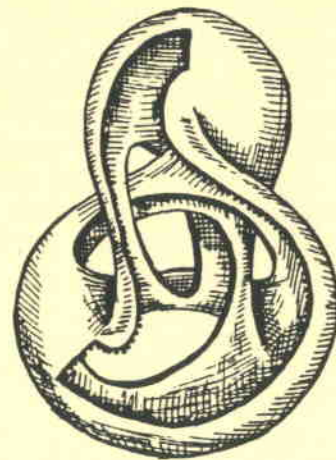
1995 quarter he organized a Probability Seminar at Northwestern. Among the places he has given invited talks are universities in Zürich, Switzerland, and Warwick, England, as well as at several conferences in France.

He has taught at the University of Maryland, the University of Southern California and at Northwestern, where he taught probability and calculus.

It is not enough to have a good mind. The main thing is to use it well.

Descartes

Mathematics, begun in the 1994-95 academic year. Mathematicians, both visitors and members of the department, have given talks as well as people in fields such as physics and economics who use mathematics in their research.



Reshetnyak Here



Yurii Reshetnyak

This semester Russian Academician **Yurii Grigorevich Reshetnyak** is George A. Miller visiting professor in the department. Professor Reshetnyak who was born in St. Petersburg in 1929, received his Ph.D. from Leningrad State University in 1954 and in 1960 was awarded a research doctorate. The Russian Federation gave him the title of Meritorious Scientist, and in 1987 he was elected to full membership in the Soviet (later Russian) Academy of Sciences.

His main fields of interest are geometry, quasiconformal space mappings and its generalizations, functions with generalized derivatives, and elliptic partial differential equations and variational calculus. Professor Reshetnyak, who was named head of the Department of Geometry and Analysis, Institute of Mathematics of the Siberian Branch of the Soviet Academy of

Faculty Notes

C. Ward Henson is an organizer of a major program in Nonstandard Analysis and its Applications which will take place July 1-August 17 this summer in Edinburgh, Scotland, starting with a two-week long NATO Advanced Study Institute to be attended by 60 or more advanced graduate students and postdocs. The middle four weeks will be a research workshop, and the final week will be an International Symposium.

The program is sponsored by the International Centre for Mathematical Sciences in Edinburgh and is supported by NATO and a number of other funding agencies in Europe. Attending from Urbana will be Professor **Peter Loeb**, who is one of the lecturers in the NATO Institute, teaching associate **Beate Zimmer**, and graduate students **Markus Pomper** and **Vladimir Troitsky**.

Professor Henson was one of the lecturers at a meeting held March 12-13 in Madison, Wisconsin, in honor of the sixtieth birthday of H. Jerome Keisler of the University of Wisconsin. Keisler is one of the leading researchers in model theory, a branch of mathematical

Sciences in 1960, is now President of the Novosibirsk Independent University.

He has served on the scientific councils of the Novosibirsk State University, and the Institute of Mathematics and is chair of the Scientific Council of the Siberian Society for Science and Education, an informal organization which was created in 1992.

logic, and the meeting presented a wide range of current research in the area, focusing especially on its applications to other areas of mathematics.

Eugene Lerman gave a talk at the Symplectic Geometry Workshop at Pennsylvania State University February 28.

Julian Palmore was appointed editor of *Phalanx*, the Bulletin of Military Operations Research last August. Palmore is the principal investigator for the Unmanned Aerial Vehicles project for the Navy through USACERL and is the advisory director for the Military Operations Research Society.

Randy McCarthy has been awarded a Sloan Fellowship for two years. Non-tenured faculty in mathematics and scientific fields are nominated by their departments for these, which are awarded to give young faculty members time to work on their research. One hundred of the fellowships are given nationally.

At a conference in Princeton, NJ, in honor of Wu Hsiang's sixtieth birthday McCarthy spoke on "A Taylor Tower for Algebraic K-theory." He was also one of the principal speakers at the second K-theory conference in Toronto.

In Faro, Portugal in January, at a conference on Regularization Methods of Free Boundary Problems, **Robert Jerrard** spoke on "Ginzburg-Landau vortices in arbitrary dimensions."

Visiting scholar **James Haglund** has been awarded a three year National Science Foundation Post Doctoral Fellowship. He plans to spend the first year in Urbana and at MSRI in Berkeley, CA.

UIUC at *Supercomputing '95*

Professor **George Francis** and several mathematics graduate students participated in the Supercomputing 95 conference sponsored by the ACM and the IEEE in San Diego. The exhibits are described in *Virtual Environment and Distributed Computing at SC'95*, the book published by ACM/IEEE Supercomputing '95.

One exhibit the Illini group demonstrated at this conference was *Laterna matheMagica*. Among those who helped Francis in its development were teaching associate **Paul McCreary**, Fellow **Glenn Chappell**, and graduate assistants **Alexei Bourd**, and **Chris Hartman**. *Laterna matheMagica* enables mathematicians to explore previously inaccessible problems in geometry, especially when a complex object evolves so as to optimize its shape, with powerful parallel computers networked to virtual environments. For instance an unknotted loop of string, no matter how tangled, can be persuaded to move automatically, and without breaking, into a circle.

In four dimensions a surface such as a topological sphere may be knotted. When it is merely tangled, mathematicians evolve it to its familiar round shape to show it was unknotted. They show, too, how a 3-sphere can be turned inside out, keeping the surface smooth but allowing complex self-intersections. The researchers presented for the first time a geometrically optimal and computationally automatic eversion of the sphere.

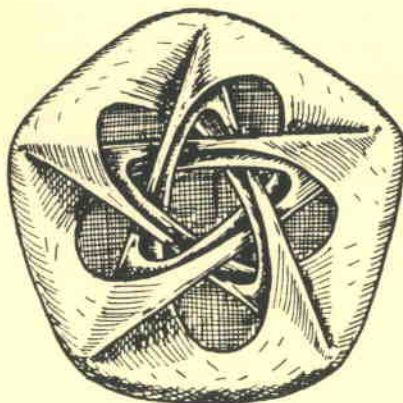
Bourd and Hartman also developed with Francis a *Cellular Semiotics: Molecular Recognition on Biological Membranes* which simulates molecules interacting in

specific ways that result in physiological changes. This offers a visualization of the molecules in action and enables the viewer to comprehend this intricate movement of intermolecular forces.

Engineering Open House

At the annual Engineering Open House, held in March on the Urbana campus, one of the most popular exhibits was the CAVE, another of George Francis's projects. Knowledgeable students led tours of the CAVE every half hour. It is a virtual environment in which the visitor, wearing special computer-driven eyepieces, appears to be in a very realistic three-dimensional space which may contain anything from fish swimming past at arms length, to manifolds distorting and turning in non-Euclidean space.

The visitors included school children on tour, professional colleagues and the Illinois Lieutenant Governor's family, Francis said. CAVE's theme was Distributed-Parallel-Networked Computing and among the demonstrations were, Minimax Sphere Eversion, Unravelling Unknots and Cave Bounce, a cave to cave paddle ball game.



Dornhoff Uses Net

Students in Professor **Larry Dornhoff's** Math 120 calculus can now see homework solutions, as well as answers to exam and quiz questions, by using the Internet.

Previously these solutions were on sale at a local copy shop. This was expensive and inconvenient for the students. This year he put worked problems, lecture notes and exams from previous years on the Internet at the address <http://albert.math.uiuc.edu/math120.htm>

One of Professor Dornhoff's students wrote that he had learned a lot from the web notes "Especially the worked out homework problems...I really need to see many examples of worked out problems." Dornhoff doesn't know how people are using the web for other courses, but predicts that it will be used in the future for many classes in all sorts of ways.

A former student of Dornhoff's was excited when he recently came across the Math 120 home page because he has just started teaching AP calculus in high school. He wrote that he admired Dornhoff's interest in integrating technology and mathematics courses. He said, "I really loved your class.... your lessons helped me a great deal.Thanks for being a great role model."

A professor from New York who is teaching calculus for the first time since he took it in 1965 wrote Professor Dornhoff that he would appreciate any information on how to get started on a web page. He added that he was very impressed with Dornhoff's web page and with his "efforts to afford students all the help they need to be successful."

M.S. Options

It is becoming necessary for graduate students in mathematics to be prepared for a wide variety of possible careers says Professor **John Gray**, the Director of Graduate Studies. In particular, he says, many students must think in terms of future industrial or government employment instead of the academic jobs many of them have aspired to. In such jobs, flexibility and breadth are at least as important as the usual depth that is expected from a mathematics graduate student.

Three important characteristics that are desirable in such occupations are the ability to work in teams, the ability to quickly master a subject and make a contribution to it, and good writing skills.

To address these concerns and to help students become more employable, Gray and the Graduate Affairs Committee are proposing several new options for master's degree students which will not be required but will be strongly recommended.

Two options are in the Mathematics Department. In one the students will write a thesis which can either be 1) a descriptive paper of at least 20 pages which synthesizes material from one or more papers on a mathematical or applied mathematical topic, 2) a historical account of some branch of mathematics, or 3) a computer program with extensive commentaries and examples.

A second choice a student can make is a Master's degree in applied mathematics with a mathematical computation option. In this the goal is to educate graduate students in using

Graduate Topology Revised

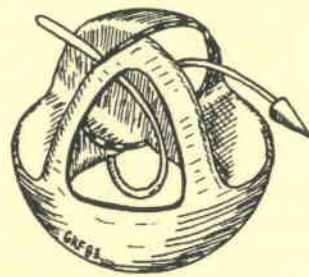
The sequence of graduate courses in topology has been redesigned; the new and revised courses will be offered for the first time next fall. Starting in the spring of 1997, students will have two options for the topology sequence covered in the preliminary examinations. Both will include the new course, Math 430, which is an introductory topology course that begins with multivariable calculus and path integrals. It develops foundational ideas of modern topology by exploring specific questions and examples that were historically important. The main topics introduced are winding numbers, covering spaces, fundamental groups and singular homology.

computers to gain an understanding of mathematical theories and applied problems. They will study the use of symbolic and graphical computer programs in mathematics.

The third option is also in applied mathematics, but is part of the Computational Science and Engineering (CSE) program in the College of Engineering. In this option students will study mathematics and the use of computers in mathematics. Through computers they will gain an understanding of mathematical theories and applied problems, and will have an opportunity to examine significant mathematical questions that arise in the process.

The second course of the sequence can be either general topology as it has been traditionally taught, or a new version of the basic algebraic topology course. The latter will cover cellular homology and cohomology and finish with various duality theorems.

Math 430 is intended to help students recognize when topological ideas and methods may apply to their research. It will provide them with the historical background to show how topological methods were developed in response to concrete problems, and will demonstrate that topology is not isolated but gives to and takes from other branches of mathematics.



Henson Reelected

Professor **C. Ward Henson** was re-elected to a 3-year term 1996-99 as Secretary-Treasurer of the Association for Symbolic Logic, a position he has served in since 1983. Because he holds this office, the business home of the association is at UIUC in room 331, Altgeld hall. Joanne Fetzner is staff associate of the Association. Anyone interested in the business of the association should contact her at the office or by e-mail at: asl@math.uiuc.edu

Four Professors Retire

The former head of the department and three long term faculty members are retiring this semester and are being honored at a reception on May 5 at Levis Faculty Center.

Peter Braunfeld was born in Vienna, Austria, and educated in the United States. He received his Ph.D. in mathematics from UIUC in 1959, was a research assistant professor at the UIUC Coordinated Science Laboratory from 1959 until 1966, when he became an associate professor. In 1968 he was promoted to professor of mathematics and education here. His special interests have been in developing mathematics curriculum for elementary and secondary school teachers and he has served on a number of national committees working on improving mathematics education.

Heini Halberstam came from Nottingham University in England to Urbana to head the mathematics department in 1980. Educated in England, he received his Ph.D. in 1952 from the University of London, with a dissertation on topics in the theory of numbers. He was a professor of mathematics at Trinity College, University of Dublin in Ireland, and was named Professor of Pure mathematics at Nottingham University in 1964, then Dean of Pure Science, a position he held until he came to Illinois.

In 1988 Halberstam stepped down as head to return to teaching and research. He has held visiting appointments at universities in Europe, Asia and the United States, is a fellow of University College, London and has been an editor of the Journal of Number Theory and

the Cambridge Mathematical Tracts. Last spring an international conference on analytic number theory was held in his honor, at the university's Allerton Park.

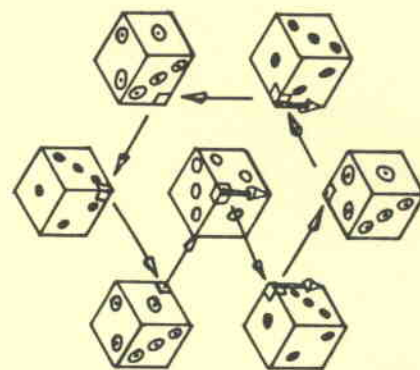
Anthony Peressini received his M.A. and, in 1961, his Ph.D. at Washington State University. That year he joined the UIUC mathematics faculty and in 1972 was named a professor. His research interests are in Banach lattices and operator theory. In addition to his research, he has devoted much attention to improving mathematics teaching. He has developed and conducted training programs for teachers and for students with low placement scores. He has also prepared tests and instructional materials, including a series of student computer laboratories. He has received awards for his teaching and was one of 50 university educators cited in a special issue of *Change* magazine by the American Association for Higher Education for extraordinary educational leadership.

Gaisi Takeuti attended Tokyo University where in 1956 he received his Ph.D. and, while still a student, was named an instructor. He came to the UIUC Department of Mathematics as a professor in 1966. Since then he has spent four years as a member of the Institute of Advanced Study in Princeton. He has also been recognized by the University of Illinois for excellence as a scholar, and has had three appointments as a member of the Center for Advanced Study at UIUC. He was the chair of the organizing committee of the Logic Section at the Philosophy of Science

Cairns Lectures

Professor Robert D. MacPherson, of the Institute for Advanced Study, delivered the Stewart S. Cairns memorial lectures at the UIUC math department this April on the topic "Topology of Spaces with Torus Actions." The lecture honors the memory of **Stewart S. Cairns**, former head of the department and professor of mathematics from 1948 until his retirement in 1972. The family of Professor Cairns established a fund to endow an annual series of public lectures to be delivered by outstanding mathematicians.

Professor MacPherson, who received his Ph.D. from Harvard in 1970, has been on the faculty at MIT and Brown and has had visiting appointments in France, Germany, Italy and Russia. He is a member of the National Academy of Sciences and the American Academy of Arts and Sciences and received the National Academy of Sciences Award in Mathematics in 1992.



Congress in 1991 in Uppsala and has been a guest professor in Japan, Germany and England. In 1993 he was honored at Colloque Takeuti in Luminy, France.

Calculus&Mathematica

UIUC mathematics faculty members are trying several methods to improve the teaching of calculus. One of the most successful has been the Calculus & Mathematica project, according to **J. Jerry Uhl**, who finds that students are excited with this modern calculus course which uses both state-of-the art technology and up-to-date teaching methods.

Approximately 20 sections will be taught next fall. There are now three laboratories for the project on campus. Two are in the Mathematics Department, one in Illini Hall and one in Altgeld, and

the third is in the Natural History Building. In addition to the faculty members in charge of the course and the graduate assistants, the laboratories are staffed with highly qualified undergraduates who work as classroom assistants, helping the calculus students.

Next semester for the first time linear algebra will be taught as part of the Calculus & Mathematica program. Also, this is the third year of a BioCalc program in which entering students in the College of Life Sciences take a Calculus & Mathematica course tailored especially to their needs.

Top Teacher

We recently learned that alumnus John Carter received the Presidential Award for Excellence in Secondary School Mathematics and Science Teaching. Mr. Carter who teaches at Adlai Stevenson High School in Libertyville, graduated from UIUC in 1987 with Highest Distinction in the LAS Teaching of Mathematics Curriculum. In 1993 he received a Master's degree in curriculum and instruction at UIUC. He has also been honored by Business Week as one of the country's top 20 innovative teachers of science and mathematics.

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