Calculus Redux

Paul Zorn

Should calculus be taught differently? Can it? Common wisdom says "no"—which topics are taught, and when, are dictated by the logic of the subject and by client departments. The surprising answer from a four-day Sloan Foundation-sponsored conference on calculus instruction, chaired by Ronald Douglas, SUNY at Stony Brook, is that significant change is possible, desirable, and necessary. Meeting at Tulane University in New Orleans in January, a diverse and sometimes contentious group of twenty-five faculty, university and foundation administrators, and scientists from client departments, put aside their differences to call for a leaner, livelier, more contemporary course, more sharply focused on calculus's central ideas and on its role as the language of science.

That calculus instruction was found to be ailing came as no surprise. As one conferee put it, "calculus is the course mathematicians love to hate." Too many students seem to agree; at some schools fewer than half of those who enroll pass the course. Those who do pass, and their teachers, may have to cope with poor pre-calculus preparation, inexperienced or discouraged instructors, an over-fat text with syllabus to match, little or no feedback on regular assignments, and worst of all, a rich and powerful subject reduced to mechanical drills.

Client department's demands are sometimes blamed for calculus's overcrowded and rigid syllabus. The conference's first surprise was a general agreement that there is room for change. What is needed, for further mathematics as well as for client disciplines, is a deep and sure understanding of the central ideas and uses of calculus. Mac Van Valkenberg, Dean of Engineering at the University of Illinois, James Stevenson, a physicist from Georgia Tech, and Robert van der Vaart, in biomathematics at North Carolina State, all stressed that while their departments want to be consulted, they are less concerned that all the standard topics be covered than that students learn to use concepts to attack problems in a flexible and incisive way.

Will the discrete mathematics of computation render calculus obsolete? Not according to the Tulane conferees. On the contrary, while the computer surely obliges us to rethink what we want from calculus, it also presents new opportunities for applying and understanding calculus ideas, and for extending the reach of applications well beyond the tra-
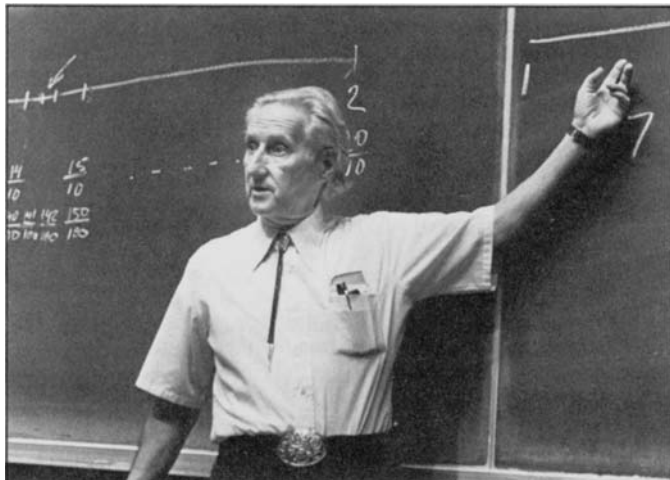
Arnold E. Ross, Professor Emeritus at The Ohio State University, was awarded the MAA's highest honor at its Annual Meeting. See page 3 of this issue.

International Congress of Mathematicians Featured in Center Section

The center section of this issue focuses on the International Congress of Mathematicians (ICM-86) to be held August 3-11, 1986 on the campus of the University of California, Berkeley. Members are urged to take advantage of this unusual opportunity to meet with many of the world's most prominent mathematicians.

Employment Advertisements

For the second time, FOCUS has included in the center section, employment advertisements. You will find the rates and deadline information on page v.

Calculus *(continued from page 1)*

ditional closed-form methods applied to elementary functions. For example, calculus has much to do with the fascinating interplay between the discrete and the continuous. Computing in calculus embodies and illustrates that rich and deep relationship.

Already, inexpensive hand-held calculators approximate definite integrals and solve equations numerically. (Try to think of five really different arc-length problems that can be solved in closed form.) Still more powerful tools are just appearing on the calculus scene. Computer algebra systems (MACSYMA, Maple, SMP, MuMath, and others) act as "super calculators", easily handling graphical, numerical, and symbolic computations that would have baffled the best students of five years ago. Participants agreed that if due caution is exercised, using such devices to handle routine computation can help shift calculus's focus back to ideas, where it belongs. We can use computer technology badly or well, but we cannot ignore it; our choice is either to lead or to follow.

Conferees agreed that we must change not only what we teach but also how we teach it and how we evaluate the results. Calculus can no more be taught effectively on the cheap than can, say, beginning French. Calculus students, like language students, must move along with the course. To ensure this entails frequent and regular checking of progress and committing the necessary resources. (One participant, a university administrator, accused mathematicians of pressing their claims for resources ineptly, compared to their colleagues in other disciplines.) Not all our problems are financial. Again and again, conferees observed that too often, we have gotten just what we asked for—shallow technical facility instead of deeper understanding—because the former is easier to teach and test for than the latter.

Their complaints notwithstanding, the Tulane conferees came not to bury calculus, but to praise it. Calculus, they agreed, is vital, as training for analytical thinking, as general education, as a foundation of higher mathematics, and for describing natural laws and deducing their consequences. To give concrete, constructive shape to the group's findings, three subcommittees met, to draft detailed syllabi for the first year, to recommend new ways of teaching, testing, and administering calculus, and to devise strategies for bringing all these changes about.

The content subcommittee, led by Thomas Tucker of Colgate University, drew up a two-semester syllabus that aims to build intuition and conceptual understanding, stressing numerical and geometrical ideas as well as algebraic techniques. To support this viewpoint, access to calculators with definite integral and equation-solving keys will be assumed. Within these guidelines, three alternative year-courses are envisioned, all sharing a common first semester: one covering single variable calculus through Taylor's series and the beginnings of differential equations; another that cuts short the single variable material to cover the basics of several variable calculus in the second semester; and a third that makes full use of the computer algebra systems soon to be widely available. Colleges and universities would offer one or more, as their needs dictate. Bringing new tools, ideas, and enthusiasm to an old and important effort, the new courses should free up a tight syllabus (courses are calculated at no more than 35 lecture-hours per semester) and, in time, generate new texts and materials.

Wisconsin Section to Offer Short Course

The Wisconsin Section is sponsoring A Short Course in Algorithms of Discrete Mathematics, June 16-20, 1986 at Cardinal Stritch College, Milwaukee, Wisconsin.

Principal presenters will be Walt Meyer of Adelphi University and Doug Harris, Chairman of the Department of Mathematics, Statistics, and Computer Science at Marquette University. Other presenters will be John Dossey of Illinois State University who will kick off the session and Karl Beres, Chairman of the Department of Mathematics and Computer Science at Ripon College.

Among the topics discussed will be Data Compression and Huffman Codes, Graph Theory, Recursion, Machines and Behavior, Codes and Communication, and Grammar and Languages.

The presentations will be aimed at high school teachers and teachers of introductory college math courses.

For more information please contact: Professor R.J. Mihalek, Department of Mathematical Sciences, University of Wisconsin-Milwaukee, Box 413, Milwaukee, Wisconsin 53201, (414) 963-4516, or Professor Barbara Reynolds, Cardinal Stritch College, 6801 North Yates Road, Milwaukee, Wisconsin 53217, (414) 352-5400.

Awards Presented in New Orleans

Four individuals received special recognition at the annual business meeting of the MAA held on January 10, 1986.

Award for Distinguished Service to Mathematics

Arnold E. Ross, Professor Emeritus of The Ohio State University, was presented with the Award for Distinguished Service to Mathematics in recognition of the scores of gifted young people whom he identified and encouraged to study sophisticated mathematical concepts at an early age. The citation, written by Annelli Lax, NYU Courant Insititute, and Alan C. Woods, Ohio State University, reads, in part:

The 1985 recipient of MAA's Award for Distinguished Service to Mathematics is Arnold Ephraim Ross who has devoted his life to Science Education through his unique summer program for high school students. He has profoundly influenced many people early in their lives, among them a great number of our most original, now eminent, colleagues in mathematics. He receives this award for his significant impact on mathematics, via mathematics education, on a national scale. Indeed no major mathematics conference is without a knot of mathematicians who compare notes on their experience in "The Summer Program."

Because Ross believes that talent is no respecter of social status, he carried out (and continues to carry out) his search with the broadest social base. Seldom has a family had so many gifted "children" as has that of Arnold and Bea Ross.

The award citation appears in the March 1986 issue of the *American Mathematical Monthly*. Ross received a check for $750 from the MAA.

Do You Want to Change Your Section Affiliation?

Members are reminded that the Section to which you belong may be changed at your request. If you wish to become a member of a different Section, simply notify the Membership Office, Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036; (202)387-5200.

MAA President Lynn Steen (far right) greets some of the 13 undergraduate math majors from Florida Agricultural and Mechanical University (FAMU) at the MAA meeting in New Orleans. Presenting the students is MAA-Florida Governor Don Hill, professor of mathematics at FAMU.

MAA Book Prize

Edward W. Packel, of Lake Forest College was awarded the MAA Book Prize for "The Mathematics of Games and Gambling", which was published in 1981 as part of the New Mathematical Library series.

The selection committee consisted of Doris Schattschneider, J. Arthur Seebach, and Gary J. Sherman. In part, the citation reads:

In appealing to a wide audience, Packel's book successfully achieves the goal of the New Mathematical Library series. The book contains fascinating historical anecdotes as well as descriptions of games and gambling which Packel uses skillfully to introduce elementary concepts of probability and game theory. Packel's enthusiasm about the mathematics behind games is contagious; readers will welcome the opportunity to learn more about the chances of winning these games. The reader cannot help but be inspired by Packel's presentation.

The MAA Book Prize was established by the Board of Governors in August 1982, for distinguished, innovative books published by the MAA. Winners receive a check from the MAA for $500.

Chauvenet Prize

George Miel, of Hughes Aircraft Corporation, was presented with the Chauvenet Prize and a check for $500 for his paper "Of Calculations Past and Present: The Archimedean Algorithm," which appeared in the *American Mathematical Monthly*, 90 (1983) pp. 17-35.

The Committee on the Chauvenet Prize (Peter J. Hilton, Theodore W. Gamelin, and Lawrence Zalcman) described the paper as follows:

Dr. Miel takes as his starting point the method of Archimedes for the approximation of pi by inscribed and circumscribed polygons. He reformulates the method as an algorithm and traces it and its close relatives to modern times, showing its passage from geometrical beginnings to an analytical method for calculating inverse circular, hyperbolic, and lemniscate functions. Miel weaves a web of fascinating historical connections among various forms of the Archimedian algorithm in which a number of notable mathematicians past and present play a role. Miel treats his subject from the point of view of numerical analysis, paying attention especially to computational efficiency. In addition to an inspiring story, Miel provides a number of ideas for use in the classroom.

Certificate of Merit

A Certificate of Merit was awarded to **Raoul Hailpern** who has served the MAA for 22 years: as Associate Secretary, Associate Director, and, since 1968, as Editorial Director.

In making the presentation, Paul Halmos stated:

Raoul Hailpern must surely be an instance of a uniqueness theorem. There cannot exist on this planet another person with his combination of mathematical knowledgeability, meticulous attention to detail, devotion to accuracy, and fanaticism for meeting deadlines. In all he has worked for fifteen editors who exhibited fifteen different styles of operations, but somehow he managed to get along with them all.

A Certificate of Merit is intended to recognize and to reward merit. According to my dictionary, merit means value, excellence, superior performance. In his work for the Mathematical Association of America Raoul Hailpern has demonstrated all these qualities; in my opinion no one has ever deserved a Certificate of Merit more than he.

from the President's desk. . .
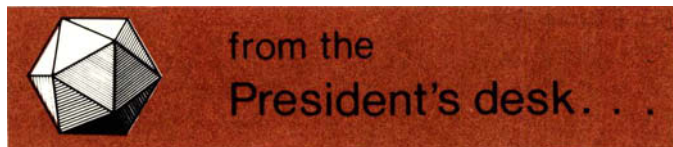
Lynn Arthur Steen, St. Olaf College

Taking Calculus Seriously

Two or three years ago MAA meetings were filled with debates about discrete mathematics vs. calculus. These discussions had two good effects—one intentional, the other not: they promoted innovation in teaching discrete mathematics, and at the same time they showed that the emperor of calculus has almost no clothes on.

Calculus is required of every student who intends to pursue a scientific career, and is elected by most of the educated elite who will become the leading professionals of the next generation. It is a powerful subject with a rich history, worthy of being the centerpiece of mathematics' contribution to scientific and liberal education.

Yet the teaching of calculus is a national disgrace. In many universities the combined failure and withdrawal rate exceeds 50%. Too often calculus is taught by inexperienced instructors to ill-prepared students in an environment with insufficient feedback. The result is a serious decline in the number of students pursuing advanced mathematics, and a majority of college graduates who have learned to hate mathematics.

The illusion of grandeur is maintained by a conspiracy of neglect among students, instructors, and administrators who all agree to not expect very much. In times of tight budgets, calculus is treated like a stepchild, with resources (both financial and intellectual) drained away to more advanced and "important" work. Left without motivation or encouragement, calculus instructors drill on basic mechanics, devoid of subtle ideas; students welcome template-based exams that fit exactly the mechanical forms on which they have been drilled. The system is in stable equilibrium at an intellectual depression, with no force seeming able to move it to an appropriate height of excellence.

The discrete math debate gave calculus a good hard knock: it made mathematicians take a second look, to see just what substance was behind the image. One result was a conference organized at Tulane University (as reported on page 1 of this issue) to re-examine the content and pedagogy of calculus, to make it as good as it could be. Conferees represented the entire spectrum of American higher education—from urban community colleges to the National Academy of Science—and a spectrum of client disciplines, from engineering to biostatistics. Remarkably, perhaps, they reached easy consensus on some important yet simple principles.

First, calculus should not and need not be an experience of failure for a majority of college freshmen. Good placement practices combined with good teaching, backed up by timely, sensitive academic support structures, should insure that most students who enroll in calculus will succeed at it. Success breeds success, and students who succeed in calculus will support mathematics as professionals in whatever career they select. It's in our own best interest to work very hard to reduce the failure rate in calculus.

Second, the current curriculum is overcrowded and outdated. Not even the engineers insist any more on centroid calculations and related rate problems. Students using sci-entific calculators (not to mention computers) experience the functions of calculus both earlier and more effectively. The rapidly increasing role of symbolic algebra computer systems in scientific research forces a fundamental rethinking of the nature and scope of traditional freshman calculus.

Third, calculus as presently taught is failing to achieve its most important general goal—to help students to develop acumen in analysis and precision in expression. Mimicry mathematics does not develop adequately an appropriate conceptual understanding of the nature of change, which is after all, what calculus is all about.

Ideas generated at the Tulane conference should stimulate all mathematics teachers to examine anew the content and teaching of calculus. "Revolution, si; surfaces of revolution, no" was the battle cry of one distinguished member of the Tulane group. If mathematics faculties do not take seriously the teaching of calculus, others will do it for us.

Highlights of the Board of Governors Meeting

Elections

President-Elect Leonard Gillman has resigned as Treasurer and the Board has elected Donald L. Kreider, Dartmouth College to complete his term, i.e., to serve until January 1988. Kreider has been one of two at-large members of the Finance Committee for eight years but is vacating that position to become our Treasurer. The Board elected Gerald J. Porter, University of Pennsylvania, to be the new at-large member of the Finance Committee. Porter is now automatically a member of the Board. The Board also elected two new Governors-at-Large: Rogers J. Newman, Southern University in Baton Rouge, and Edward J. Barbeau, University of Toronto.

Resolutions

A statement titled "College and University Responsibilities for Mathematics Teacher Education" was approved. Copies will be sent to department chairmen and deans at colleges and universities thoughout the country. The Board also endorsed the position of NCTM expressing concern over the awarding of mathematics credit in secondary schools for computer courses.

USCMI to Sponsor Pre-Congress Series of Invited Survey Talks

The U.S. Commission on Mathematical Instruction (USCMI) will sponsor a series of invited survey talks on August 2, 1986, the day before the opening of the Congress. The talks, to be held from 2:00 p.m. to 6:00 p.m. on the campus of the University of California, Berkeley, will be aimed at enhancing understanding and appreciation of some of the major research-related work to be presented at ICM-86. Presently confirmed speakers and their thematic presentations include: **Robert Edwards**, Highlights of Low Dimensional Topology, and **Andrew Ogg**, Modular Functions and Number Theory.

Further details, including the names of additional speakers and titles of their survey talks, will be announced in the May-June issue of FOCUS. For further information, contact Warren Page, New York City Technical College, 300 Jay Street, Brooklyn, NY 11201. (718) 643-3637 or 643-2470.

International Congress of Mathematicians

For only the second time since the first International Congress of Mathematicians was convened in 1893 at Northwestern University, the Congress will be held in the United States. ICM-86, which will be held on the campus of the University of California, Berkeley, August 3-11, 1986, is the first Congress to be held in this country since the 1950 Congress at Harvard.

The National Academy of Sciences, through the United States National Committee for Mathematics, invited the International Mathematical Union (IMU) to hold the 1986 ICM in the United States. The Chancellor and Department of Mathematics of the University of California, Berkeley, invited the U.S. National Committee to locate the Congress on their campus. The Academy asked the American Mathematical Society to manage the organization of and assume financial responsibility for the Congress. The Society agreed to do so as a service to the world's mathematical community, and its staff has been working on arrangements for the Congress under the direction of a Steering Committee composed of representatives from the U.S. mathematical community.

A rich and varied program as well as numerous opportunities to socialize with participants from other countries await participants in the Congress. Organized under the auspices of the International Mathematical Union, the Congress is expected to attract 4,000 mathematicians to discuss their latest discoveries. Not only does the Congress provide an opportunity for mathematicians to review the progress made in their subject over the past four years but it likely will provide insights into future directions of mathematical research as well. Additionally, the Congress provides a setting in which to recognize, through the awarding of the Fields Medals, outstanding contributions made by younger mathematicians. A Fields Medal, counterpart in mathematics to the Nobel Prize in other disciplines, is the highest honor that can be paid to a research mathematician.

Opening and Closing Ceremonies

The Opening Ceremonies will be held in the Greek Theater at 9:00 a.m. on Sunday, August 3. As part of the program, the Fields Medals and Nevanlinna Prize will be awarded. Addresses on the works of the medalists and prize winner will be given in Zellerbach Auditorium (and over closed-circuit television, if necessary) between 11:00 a.m. and 12:30 p.m. the same day.

The Closing Ceremonies are scheduled to be held on Monday, August 11, at 12:15 p.m.

Plenary Addresses

At the recommendation of the Program Committee, appointed by the International Mathematical Union (IMU), the Steering Committee has invited 16 mathematicians to give one-hour Plenary Addresses. These addresses are intended to inform participants of major concepts, problems, and trends in mathematics, and are broad surveys of interest to a wide audience of nonspecialists. Plenary speakers who are known at time of publication are: **Louis de Branges**, Underlying concepts in the proof of the Bieberbach conjecture; **Gerd Faltings**, Recent progress in arithmetic algebraic geometry; **Jurgen M. Frohlich**, Analytical approaches to quantum field theory and statistical mechanics; **Frederick W. Gehring**, Quasiconformal mappings (Provisional title); **Mikhael Gromov**, Soft and hard symplectic geometry; **H.W. Lenstra, Jr.**, Efficient algorithms in number theory (provisional); **Richard M. Schoen**, New developments in the theory of geometric partial differential equations; **A.V. Skorokhod**, Random processes in infinite dimensional spaces; **Stephen Smale**, Complexity aspects of numerical analysis; **Elias M. Stein**, Not available; **Andrei Aleksandrovich Suslin**, Algebraic K-theory of fields; **David A. Vogan, Jr.**, Representations of reductive Lie groups; and **Edward Witten**, String theory and geometry.

The complete list of speakers , their affiliations, the dates, times, and titles of their addresses will appear in the Third Announcement, which will be mailed in early 1986 to all Ordinary Members who have preregistered for ICM-86. (Membership in ICM-86 is defined in the section on Registration.)

Tickets

Plenary Addresses will be given in Zellerbach Auditorium, which has a seating capacity of 2,200. If preregistration for ICM-86 indicates attendance by more than 2,200 mathematicians, arrangements will be made to provide additional viewing of the Plenary Addresses through simultaneous, closed-circuit television broadcast of the talks to other large lecture halls on the campus. Requests for tickets (two choices allowed) can be made when pre-registering.

Videotape Showings

Videotapes of the Plenary Addresses will be shown several evenings during the Congress for the benefit of participants who either missed a talk or who would like to see it again.

Lectures in Sections

Also at the recommendation of the IMU Program Committee, about 145 mathematicians have been invited to give 45-minute Lectures in specified sections. These lectures are intended to be surveys of significant topics related to the area of the sponsoring section, but also accessible to nonspecialists with closely related interests. The list of sections is as follows. The number in parentheses indicates the number of invited 45-minute Lectures in that section. Details will be found in the Third Announcement.

1. Mathematical logic and foundations (6)
2. Algebra (9)
3. Number theory (7)
4. Geometry (10)
5. Topology (7)
6. Algebraic geometry (8)
7. Complex analysis (8)
8. Lie groups and representations (8)
9. Real and functional analysis (12)
10. Probability and mathematical statistics (7)
11. Partial differential equations (12)
12. Ordinary differential equations and dynamical systems (10)
13. Mathematical physics (8)

Special provision is being made at this Congress for the interests of those who are concerned not only with research, but also with the necessary adaptations of the curriculum as a consequence of the new uses of mathematics.

Speakers in sections 14-19 who are known at time of publication are given below. A complete list will appear in the Third Announcement.

14. Numerical methods and computing (8): **Achi E. Brandt**, Multi-level approaches to large scale problems; **Alexandre J. Chorin**, Vortex methods in the analysis of turbulent flow; **Germund Dahlquist**, Some questions related to numerical methods for stiff, non-linear ODE's; **Sergei Konstantinovic Goduncv**, The problem of guaranteed accuracy in numerical methods of linear algebra; **Dennis A. Hejhal**, Zeros of Epstein zeta functions and the CRAY-1 supercomputer (title tentative); **O. Lanford**, Computer-assisted proofs in analysis; **Steven A. Orszag**, Mathematical, physical, and computational aspects of turbulence.

15. Discrete mathematics and combinatorics (7): **Jozsef Beck**, Not available; **Anders Bjorner**, Not available; **Peter Frankl**, Intersection theorems for finite sets; **A. Schrijver**, Polyhedral combinatorics—Recent developments.

16. Mathematical aspects of computer science (7): **Manuel Blum**, Pseudo-random sequences that pass all polynomial time statistical tests . . . and other tales of randomness; **Robin Milner**, Concurrent Computation (title provisional); **Nicholas Pippenger**, Prefers to defer selection; **A.A. Razborov**, Lower bounds for the monotone complexity of boolean functions; **Adi Shamir**, The search for provably secure cryptosystems.

17. Applications of mathematics to nonphysical sciences (4): **Stuart Geman**, Markov random field image models, and their applications to computer vision; **Werner Hildenbrand**, Equilibrium analysis of large economies; **John Rinzel**, Qualitative analysis of bursting oscillations in biological systems; **Jack Schwartz**, Not available.

18. History of mathematics (4): **I. Bashmakova**, Equations diophantiennes et l'evolution de l'algebre; **H.J.M. Bos**, Not available; **T. Hawkins**, The origins of the representation theory of semisimple Lie algebras; **Wu Wen-tsun**, Recent studies on the history of Chinese mathematics.

19. Teaching of mathematics (3): **Judith V. Grabiner**, The centrality of mathematics in the history of western thought (working title); **Jean-Pierre Kahane**, Mathematical teaching, computer, and informatics; **Zbigniew Semadeni**, Verbal problems in arithmetic teaching.

Short Communications

Ordinary Members of ICM-86 will have the privilege of presenting a 10-minute, oral communication of their mathematical work, provided that they have registered by April 8, 1986, and that they have also submitted an abstract, including the title of their talk and the appropriate section (as listed above) by that date. Abstracts may be submitted in English, French, German, or Russian. Abstracts which are properly prepared and received by April 8, 1986, will be reproduced in the language and form in which they are submitted and distributed to all Ordinary Members when they pick up their registration packet in Berkeley. Late papers will not be accepted.

Each abstract should be typewritten within a rectangle 8" wide by 4" high (20 cm × 10 cm) on good quality, heavy, white paper, using black ribbon. If symbols are added by hand, black ink must be used. The typed-portion cannot be wider nor higher, but may be shorter than indicated above. It should be in a form ready for photographic reproduction. Last/family/surname, given/first name, middle name/initial, institutional affiliation and country, and title of abstract (in that order) should be typed single-spaced on the first two lines. N.B.: A classification of the subject according to the 19 sections listed above should appear at the top of the page outside the rectangle containing the text of your abstract. If no classification is given, the abstract will be returned to the author for resubmission. In cases of joint authorship, the presenter's name should appear outside the rectangle. Participants submitting abstracts who have time restrictions as to when their paper can be given should so state clearly on the abstract, again outside the rectangle.

Since preregistration is a requirement for submission of an abstract, please be sure that your name appears on the abstract in exactly the same form as it appears on the Preregistration/Accommodations Form. It would be very helpful if preregistrants would submit their abstracts in the same envelope with their Preregistration/Accommodations Form.

It is anticipated that 1,000 short communications will be presented at the Congress.

The Fields Medals and the Nevanlinna Prize

At the 1924 International Congress in Toronto, a resolution was adopted that at each international mathematical congress (two) gold medals should be awarded. Professor J.D. Fields, a Canadian mathematician who was secretary of the 1924 Congress, later donated funds establishing the medals which were named in his honor.

Professor Fields wished that the awards should be open to the whole world and should recognize both existing work and the promise of future achievement. Consistent with this wish, it was agreed to restrict the medals to mathematicians not over forty years of age.

The first two medals were awarded at the 1936 Congress in Oslo, and the next two were awarded at the first post-war Congress which was held in Cambridge, Massachusetts in 1950. Medals have been awarded at all subsequent congresses.

For the awards in 1966 it was agreed that, in light of the great expansion of mathematical research in the world, up to four medals could be awarded at each congress. The selection committees appointed by the International Mathematical Union for succeeding congresses have chosen two, three, or four medalists per congress.

The University of Helsinki has granted funds to award a Nevanlinna Prize in the mathematical aspects of information science to a young mathematician, to be given at the International Congress of Mathematicians. The first prize was awarded in 1982 to Robert Tarjan now of AT&T Bell Labs.

Listed below are the names of the Medalists since the inception of the awards.

FIELD MEDALISTS

1936, Oslo, Norway
Lars Ahlfors
Jesse Douglas

1950, Cambridge, U.S.A.
Atle Selberg
Laurent Schwartz

1954, Amsterdam, Netherlands
Kunihiko Kodaira
Jean-Pierre Serre

1958, Edinburgh, Scotland
Klaus Roth
René Thom

1962, Stockholm, Sweden
Lars Hörmander
John Milnor

1966, Moscow, U.S.S.R.
Michael Atiyah
Paul J. Cohen
Alexander Grothendieck
Stephen Smale

1970, Nice, France
Alan Baker
Heisuke Hironaka
Sergei Novikov
John G. Thompson

1974, Vancouver, Canada
Enrico Bombieri
David Mumford

1978, Helsinki, Finland
Pierre Deligne
Charles Fefferman
Gregori Aleksandrovitch Margulis
Daniel Quillen

1982, Warsaw, Poland
Alain Connes
William P. Thurston
Shing-Tung Yau

NEVALINA PRIZE

1982, Warsaw, Poland
Robert E. Tarjan

Summer Meetings Will Continue

The Council of the American Mathematical Society has agreed to continue joint summer meetings indefinitely. In particular, there will be joint summer meetings in 1987 and 1989. This summer there will be no such meeting because of the International Congress of Mathematicians being held at Berkeley from August 3 to August 11. We will also not meet jointly in 1988 in deference to the Society's centennial celebration.

Berkeley campus, site of ICM-86.

Other Events of Mathematical Interest

Exhibits

The book and educational media exhibits, located in the Pauley Ballroom in the Student Union, will be open from 10:00 a.m. to 6:00 p.m., August 4-6 and August 8; from 10:00 a.m. to 1:00 p.m. on August 7; and from 10:00 a.m. to 3:00 p.m. on August 9. All participants are encouraged to visit the exhibits during the Congress.

Mathematical Sciences Research Institute

Mathematicians attending ICM-86 are cordially invited to visit the new home of the Mathematical Sciences Research Institute in Berkeley. It is situated on a hill overlooking the campus, with a sweeping view of the San Francisco Bay area.

Visitors are welcome any weekday (Monday through Friday), between 9:00 a.m. and 5:00 p.m. Humphrey Go-BART, a free shuttle, operates between MSRI and Evans Hall, the mathematics building at the center of campus. Trips up the hill start at 15 and 45 minutes after the hour, and trips down start on the hour and half-hour.

Social Program

In order to promote personal contacts among participants, a number of social events have been planned.

The Chancellor of the University of California, Berkeley will host a complimentary reception for all Ordinary Members and Accompanying Members 16 years of age and over at 6:30 p.m. on Sunday, August 3, in the Faculty Glade on campus.

On Thursday, August 7, a Western Barbeque and Rodeo has been planned to take place at the Cow Palace in San Francisco. This event is free to all registered Ordinary, Accompanying and Child Members.

Two free concerts are planned for Ordinary and Accompanying Members for Saturday and Sunday evenings, August 9 and 10. One will feature jazz, and the other classical music.

Other special events are planned especially for Accompanying and Child Members, and of course there are many sights to see in the Bay Area.

Registration

All mathematicians who wish to attend sessions are expected to register, and should be prepared to show their Congress badge, if so requested. Badges are required to exchange currency or cash a travelers' check with the cashier, to use the free shuttle service, and to attend all Plenary Addresses and 45-minute Lectures. Badges will also be required at the Chancellor's Reception, the Barbecue/Rodeo, and the Concerts. (If a preregistrant should arrive too late in the day to pick up his/her badge, he/she may show the acknowledgment received from the ICM-86 Housing Bureau as proof of registration.)

Participants should be aware that a registration is not considered valid until the appropriate payment has been made and has cleared to the ICM-86 account. Similarly, a reservation of accommodations will be valid only after payment of the hotel deposit or residence hall package fee to the ICM-86 account. All amounts stated in this announcement are in U.S. dollars, and all payments to ICM-86 must be made in U.S. dollars. Participants from countries where there is no currency exchange with the United States are advised to apply to the Academy of Science in their country for advice and possible assistance. It is also possible that a travel agent in your geographic area may be of some assistance.

Membership in ICM-86

A participant in ICM-86 may be either an Ordinary Member, an Accompanying Member, or a Child Member. An Ordinary Member is any professional mathematician wishing to attend scientific sessions.

Accompanying membership is available only to persons 16 years of age or older accompanying an Ordinary Member but not participating in the scientific activities of the Congress.

A special Child membership is available for children from five years of age to 15 years of age, which entitles them to participation in the Barbecue/Rodeo and any activity planned for Accompanying and/or Child Members which has no age restriction. There is no fee for children four years of age and under. It is not necessary to register children accompanying Ordinary Members if the children will not participate in any of the Congress activities, and the only service requested for them is reservation of accommodations.

Accompanying and Child Members will not receive a copy of the Abstracts, Program, or Proceedings, and are not expected to attend sessions, but Accompanying Members will enjoy all other privileges of Ordinary Members. In addition, some special activities are being organized for the benefit of Accompanying and/or Child Members only.

Accommodations

Numerous options for housing and dining exist: residence halls at the University, motels and hotels in the Berkeley or nearby communities, and camping. Detailed information is given in the Second Announcement or in the *Notices* of the AMS.

Applications to live in University housing must be made before May 15, 1986. The sooner that requests for accommodations are made, the more likely that they will be honored.

How to Preregister and Obtain Accommodations

The importance of early preregistration cannot be overemphasized. Some of the benefits of early preregistration are assignment to hotels/motels with lowest rates, being included in the list of preregistrants handed out at ICM-86, inclusion in the alphabetical list of preregistrants displayed in the registration area, receipt of advance program information contained in the Third Announcement which will be mailed to all preregistrants in early 1986, reduced waiting time at the ICM-86 registration desk upon arrival in Berkeley, and registration fees 30 percent lower than the fees that will be charged for registration at the Congress.

Preregistration Fees, if received by May 15, 1986, are:

Ordinary Member	**$125.00**
Accompanying Member	**$ 60.00**
Child Member	**$ 30.00**

Current Information and preregistration forms may be obtained by writing to: ICM-86, P.O. Box 6887, Providence, Rhode Island 02940, (401) 272-9500.

See you at the Congress!

FOCUS EMPLOYMENT ADVERTISEMENTS

Rates for FOCUS Employment Ads are:

● 50 words or less: $25.00

● More than 50 words: $30 per column inch

There is a 15% discount for the same ad in 3 consecutive issues (with contract in advance). An insertion order on institutional letter head will be considered a contract. Charges will be billed after the last occurrence specified in the contract.

Anyone wishing to place an employment ad in FOCUS should write to: FOCUS Employment Ads, Mathematical Association of America, 1529 Eighteenth Street, N.W., Washington, D.C. 20036. Or for more information, call the MAA Washington Office at (202) 387-5200.

The deadline for submission in the May-June issue is April 1.

Carolina in the heart of the southern ski area; has enrollment of 10,000; the Department of Mathematical Sciences is housed in the College of Arts and Sciences; department includes Mathematics, Computer Sciences, Statistics, Applied Mathematics and Mathematics Education; approximately 350 majors; strong master's degree program; micro labs, mini labs, and labs with mainframe terminals are maintained within the department; well equipped faculty work stations; primary emphasis on teaching but research is encouraged; teaching load 9-12 semester hours; Ph.D. in Computer Science or in a Mathematical Science with expertise in computer science is preferred. Commitment to teaching mandatory. Rank and Salary will be based upon qualifications and experience. To apply, send letter of application, resume, graduate transcripts, and three current letters of recommendation to: H.W. Paul, Mathematical Sciences, Appalachian State University, Boone, North Carolina 28608. Completed application must be received by February 24, 1986. An Equal Opportunity Employer.

Head, Department of Mathematics
Northeast Louisiana University

Tenure-track appointment beginning July 1, 1986. Faculty of 25 members, offering the Bachelor of Science degree in Mathematics. Rank and salary open. Qualifications are a Ph.D. in mathematics, evidence of scholarly activity, and experience in teaching and conducting research. Candidates should have a minimum of 5 years of full-time university level teaching and some administrative experience. Equal opportunity/ affirmative action employer. Application deadline: April 1, 1986. Apply to:

Dr. Daniel E. Dupree, Dean
College of Pure and Applied Sciences
Northeast Louisiana University
Monroe, LA 71209

Mathematical Sciences: Tenure track position beginning August 1986. Appalachian State University is a member of the University of North Carolina system; located in the Blue Ridge Mountains of western North Carolina in the heart of the southern ski area; has enrollment of 10,000; the Department of Mathematical Sciences is housed in the College of Arts and Sciences; department includes Mathematics, Computer Sciences, Statistics, Applied Mathematics and Mathematics Education; approximately 350 majors; strong master's degree program; micro labs, mini labs, and labs with mainframe terminals are maintained within the department; well equipped faculty work stations; primary emphasis on teaching but research is encouraged; teaching load 9-12 semester hours; Ph.D. in a mathematical Science is preferred. Commitment to teaching mandatory. Teaching assignments to include courses at the general undergraduate and/or graduate levels. Suggested Rank: Assistant Professor, but rank and salary will be based upon qualifications and experience. To apply, send letter of application, resume, graduate transcripts, and three current letters of recommendation to: H.W. Paul, Mathematical Sciences, Appalachian State University, Boone, North Carolina 28608. Completed application must be received by March 25, 1986. An Equal Opportunity Employer.

Applied Mathematics
University of Washington

Applications and nominations are invited for one position budged as a tenure-track assistant professor. Outstanding candidates at higher levels may also be considered. Candidates should have a demonstrated record of research in any area of applied mathematics. They should also have substantial experience in some area of applications as well as a breadth of interest in mathematics relevant to the teaching requirements of the department. Applications (with a resume and three letters of recommendation) will be accepted by:

Professor Frederic Wan, Chairman
Department of Applied Mathematics, FS-20
University of Washington
Seattle, Washington 98195

until the position is filled. The University of Washington is an Equal Opportunity/Affirmative Action Employer.

SOUTHWEST MISSOURI STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS

Applications are sought for several positions of Professorial rank. It is hoped to fill at least one Professorship, one Associate Professorship and two Assistant Professorships for Fall 1986. All positions are tenure track (or tenured). Applications for visiting positions will certainly be considered. A Ph.D. in mathematics or statistics, and a commitment to teaching are required. For senior appointments an established research record and the ability to work alone are essential. Some preference may be given to candidates whose research speciality is in analysis, applied analysis, or statistics, but all specialities will be considered. Applicants should send a complete Curriculum Vitae and the names of at least three referees to the Department Head, Simon J. Bernau, Department of Mathematics, Southwest Missouri State University, Springfield, Missouri 65804-0094. Southwest Missouri State University is an equal opportunity, affirmative action employer.

Four tenure-track positions Fall 1986. Doctorate is desirable. Interested in applicants from all areas of mathematics with a commitment to excellence in teaching and scholarly activity. Teaching load 9-12 hours per week; possibility for released time for research. Contact Dr. DiPietro, Eastern Illinois University, Charleston, IL 61920. AA/EOE

MATH DEPT: UNIVERSITY OF NORTH DAKOTA
GRAND FORKS, ND 58202

Applications invited for tenure track position at Asst. Prof. level in Math, starting 8/16/86. Requirements: PhD in Applied Math or in Math with strong concentration in Applied Math along with commitment to teaching and interest in research. Teaching load is 3 courses per semester. Salary competitive. Send vita, 1 copy of graduate transcripts and 3 names of references to Selection Committee. Initial screening begins Feb. 15, 1986.
UND is an EO/AAE

MATHEMATICS DEPARTMENT

Heidelberg College is seeking a person to fill a full-time position in the Department of Mathematics for the fall of 1986. The ideal candidate should have a Ph.D. in mathematics and undergraduate teaching experience. Heidelberg College has 1000 undergraduate students and a history of strength in the sciences. This position is a wonderful opportunity for the person who wants to be involved with students and considers teaching the most important aspect of a faculty position. Send letters of application, resume, and names of three references to:

Dr. Preston Forbes
Vice President for Academic Affairs
Heidelberg College
310 East Market Street
Tiffin, Ohio 44883

Heidelberg College is an Affirmative Action/Equal Opportunity Employer.

MATHEMATICS FACULTY POSITION—Master's degree or equivalent in Mathematics. Applicant must be enthusiastic, versatile, and possess the ability to teach a wide range of Mathematics courses from the remedial through college level. Previous community college teaching experience preferred. Review of applications will begin on February 14, 1986, and continue until the position is filled. Probationary appointment starting Fall 1986. Send letter of application and resume to:

Director of Personnel
Mohawk Valley Community College
1101 Sherman Drive
Utica, NY 13501-5394
AN EQUAL OPPORTUNITY EMPLOYER

ST. OLAF COLLEGE
Northfield, Minnesota 55057

Fall, 1986. The Department of Mathematics anticipates two positions at the assistant professor level. One of these is potentially tenure track. Applicants must have a clear commitment to excellence in teaching and an appreciation for the value of the liberal arts. Send a resume, three letters of recommendation, and a statement of professional goals and interests to: Paul D. Humke, Chair, Department of Mathematics. The selection procedure will begin 1/15/86. Applications for visiting positions at all ranks are sought. St. Olaf, a college of the American Lutheran Church, is an equal opportunity employer and specifically invites applications from women and minorities.

Tenure-track and visiting positions in mathematics, applied mathematics and statistics are available beginning September 1986. Excellent teaching and a commitment to research are required. Some 3-year instructorships may also be open. The department offers B.S. and M.S. degrees. MTU is a state supported university emphasizing science and engineering. To apply, write: Dr. Martyn R. Smith, Head, Mathematical and Computer Sciences, Michigan Technological University, Houghton, MI 49931
Michigan Technological University is an equal opportunity educational institution/equal opportunity employer.

DICKINSON COLLEGE
DEPARTMENT OF MATHEMATICAL SCIENCES
CARLISLE, PENNSYLVANIA 17013

Tenure-track position at the Assistant Professor level beginning September 1986. Slight preference for an individual specializing in mathematical logic, but individuals in other fields are encouraged to apply; willingness to teach entry-level computer science courses is desirable. Ph.D. required. Commitment to undergraduate teaching and to continuing research. Teaching load is three courses (usually two preparations) per semester. Send application, resume, and three letters of recommendation to Dr. Robert Paul, Chairman. Dickinson College is an Affirmative Action/Equal Opportunity Employer.

Saint Joseph's University

The Department of Mathematics and Computer Science has a tenure track position available beginning September, 1986. Applicants should have a Ph.D., be committed to teaching and have an interest in research. Those interested should send a resume to: Thomas J. O'Reilly, Chairman, Department of Mathematics and Computer Science, Saint Joseph's University, Philadelphia, PA 19131. An Equal Opportunity/Affirmative Action employer.

Marian College, Indianapolis, IN 46222. Full-time position. Responsibilities include directing of microcomputer center and teaching computer science courses. Doctorate in computer science or mathematics preferred. Master degree required. Teaching experience preferred. Small liberal arts college. Equal opportunity employer. Send resume and three references to Sister Carol Slinger, Chair, Mathematics Department.

A tenure-track entry-level (Assist. Prof.) position is available in the Mathematics Department at Claremont McKenna College. Qualifications include a Ph.D. in mathematics, with some formal education in computer science. Responsibilities include teaching, research, and curriculum development. The appointee will be expected to teach traditional mathematics courses, courses involving applications of mathematics to business and economics, and beginning courses in computer science. Compensation is competitive and shall depend in part on the appointee's qualifications. Claremont McKenna College is part of the Claremont College group, which has a total of approximately 40 mathematicians and computer scientists. The College is an equal opportunity employer and invites applications from qualified persons of both sexes and all ethnic backgrounds. Applications will be accepted until March 1, 1986. Please arrange to have vita and at least three letters of recommendation sent to:

Professor G.L. Bradley, Chair
Mathematics Department
Claremont McKenna College
Claremont, CA 91711.

MATHEMATICS DEPARTMENT
Lafayette College
Mathematics Dept., Easton, PA 18042

Assistant Professor (Ph.D. required) or instructor to teach undergraduate mathematics beginning late August, 1986. Teaching load 3 courses per semester. Lafayette offers liberal arts and engineering in a small (2000) college not far from New York City and Philadelphia. Salary competitive (1985 AAUP salary rating 1* in all ranks). Send resume, 3 reference letters, and telephone number (office and home) to Chairman, Mathematics Search Committee. An Equal Opportunity Employer.

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
HOBART AND WILLIAM SMITH COLLEGES

Applications are invited for a tenure-track position, beginning September 1986. The Ph.D. in Mathematics is required, as well as a strong background (preferably a Master's) in Computer Science. Duties include teaching all levels of undergraduate mathematics and computer science, and participation in the General Curriculum. Candidates should have strong commitment to excellence in teaching and promise of continued scholarly activity. The teaching load is two courses per trimester. Salary is negotiable and competitive. Hobart and William Smith Colleges are coordinate, four year, liberal arts colleges with a combined enrollment of approximately 1800. They are located in Geneva, New York, a city of 15,000 on the northern shore of Seneca Lake. Within an hour's drive are three major universities: Cornell, Rochester, and Syracuse. Applicants should send detailed resume, three letters of recommendation (at least one including comments on teaching ability), and undergraduate and graduate transcripts (unofficial photocopies are acceptable) to:

Professor Lawrence Smolowitz, Chair
Department of Mathematics and Computer Science
Hobart and William Smith Colleges
Geneva, New York 14456
The Colleges are an Equal Opportunity Employer.

United States Naval Academy

Applications are invited for a three year tenure-track appointment as an Assistant Professor commencing August 1986. Ten month salary is $24,000-37,900, commensurate with experience and qualifications. Research opportunities exist for augmenting salary during summer. Applicants must possess Ph.D., have a commitment to excellence in teaching, and be capable of pursuing independent research.
Send inquiries and applications to Prof. F.I. Davis, Chairman, Mathematics Department, U.S. Naval Academy, Annapolis, MD 21402. Required of each applicant are a resume, transcripts, and three letters of recommendation discussing applicant's teaching and research.
The Naval Academy is an EO/AA employer.

Assistant/Associate Professor of C.S.; Tenure Track position at competitive salary; Must have Ph.D. in C.S. or Ph.D. in related field. and M.S. equivalent in C.S.; Good retirement and employee benefits; Professional benefits negotiable; Contact Dr. Steward B. Carpenter, Midwestern State University, 3400 Taft, Wichita Falls, Texas 76308, 817-692-6611 x4279.

UNION COLLEGE, SCHENECTADY, NY 12308. We expect one to three temporary assistant professorships (one or two years). Excellence in teaching and interest in scholarly activity required. Teaching load is five courses per year; salary negotiable. Please sent vita and three letters to A.D. Taylor, Chairman, Department of Mathematics, at above address.

DEPARTMENT OF MATHEMATICAL SCIENCES. Applications are invited for one year temporary instructorships starting Fall 1986. Masters degree and strong commitment to teaching in mathematics required. Four course load. Applications including vita and names of references should be sent to Anton Zettl, Chair, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL 60115-2854, by February 15, 1986 or until positions are filled. EO/AAE.

Computer Science and Mathematics position for Fall 86. PhD in reasonable area, ability to teach CS1 & CS2 of ACM 78, and genuine interest in expanding into upper level CS. Send resume, 3 letters (focus on teaching) to: Dr. Douglas L. Cashing, Dept of Math & Computer Science, St. Bonaventure Univ, St. Bonaventure NY 14778.

FACULTY POSITION IN COMPUTER SCIENCE. M.S. in computer science, information systems, or equivalent required; A.B.D. or Ph.D., desirable. Must know COBOL; knowledge of several programming languages and experience on different types of computers helpful. IBM 4341 and Apple equipment. Salary and rank negotiable. Send resume and three letters of reference to Dr. Merry L. Allen, Head, Department of Mathematics and Computer Science, Longwood College, Farmville, VA 23901. EO/AAE

NEW MEXICO INSTITUTE OF MINING AND TECHNOLOGY, SOCORRO, NEW MEXICO 87801. Tenure-track position at the assistant professor level starting August 1986. Applicants should have an interest in Applied Mathematics (numerical analysis, operations research or statistics preferred) with a strong emphasis on applications. The position involves teaching undergraduate and graduate courses, doing research, and consulting in other disciplines. A Ph.D. is required. Send application and resume to: Personnel Department, Brown Hall and have three letters of reference sent to: Dr. Allan Gutjahr, Chairman, Department of Mathematics. EO/AAE.

Thomas College. Ph.D. or equivalent background in a closely related area (operations research, statistics). Rank and salary are competitive and dependent on qualifications and experience. Opportunity exists to participate in an M.B.A. program. The college encourages the use of computing in the curriculum; the academic computer is a VAX 11/750 running VMS, supporting several languages and subsystems. Thomas College is a small college of management, located in an active commercial community with major multinational firms nearby with which the college has cooperative relationships. Consulting and professional activities are encouraged; individual faculty initiatives are strongly supported. Please submit a resume by April 15, 1986 to Dr. Richard Willis, Chairman, Division of Humanities and Sciences, Thomas College, Waterville, ME 04901. AA/EOE.

MATHEMATICS FACULTY. Beginning September 1, 1986. Masters degree in math acceptable, Ph.D. in math preferred. Day and night teaching of lower division courses in major discipline or closely related subjects as qualified. Application concludes April 15. Contact: Math Search Committee, Division of Natural Sciences and Mathematics, Macon Junior College, Macon, GA 31297. Macon Junior College is an Equal Opportunity, Affirmative Action Employer.

OLD DOMINION UNIVERSITY
MATHEMATICAL SCIENCES:
Two tenure track positions available beginning August 1, 1986. The department has a strong Ph.D. program and is interested in hiring people who are capable of teaching at both graduate and undergraduate levels. A Ph.D. in mathematics and demonstrated research ability is required. One position is expected to be filled at the full professor level by an individual with strong research interests in Applied Analysis or Continuum Field Theories. The second position is expected to be filled at the assistant/associate professor level with preference being given to individuals having research interests in some branch of analysis or numerical analysis. Send a vita and three letters of recommendation by March 15, 1986 to: Dr. John Tweed, Department of Mathematical Sciences, Old Dominion University, Norfolk, VA 23508. Old Dominion is an affirmative action, equal opportunity institution.

CARLETON UNIVERSITY
The Department of Mathematics and Statistics has a one year vacancy in Mathematical Analysis and a one year vacancy for an Instructor in Mathematics. Applicants should have a Ph.D. in Mathematics, and must be Canadian citizens or permanent residents of Canada. The University welcomes applications from qualified women as well as qualified men. Applications, including curriculum vitae and the names of three referees, should be sent to Dr. B.M. Puttaswamaiah, Chairman, Department of Mathematics and Statistics, Carleton University, Ottawa, Canada, K1S 5B6.

MATHEMATICS
Saint John's University, a private liberal arts college for men, announces two openings (two, one year positions, non-tenure track) in mathematics. The Mathematics Department is a joint department with The College of Saint Benedict, a private liberal arts college for women. These two colleges have combined curriculum and coeducational classes. The members of this department seek colleagues who share their strong emphasis on the teaching and learning of mathematics. Rank and salary are dependent on the applicant's background and education. A Ph.D. is preferred. Evidence of effective teaching is also required. Applications received after April 1, 1986 cannot be guaranteed full consideration. Send vitae, official transcripts and 3 letters of recommendation to Personnel Director, Saint John's University, Collegeville, MN 56321. Women and Minorities are encouraged to apply.

Faculty Position in Computer Science
Augusta College
Augusta, Georgia 30910
Tenure track position in computer science available September 1986. Master's degree in computer science required, doctorate preferred. Primary duties will be teaching undergraduate computer science courses and, on occasion, lower division service courses in mathematics. Some graduate teaching is possible. The normal teaching load is three courses (15 hours) per quarter. The department offers the B.S. degree in computer science with 300 majors. Salary is competitive. Send resume, transcripts, and three letters of recommendation to Dr. Bill Bompart, Chairman, Department of Mathematics and Computer Science, Augusta College, Augusta, Georgia 30910.

BELLARMINE COLLEGE
Invites applications and nominations
for the position listed below.
COMPUTER SCIENCE/INFORMATION SYSTEMS One Assistant Professor position, tenure-track, commencing fall, 1986. Computer Science instructor with specialty in Information Systems. Ph.D. in Computer Science, Math, Engineering or related fields preferred. M.S. in Computer Science (or equivalent training) and commitment to complete Ph.D. considered. Ability to teach advanced undergraduate courses in such areas as operating systems, software design, information systems, data processing, computer communications. Send vita, three letters of reference to Prof. David O'Toole/Chair, Department of Math & Computer Science.

Full Time Math position available starting Fall 1986. Excellent salary and working conditions. Ability to deal with non-math majors is a must. Minimum requirements: Masters degree plus 30 graduate credits in math. Send resumes to:
Dr. Joseph Costelli
Fashion Institute of Technology
227 W. 27th Street, Room B831
New York, New York 10001

RANDOLPH-MACON COLLEGE

Computer Science Department Randolph-Macon College invites applications for a tenure-track faculty position beginning in September, 1986. Area of specialization is open, but evidence of strong, general teaching ability in computer science will be necessary. A candidate with a Ph.D. in Computer Science or in a closely related discipline is preferred. In particular, Ph.D. mathematicians with a keen interest in computer science are encouraged to apply. Salary and rank will be commensurate with credentials and experience.

Candidates for a possible visiting position beginning in September, 1986, are also being sought. A Master's degree in Computer Science is required.

For either of these positions, submit a cover letter, resume, transcript, and names of three references to John Rabung, Chairman, Department of Computer Science, Randolph-Macon College, Ashland, VA 23005. Randolph-Macon College is an equal opportunity and affirmative action employer.

St. John's University
New York
Staten Island Campus

Division of Mathematics and Science, Notre Dame College of St. John's University, SI—Assistant Professor: Mathematics, Computer Science, possibly Statistics, Physics, and other sciences. The broader the background the better. Resume to:

Dr. Michael F. Capobianco, Chairman
St. John's University
Staten Island, NY 10301

DOANE COLLEGE
Mathematics Position

Applications are invited for a tenure track position at the Assistant Professor level beginning fall, 1986. Requirements include a terminal degree, a strong commitment to quality undergraduate teaching, and a desire to make a positive contribution to an independent liberal arts college. Doane enrolls 650 students and is located in a pleasant residential community of 5000 people 25 miles southwest of Lincoln, Nebraska. Send resume, transcripts, and three letters of recommendation to:

Academic Affairs Office
Doane College
Crete, Nebraska 68333

Doane is an equal opportunity, affirmative action employer.

POSITION AVAILABLE
Wellesley College
Wellesley, Massachusetts 02181

Temporary (or visiting) position for 1985-86 (possibly 1985-87). Requirements include Ph.D. in mathematics, excellence in and commitment to mathematical research and undergraduate teaching in a liberal arts environment. Applicants should send a curriculum vitae and at least three letters of recommendation that address both teaching and research. Contact Chair, Department of Mathematics. Wellesley College is an Equal Opportunity/Affirmative Action Employer and particularly encourages applications from women and minority candidates.

Remedial Mathematics Coordinator
Wright State University
Department of Mathematics and Statistics
Dayton, Ohio 45435

Twelve-month position starting July 1, 1986. Responsibilities include supervising a mastery-learning course in elementary algebra taught via a personalized system of instruction. Bachelors degree in mathematics or mathematics education required. Masters degree, full-time teaching experience, and training and/or experience in developmental/remedial education preferred. Competitive salary and excellent fringe benefits. Please send resume, transcript(s), and three letters of reference to: Dr. Edgar Rutter, Chair. Closing date: March 15, 1986, then every two weeks until selection or July 1, 1986. WSU is AA/EOE.

SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE,
DEPARTMENT OF MATHEMATICS, CARBONDALE, IL 62901.

Visiting positions at the rank of lecturer are anticipated starting on August 16, 1986. Strong masters degree in mathematics or admission to candidacy required; Ph.D. preferred. Applicants should provide evidence of excellence in teaching and foreign applicants ability to teach effectively in English. Preference given to applicants with research interests compatible with those of our faculty. The duties consist of 12 hours of undergraduate mathematics instruction each semester. Closing date May 1, 1986 or until positions are filled. Send applications (including transcripts) to: Visiting Positions; c/o Ronald Kirk, Chairman; Department of Mathematics; Southern Illinois University; Carbondale, IL 62901. SIU-C is an Equal Opportunity/Affirmative Action Employer.

Mathematics Faculty Position: The Behrend College, The Pennsylvania State University. Applications are invited for a faculty position at the assistant professor level to teach baccalaureate level mathematics courses starting Fall 1986. Prefer Ph.D. in mathematics. Applicants should have an interest in undergraduate teaching and the ability to develop a research program. Penn State-Behrend is a 4-year, primarily undergraduate institution within the 22-campus Penn State system. Application deadline is March 24, 1986 or until position is filled. Send complete resume, official transcripts and the names of three references to Dr. A.H. Pulsifer, Head, Division of Science, Engineering and Technology, Department P, The Pennsylvania State University, Erie, PA 16563. An equal opportunity/affirmative action employer.

DEPARTMENT OF MATHEMATICS
MARIETTA COLLEGE

Tenure-track mathematics position at the assistant professor level available August 1986. Ph.D. in mathematics and a strong commitment to undergraduate teaching are required. Responsibilities include teaching undergraduate mathematics courses at all levels. Salary is competitive and will depend on qualifications and experience. Submit a letter of application, resume, graduate transcripts, and three letters of recommendation to: Neil Bernstein, Chairman, Dept. of Mathematics, Marietta College, Marietta, Ohio 45750-3058. Marietta College is a 150 year old private college of about 1200 students with a strong science program including petroleum engineering, located in a historic, scenic town on the Ohio River in southeastern Ohio. An Equal Opportunity/Affirmative Action Institution.

LE MOYNE COLLEGE
Computer Science Department
Syracuse, New York 13214

TENURE-TRACK POSITION, COMPUTER SCIENCE. Beginning Fall semester 1986: Assistant Professor with PhD in CS, or in cognate area with experience in computing (preferably Master's degree in CS). Le Moyne College is a four-year Jesuit college with approximately 1800 students, located on a suburban 150-acre campus. The CS department, with 7 full-time faculty members, offers two strong mathematical major programs and a minor. Students use the college's VAX 11/780 computer (running VMS), which is dedicated to instruction and research, as well as the department's PDP 11/44 (running ULTRIX-11) and a microcomputer laboratory with color graphics equipment.

Duties: undergraduate teaching; some evidence of successful scholarly initiative also expected. Salary: competitive, depending on qualifications and experience.

Applicants should send resume to: James F. Smith, Chairman, Computer Science Department, Le Moyne College, Syracuse, NY 13214. EO/AA employer.

NORTHERN STATE
MATHEMATICS POSITION

Northern State is seeking a first-rate mathematician for a tenure-track position at the assistant/associate professor rank. Teaching responsibilities will include courses in general mathematics as well

as those at the upper-level undergraduate and graduate levels. Candidates with an earned doctorate or with a dissertation in progress who are dedicated to excellence in teaching and research and who have a commitment to service are encouraged to apply. Send resume and three letters of recommendation by April 15 to Dr. Thomas O. Flickema, Dean of Faculty, Northern State, Aberdeen, SD 57401.

FERRIS STATE COLLEGE
Department of Mathematics
A full-time, tenure-track teaching position, commencing September, 1986. Opening subject to approval. A doctorate in Mathematics or Mathematics Education is desired. A masters in mathematics or computer science and ability to teach upper-level courses in either discipline are required. Opportunity exists for development of special interests in areas of applied mathematics, computer science, mathematics education, or pre-college mathematics. Resume and three letters of reference to: Dr. Robert Kosanovich, Department of Mathematics, Ferris State College, Big Rapids, Michigan 49307.

Math instructor (tenure track) to teach in a comprehensive community college math program which includes developmental, technical, transfer courses through D.E. and computer related courses. Master's required. Preference given to those with previous college teaching experience and ability to teach programming languages. $16,671—$35,121 on 85-86 two-semester salary. Begins August 18, 1986.
Contact Vice President, Academic Services, Lincoln Land Community College, Springfield, IL 62708. EOE.

MATHEMATICS DEPARTMENT CHAIRPERSON
DEPARTMENT OF MATHEMATICS
ILLINOIS STATE UNIVERSITY
The Department of Mathematics at Illinois State University invites applications for the position of Chairperson at the rank of Professor. Qualifications: Applicants must have a Ph.D. in Mathematics or Mathematics Education and a solid record of achievement in research, teaching, and leadership. They must have demonstrated effective administrative skills and a strong commitment to mathematics, applied mathematics, statistics, and mathematics education. Experience with graduate programs is desirable. The salary is competitive. Duties begin July 1, 1986.
The Department: The ISU Department of Mathematics has 42 full-time faculty positions and offers undergraduate, masters, and Doctor of Arts programs with opportunities in both mathematics and mathematics education. A Ph.D. in Mathematics Education is currently being developed. Current faculty research interests include analysis, combinatorics, graph theory, number theory, statistics, and various areas of mathematics education. The department serves over 4000 students each semester.
Application Procedures: To ensure consideration applicants should send a letter of application, a complete vita, a transcript, and names and addresses of at least 3 references to Professor Martin A. Young, Secretary, Mathematics Chair Search Committee, 204 Fairchild Hall, Illinois State University, Normal, IL 61761, before March 24, 1986. Illinois State University is an Equal Opportunity/Affirmative Action Employer.

Barton County Community College seeks a Computer Science-Mathematics Instructor beginning August 14, 1986. Duties will include teaching calculus and pre-calculus courses as well as introductory and intermediate level computer science courses. A proficiency in Pascal and Fortran is required. Preference will be given to applicants with at least three years of teaching experience and a masters degree in Computer Science or Mathematics. Salary open. The deadline for applications is March 15, 1986. Applications should be mailed to Dr. Patrick J. McAtee, Vice President/Dean of Instruction, Barton County Community College, Great Bend, Kansas 67530.

Mankato State University
Department of Mathematics, Astronomy, and Statistics
Mankato, MN 56001
Tenure track position in mathematics is available beginning September, 1986. Rank and salary are dependent on qualifications. Ph.D. in mathematics education or Ed.D. and equivalent of a masters degree in mathematics, a strong commitment to undergraduate teaching, and evidence of successful teaching at both the secondary and postsecondary levels are required. Teaching load is 36 quarter hours per 9 month academic year. Successful candidate will teach undergraduate and graduate classes in mathematics and mathematics education, serve as a liaison to public and private elementary and secondary schools, be active in the various professional education organizations, demonstrate leadership in mathematics education, assist with student advising, serve on various departmental committees, and conduct appropriate research. Application deadline is April 15, 1986 or until filled. Send letter of application, vita, teaching and research interests, and three (3) letters of reference to F.T. Hannick, Chairperson. AA/EOE.

FORT LEWIS COLLEGE—MATH DEPT
DURANGO, COLORADO 81301
Two tenure track positions. Ph.D. expt. One position to include some math-ed. Asst. Prof. level. 12-hrs undergraduate teaching. Salary open. Fort Lewis College is a state-supported liberal arts college of 3900 (Math Dept. of 15) in mountains of SW Colorado. Letter of application, vita, transcripts and 3 letters of recommendation (including one from a dept. chair or other academic official that addresses teaching) by March 28 to: Dr. William C. Ramaley, Chair., Math. Dept. Fort Lewis College is committed to equal opportunity through affirmative action.

NORTHWEST NAZARENE COLLEGE
Nampa, Idaho 83651
The Department of Mathematics has a regular faculty position available beginning 9/86. Requirements include a Ph.D. degree, commitment to undergraduate teaching, and a desire to make a positive contribution to a Christian church-related liberal arts college. A number of fields of speciality would be appropriate. Northwest Nazarene College with a student enrollment of 1100 is located in southwestern Idaho about 20 miles west of the capital, Boise. Applicants should send a letter expressing interests, a resume, transcripts, names, addresses and phone numbers of three people familiar with their professional activities to Dr. Gary Ganske, Head of Department of Mathematics, Northwest Nazarene College, Nampa, Idaho 83651.

Erskine College
Department of Mathematics
A full-time, tenure track position beginning in the fall, 1986. Master's in math or related field required. Successful candidate must be committed to excellence in teaching at a small, church-related, liberal arts college in a rural setting. Send letter and resume to Dean J.A. Knight, Erskine College, Due West, SC 29639.

ASSISTANT PROFESSOR
WRIGHT STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS AND STATISTICS
DAYTON, OH 45435
Tenure-track position anticipated for Fall 1986. Applicants should expect to complete all requirements for the Ph.D. by September 15, 1986. Excellent research potential and serious commitment to teaching required. Preference given to fields complementing existing research specialities. Competitive salary and excellent fringe benefits. Two-course teaching load. Department has 32 Ph.D. faculty and offers a masters degree. Please send vita, graduate transcript(s) and three letters of reference to: Faculty Search Committee. Closing date: February 1, 1986, then every two weeks until selection or July 1, 1986. WSU is an AA/EOE.

LECTURER IN MATHEMATICS (one or two year renewable non-tenure-track appointment). M.S. in mathematics or equivalent required. Duties include teaching 12 hours of lower-division mathematics courses. Preference will be given to those who can teach sophomore level courses. To apply, candidates should send a resume and transcripts to Professor Burno Wichnoski, Faculty Selection Committee, Department of Mathematics, University of North Carolina at Charlotte, Charlotte, N.C. 28223 and arrange to have four letters of reference, addressed to Prof. Joseph E. Quinn, Chairman, Department of Mathematics, sent to the same address. Closing date: March 30, 1986 and every two weeks thereafter until positions are filled.
UNCC IS AN EQUAL OPPORTUNITY EMPLOYER.

Maryville College
Department of Mathematics/Computer Science
Junior-level position on tenure track, beginning late August, 1986. Teaching duties primarily in computer science, with occasional courses in mathematics. Doctoral preparation (computer science or mathematics) preferred; M.S. considered. Commitment to superior teaching in an undergraduate college of arts and sciences essential. Send resume, transcripts, and names of three references to Dr. William Dent, Chairman, Department of Mathematics/Computer Science, Maryville College, Maryville, Tennessee 37801. Materials must be received by 4/1/86 to be assured consideration. An EO employer.

Tenure-track position starting September 1986. A Ph.D. in mathematics and strong evidence of commitment to undergraduate teaching is required. Rank and salary commensurate with experience. Send resume to H. Clyde Odom, Baptist College, Charleston, SC 29411. Baptist College is a four year liberal arts college. An Equal Opportunity, Affirmative Action Employer.

BOWDOIN COLLEGE
Brunswick, Maine 04011
Assistant Professor of Mathematics starting September, 1986. Tenure-track position; initial appointment three years with renewal possible. Ph.D. required and strong research record or potential expected. Normal teaching load 6 hours per week. Candidates with record of effective undergraduate teaching preferred. Applications now under review, but new applications will be accepted until the position is filled. Send resume and 3 letters of recommendation to Search Committee, Department of Mathematics, Bowdoin College, Brunswick, ME 04011. Bowdoin College is committed to Equal Opportunity through Affirmative Action.

BOWDOIN COLLEGE
Brunswick, Maine 04011
Visiting position, Mathematics Department, rank open, starting September, 1986. Terminal position; one year with second year possible. Ph.D. expected. Normal teaching load 6 hours per week. Candidates with record of effective undergraduate teaching preferred. Applications now under review but new applications will be accepted until the position is filled. Send resume and 3 letters of recommendation to Search Committee, Department of Mathematics, Bowdoin College, Brunswick, ME 04011. Bowdoin College is committed to Equal Opportunity through Affirmative Action.

ALBION COLLEGE
Albion, Michigan 49224
Sabbatical replacement for 1986-87 beginning 8/86. A master's degree in the mathematical sciences and teaching experience are required. Teaching load is 3 courses/sem. in math or math/CS depending on candidate's qualifications. Send resume, transcripts, and at least three letters of reference to R.C. Fryxell, Chairman, Dept. of Mathematics. (517) 629-5511. AA/EOE.

Whitman College, Walla Walla, Washington, seeks applications for a tenure track position teaching mathematics starting in the fall of 1986. The person hired will have a Ph.D. in some area of pure or applied mathematics, a strong commitment to teaching at a liberal arts college and interest in continuing mathematical research. Ability to contribute to the computer science area would be helpful but by no means necessary. Send vita and three letters of recommendation to Victor Keiser, Chair, Department of Mathematics, Whitman College, Walla Walla, WA 99362.

DEPARTMENT OF MATHEMATICS
NORTHERN ARIZONA UNIVERSITY
Applications are invited for a tenure track position at the Assistant or Associate Professor level, beginning August 21, 1986. Qualifications include a doctorate in Mathematics Education and a commitment to teaching, teacher education and research. K-12 teaching experience is desirable. Duties include teaching, advising, research, and providing leadership in the mathematics education programs of the department. Send resume and direct 3 letters of recommendation to Dr. Peter Horn, Department of Mathematics, Box 5717, Northern Arizona University, Flagstaff, AZ 86011. The search will remain open until the position is filled; however, the screening committee will begin reviewing applications on March 31, 1986. NAU is an Equal Opportunity/Affirmative Action Institution.

APPLIED STATISTICS—University of Alaska, Anchorage. 2 FACULTY POSITION OPENINGS. Fall 1986—Tenure-track. Ph.D. in Statistics (or Mathematics with emphasis in Statistics) required; candidates finishing their dissertations by August '86 will be considered; evidence of successful teaching at the post-secondary level. Responsibilities include service, research, and teaching 9 credits (3 courses) or its equivalent each semester. Applications must include a resume, official transcripts, and three letters of recommendation. Incomplete application packages will not be considered. The postmarked deadline for receipt of application materials is March 31, 1986. Apply to:
    Personnel Services Office
    University of Alaska, Anchorage
    3211 Providence Drive
    Anchorage, AK 99508
The University of Alaska is an Equal Opportunity Employer.

UNIVERSITY OF THE PACIFIC
Tenure track position at Assistant Professor level beginning mid-August, 1986. Ph.D. in Applied Mathematics, Statistics, or Operations Research. Send resume, transcripts and 3 letters of recommendation to Dr. David Hughes, Mathematics, UOP, Stockton, CA, 95211. An equal opportunity/affirmative action employer.

MATHEMATICS POSITION: Central College, Pella, IA, invites applications for a mathematics instructor. Responsibilities include teaching a range of beginning undergraduate courses in mathematics and/or computer science. This is a non-tenure track position but may be continued indefinitely. M.A. degree in mathematics and effective teaching skills required. Application with resume and letters of reference should be sent to Dr. Donald V. Meyer, Central College, Pella, IA 50219. EOE.

Computer Science
A tenure track faculty position at an assistant or associate professor level is available at the University of Michigan-Dearborn. Primary responsibilities are in the Computer and Information Science Program. This program is an interdisciplinary program involving mathematics, engineering and business administration faculty. A Ph.D. in computer science is desired. Applicants with master's level training in Computer Science and a Ph.D. in another discipline are encouraged to apply. The University of Michigan-Dearborn is one of three campuses in the University of Michigan System. It is located in the core of the southeastern Michigan industrial area. Applicants

should send a current vita, three letters of recommendation, and official transcripts to: Dr. Roger Verhey, CIS Program Director, Division of Interdisciplinary Studies, The University of Michigan-Dearborn, 4901 Evergreen Road, Dearborn, Michigan 48128-1491. The University of Michigan is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities.

SUNY—FREDONIA
Fredonia, New York 14063

The Department of Mathematics and Computer Science has two tenure-track positions available September 1986. We are seeking persons qualified to teach upper-level courses in applied mathematics or computer science; applicants must have strong academic credentials or practical experience. The Department has 17 full-time faculty and offers strong baccalaureate programs; last year 27 students graduated in Mathematics and 18 in Computer Science. Laboratory facilities include a VAX 11/750, running UNIX, and a Burroughs B7900. The College has 4500 students and is in a village of 12,000 people, located in Chautauqua County, westernmost in New York. The area is famous for its four-season beauty, with rolling hills, lakes, farms, and vineyards. Cultural and recreational opportunities abound, and the local schools are excellent. A letter of application, a resume, and three letters of recommendation should be sent to Dr. Fred Byham, Acting Chairman. An AA/EOE.

DAKOTA STATE COLLEGE
MATHEMATICS FACULTY POSITION
Search Continued

Applications are continuing to be accepted for a full-time tenure track position in the Division of Science and Mathematics. Starting date is Fall Semester, 1986.

Responsibilities of this position include teaching upper and lower division mathematics. The ability to teach physics courses is desirable. A commitment to use computers in teaching and research is essential.

For this position a Ph.D. and college teaching experience are preferred.

Applications will be accepted until April 1, 1986, or until the position is filled.

Letters of application, resumes and the names, addresses and phone numbers of three references should be sent to:

Dr. David E. Cook, Head
Division of Science and Mathematics
Dakota State College
Madison, SD 57042

An Affirmative Action, Equal Opportunity Employer.

LORAS COLLEGE

Tenure-track position in Mathematics, beginning 8/86. Rank and salary dependent on qualifications. Requirements include a Ph.D. degree, commitment to quality undergraduate teaching and a desire to make a positive contribution to a church-related liberal arts college of about 1900 students. Applications accepted until March 20, 1986 or position is filled. Send resume, transcripts and three letters of recommendation to Dr. John C. Friedell, Loras College, Dubuque, IA 52001.

THE UNIVERSITY OF THE SOUTH
Sewanee, TN 37375

Assistant Professorship, beginning late August, 1986. Three-year position with possibility of becoming tenure-track, half-time in mathematics and half-time computer science. Duties include teaching each semester 3-4 classes (10-11 contact hours per week with total enrollment of 75-90 students). Doctorate in mathematics and strong graduate training in computer science desired, together with a commitment to excellent teaching and to the values of a liberal arts education. Salary commensurate with experience. Send resume, three letters of recommendation, and a statement of professional interests and goals to W.M. Priestley, Chairman, Department of Mathematics and Computer Science. The University of the South, a coed-

ucational college of 1000 students, is an equal opportunity/affirmative action employer.

FACULTY POSITION: MATHEMATICS

The University of Pittsburgh at Johnstown, a four-year College of the University of Pittsburgh, invites applications for a tenure stream faculty position in Mathematics at the Assistant Professor level for January 1, 1987. Applicants should have a strong dedication to teaching all levels of undergraduate mathematics and a deep motivation for continuing professional development. Doctorate is strongly preferred.

Academic year is from September 1 to April 30 with limited spring or summer teaching. Salary is negotiable depending on experience and academic qualifications.

All applications received by September 5, 1986 will receive full consideration. Applications received after that date will be considered if position is still open. Send resume, at least three letters of recommendation, and other supporting documents to Dr. John D. Wilson, Search Coordinator, Department of Mathematics, University of Pittsburgh at Johnstown, Johnstown, PA 15904. UPJ is an Equal Opportunity/Affirmative Action Employer.

Search for a Secretary
of the American Mathematical Society

Position: Everett Pitcher, having served as Secretary of the American Mathematical Society since 1967, has decided not to continue in that capacity past 1988. The position of Secretary is an elected office with a two year term, but traditionally the election has been uncontested. The Society is seeking a candidate for this position to take office on 1 January 1989. It is planned that the person will be nominated for election by the Society in 1987, in order that the candidate may observe the conduct of Society business for a full year before taking office.

Duties: The Secretary of the Society is the chief policy administrator of the organization and as such must be familiar with all aspects of operation. In this respect the position should be filled by someone who has substantial knowledge of Society activities, and is willing to make a long-term commitment to the position even though the candidate and the Society have the opportunity to review their mutual satisfaction every two years.

The duties of the office cannot be superposed on full-time employment, and take about half of one's working time, with varying levels of activity during the year. Nonetheless the Secretary must be available on a regular basis to conduct business. For these reasons, it is intended that the candidate shall, with the cooperation of the Society and the employer, have a continuing arrangement of released time so that both the duties of the office and regular employment can be carried out effectively in an appropriate environment. The Society is prepared to reimburse the employing institution for the portion of time spent on Society business, and supply other benefits such as full office support and a continuing research stipend. Details of the arrangement will depend on the circumstances of the candidate and the employer.

Applications: A Search Committee with Ramesh Gangolli as chairman has been formed to seek and review candidates. Persons who wish to be considered or to make a nomination should provide supporting documentation to:

The Search Committee
Everett Pitcher
Box 2767
Lehigh Valley, PA 18001

before 31 May 1986 to receive full consideration.

Mathematics Department Chairman position. Requirements: Ph.D. in Mathematics, college teaching experience. Preference given to candidates with administrative experience and course work in Computer Science or Mathematics Education. Date of appointment: Fall 1986. Send letter of application, resume, transcripts, and three letters of reference to Personnel Office, Box C-13, Sul Ross State University, Alpine, Texas 79832. Telephone: (915) 837-8058. An equal opportunity/affirmative action employer.

Calculus *(continued from page 2)*

The methods subcommittee, headed by Alan Schoenfeld of UC-Berkeley, studied ways to revitalize calculus teaching. Their report spells out in detail what new resources (human and technological), texts, exercises, and tests will be needed if an up-to-date calculus is to fulfill its promise. A tall order, the conferees agreed, but one that can and must be met. To do so, students and faculty must aim higher, and departments and deans must support and reward the enterprise.

Sherman Stein, of UC-Davis, recommended that time saved by a streamlined syllabus and modern calculators be spent on open-ended problems, assigned outside of the usual contexts that usually cue students as to just which techniques to use. Stein encourages the freest attack on such problems, by all methods: guessing, estimation, calculation, and even, when all else fails, the full algebraic and analytic arsenal. Students might submit successive written attempted solutions over a week or more, receiving judicious hints along the way. At Tulane, Stein's idea looked good: several of his problems sent conferees scurrying for their pencils.

The implementation subpanel, chaired by Lida Barrett of Northern Illinois University, studied how to get to there from here. Full scale implementation is a long-term project. In the short run, pilot projects, to begin not later than fall 1987, will test the panel's proposals and develop course materials to support them. Financial support will be needed, from private foundations and from government sources.

Proceedings of the Tulane conference are slated to be published next summer. Readers who want further information, or who can report on their own experiments with calculus reform, should write to Ronald Douglas, Department of Mathematics, SUNY at Stony Brook, New York 11794.

(Paul Zorn teaches at St. Olaf College.)

A Mathematician Weighs Congressional Means

T. Christine Stevens

High above the entrance to the Library of Congress is an intricately decorated corridor whose elevation seems ideally suited to the abstraction of the mottoes that adorn its walls. There, among lofty pronouncements about wisdom, beauty, and the nature of man, is a tablet informing us that "Science is organized knowledge." These four words, penned by the nineteenth century philosopher Herbert Spencer, still capture the popular notion of science as an impersonal and objective enterprise, in which observation and logic lead inexorably to certainty and truth.

Politics, on the other hand, is generally held to be a very different sort of activity, pursued in a realm where the human element is paramount, all decisions are tentative, and the ability to compromise is essential. Nothing, it would seem, could be further from the science of scientists than the science of government.

Yet bringing these two disparate professions together is precisely what the Congressional Science Fellowships seek to do. Each year, under a program administered by the American Association for the Advancement of Science, about two dozen national and social scientists are placed in temporary positions on Capitol Hill. They research issues, draft legislation, organize hearings—and study at first hand the interaction of science and public policy.

During the 1984-1985 academic year, I was fortunate to be the Congressional Science Fellow in mathematics. My fellow fellows and I began our year with a brief but informative orientation that included lectures on congressional procedures, a meeting with the President's science adviser, and a description of the work of the General Accounting Office by an official with the delightfully allegorical name of Osmund Fundingsland. Each of us then embarked upon a series of placement interviews with the offices in which we were most interested. In due course, I selected a position on the staff of Congressman Ted Weiss, a Democrat from New York City. Rep. Weiss wanted someone to take full responsibility in his office for the areas of defense and arms control, as well as science and technology. This combination of issues appealed to me because it touched both my interests as a professional mathematician and my concerns as a private citizen, and because it offered me a special opportunity to observe how Congress responds to the technical aspects of larger questions of public policy, such as the desirability of the "Star Wars" antiballistic missile defense system and the verifiability of arms control agreements.

What I discovered is that the congressional attitude towards science is not very different from the popular one. Although favorably impressed by the accomplishments of science, Congressmen expect unequivocal answers from its practitioners and are often uneasy or impatient when the experts disagree. Except for those few who serve on committees having jurisdiction over agencies like the National Science Foundation, they spend little time worrying about the importance of upgrading university research facilities or the need to assure our nation an adequate supply of scientists and engineers. In my entire year on Capitol Hill, I met hardly anyone who had even heard of—let alone read—the David Committee's report on "Renewing U.S. Mathematics." It was in this context of benign neglect that Congress voted, with little debate and less opposition, to freeze the National Science Foundation's budget for the coming year.

Although most Members of Congress can afford to ignore purely technical questions, such as the merits of the physicists' proposed superconducting supercollider, there are other issues, like the "Star Wars" program, which do command their attention and in which technology plays a significant role. Even here, however, Congress is likely to focus first on the non-technical aspects of the problem. Looking at the "Star Wars" proposal, for example, a scientist might first ask whether such a system is feasible and then wonder where all the scientists and engineers to develop it would come from and how it would affect other research activities. Congress, on the other hand, prefers to discuss the strategic implications of the proposed antiballistic missile defense system and its probable impact on existing arms control agreements.

If Congressmen and their staffs are naive in their attitude towards science in general, they are even more perplexed by the role of that simultaneous "queen" and "handmaiden" of the sciences, mathematics. During my placement interviews, I encountered a recurrent but instructive congressional blind spot. Although they could easily picture a physicist handling energy issues or a biologist working on the environment, most congressional staff members were at a loss to imagine anything that a mathematician might do. One person, for example, suggested that I could help to program the House of Representatives computer; another wondered whether my knack for figures pointed to a place on the staff

Congressional Fellow *(continued from page 5)*
of the Budget Committee. No one, it seemed, thought that mathematics developed any socially useful skills, and everyone was pleasantly surprised to discover that a mathematician could be interested in something besides numbers.

This state of affairs was, of course, one of the reasons for establishing the Congressional Science Fellowship program in the first place. As the fellows were reminded during orientation, congress is a "large group of well-intentioned lawyers," and Washington is a city "filled with ex-student body presidents." However useful in their own right, neither of these occupations is likely to promote a sophisticated understanding of the significance, the requirements, or the consequences of scientific research. What the fellows offer to Members of Congress, whether or not they take a special interest in technological issues, is routine, everyday access to practicing scientists who are sensitive to the technical ramifications of legislation.

A truism tells us that in politics it isn't what you know, but who you know. For Congressional staff, whose primary role is that of information compactor, what matters most is who you know, and what they know. Simply by responding nat-

urally to the measures and issues that come before them, fellows can bring a new set of concerns to congressional attention. During my year on Rep. Weiss' staff, for example, I studied our ability to verify a comprehensive test ban and initiated a proposal to increase funding for scientific research in this area. I also advised him on legislative proposals designed to increase the number of U.S. citizens earning Ph.D.'s in technical fields and brought him up to date on the tribulations of the NSF's programs in mathematics and science education.

What fellows and their sponsoring societies gain in return is an insider's view of life on Capitol Hill. The value of this experience lies in the light it sheds on the complex task of attracting and holding congressional attention and support. As several knowledgeable speakers stressed during the fellows' orientation, "In this town, knowledge is power."

My own experience, for example, suggests that Congress will not be impressed with the importance of "renewing U.S. mathematics" unless we forcefully and persuasively link it to issues of more widespread concern, such as the need to assure the competitiveness of American industry in world markets. This message will attract more attention if we can enlist the support of journalists, for one of the things that makes the "influential" press influential is that it serves as a source of ideas for hurried and harried congressional staff.

Nor should we underestimate the significance of constituent pressure. Although letters or visits from voters are not guaranteed to secure the support of a Member of Congress, they usually do provoke a decision of some kind. For an issue like ours, which suffers more from indifference than from active opposition, simply focusing our representatives' attention on the problem can accomplish a great deal.

Finally, it is important to seize opportunities whenever they arise, for the congressional attention span is astonishingly brief. Professional mathematicians, for example, are currently caught up in efforts to improve the teaching of their subject, but Congress, having legislated on this matter in 1984, considers the problem solved!

Observations like these helped to make my fellowship year a valuable one, and it was with pleasantly mixed feelings that I returned to my position in the mathematics department at Arkansas State University. Although I appreciated the opportunity to influence public policy and enjoyed the cultural life of our nation's capital, I also missed the intellectual challenge of my research. It's nice once again to have an office of my own and to be working on problems that can, at least in principle, be solved. Meanwhile, my university is anxious to exploit my increased familiarity with sources of federal support for scientific education and research. I hope that the current fellow in mathematics has as interesting, enjoyable, and useful an experience as I did.

(T. Christine Stevens was a Congressional Science Fellow in Mathematics during the academic year 1984-85. Such fellows have been supported by the American Mathematical Society, the Mathematical Association of America, and SIAM, and sponsored by the Conference Board of the Mathematical Sciences acting through the American Association for the Advancement of Science. Professor Stevens teaches at Arkansas State University.)

Applications are invited for the 1986–87 Congressional Science Fellowship to begin September 1, 1986. Deadline for application is April 21. For further information please contact the Conference Board on Mathematical Sciences, 1529 18th Street, N.W., Washington, D.C. 20036.

In Memoriam

Paul R. Beesack, Carleton University, Ottawa, Canada, died October 16, 1985, at the age of 64. He was an MAA member for 39 years.

C. Daniel Cole, University of Lowell, died May 25, 1985, at the age of 60. He was an MAA member for 2 years.

Harold K. Crowder, Professor Emeritus, Cleveland State University, died July 6, 1985, at the age of 74. He was an MAA member for 37 years.

Robert E. Ehrlich, Salisbury State University, died October 2, 1985, at the age of 56. He was an MAA member for 26 years.

Patrick R. Jorgenson, Emmanuel County Community College, died March 4, 1985, at the age of 38. He was an MAA member for 7 years.

Lincoln Lapaz, Director Emeritus, University of New Mexico, Albuquerque, died October 19, 1985. He was an MAA member for 55 years.

Charles B. Morrey, Professor Emeritus, University of California, Berkeley, died April 29, 1985, at the age of 77. He was an MAA member for 33 years.

Henry Pixley, of Detroit, Michigan, died October 9, 1985, at the age of 83. He was an MAA member for 54 years.

Nancy T. Rich, University of Houston, died October 1, 1985. She was an MAA member for 12 years.

C. Everett Rhodes, Professor Emeritus, Alfred University, New York, died October 6, 1985, at the age of 84. He was an MAA member for 61 years.

Herbert J. Ryser, California Institute of Technology, died July, 1985. He was an MAA member for 38 years.

John H. Simester, Professor Emeritus, University of Louisville, died August 18, 1985, at the age of 86. He was an MAA member for 62 years.

L. Clifton Snively, of Boulder, Colorado, died July 22, 1985, at the age of 77. He was an MAA member for 40 years.

Peter Renz Chosen as MAA Associate Director

Dr. Peter L. Renz of Bard College has been appointed Associate Director of the Mathematical Association of America effective January 1, 1986. He will be serving the Association on a one-third basis until June. During this period, Dr. Andrew Sterrett will be assisting the MAA Headquarters staff as Interim Associate Director.

The new Associate Director's responsibilities will be mainly in the area of publications. He is currently a Consulting Editor of W.H. Freeman Co./Scientific American Books. For ten years from 1974 until 1984 he was Mathematics Editor for W.H. Freeman and had responsibility for physics and astronomy during part of that time. From 1968 until 1973 he served on the mathematics faculties of Reed and Wellesley Colleges.

Dr. Renz was educated at Reed College, the University of Pennsylvania, and the University of Washington where he received his Ph.D. in 1969.

Dr. Sterrett is Professor of Mathematics at Denison University and is a Governor of the Association representing the Ohio Section. In 1972 he served as the Executive Director of the MAA Committee on the Undergraduate Program in Mathematics.

Mathematics Awareness Week set for April 14-20

James R. Murphy

In this time of budget balancing and deficit reduction, we look upon congress primarily as the keeper of the federal purse. Our focus and concern is on increasing or perhaps just maintaining federal funding for mathematics education and research. In between bouts of budget blues, it is worth while to take a long range view and remember that congress can be an attentive audience. Like the rest of us, congressmen and congresswomen and their staffs are receptive to personal contact and effective presentations of well structured arguments when it comes to making decisions about how money is to be spent.

For this reason Senator Pete V. Domenici (R-NM) introduced a bill on January 29, 1986, to create a "National Mathematics Awareness Week", April 14-20, 1986. To quote from the Congressional Record, Senator Domenici says "National Mathematics Awareness Week gives us an opportunity to focus on the contributions that mathematics and mathematicians have made to our society, economy, and innovative technologies."

Many groups take advantage of these commemorative dates to enlighten policy makers at all levels (local, state, and federal). This type of low-key, informational interaction can plant the seeds for later, more serious, discussions with key policy makers. Senator Domenici has provided an opportunity for the mathematics community to engage in this type of dialogue. It is up to us to take advantage of it.

(James Murphy, a biostatistician from the University of Colorado Medical School, is the 1985-86 Congressional Science Fellow working as the special legislative assistant on the staff of Senator Domenici.)

MAA Officers Elected

Leonard Gillman of the University of Texas and Deborah Tepper Haimo of the University of Missouri-St. Louis have been elected, respectively, President-Elect and First Vice President of the MAA. Gillman will serve for one year in the office of President-Elect, for two years as President, and for one additional year as Past-President. Haimo will serve as First Vice President for two years.
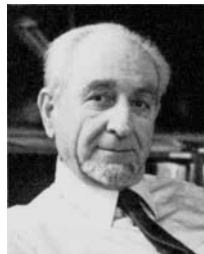
Gillman is well known in his capacity as Treasurer of the MAA, a position which he has held since 1973, and as a lecturer and author. He has given approximately 30 invited lectures at section meetings as well as several hundred talks as a Visiting Lecturer. He is the author of *Rings of Continuous Functions* (with M. Jerison) and *Calculus* (with R.H. McDowell).

Gillman has been an active participant in many discussions of curricular issues: The Committee on the Undergraduate Program in Mathematics (CUPM), the Committee on Educational Media (CEM), and the School Mathematics Study Group (SMSG). He was a member of the International Commission on Mathematical Instruction, 1966-69, and of the Organizing Committee for the First International Congress on Mathematics Education, Lyon, 1969.

Gillman's versatility is illustrated by his Fellowships: Juilliard (piano), Carnegie (mathematical statistics), Guggenheim (mathematics) and NSF (mathematics). His piano concerts (with Louis Rowen, Cello) in San Antonio added a new dimension to our Annual Meetings.

Haimo has also been active in the MAA. She serves as a visiting lecturer and consultant and was a member of CUPM, 1973-75, and a Member-at-Large of the Board of Governors of the MAA, 1974-76. She was Mathematical and Classroom Notes Editor of the *American Mathematical Monthly*, 1978-81, and has been a member of the Subcommittee on Basic Library Lists since 1983. She was a contributor to MAA Notes No. 5, Communication in *American Perspectives on the Fifth International Congress on Mathematical Education*, and to MAA Notes No. 3, Women and Mathematics Section of *Undergraduate Mathematical Education in the Peoples' Republic of China*.

Haimo's other professional activities include her research into generalizations of the heat equation, editor of *Orthogonal Expansions and their Continuous Analogues*, editorial board member of the SIAM *Journal on Mathematical Analysis*, Mathematics member of the Agency for International Development for study of graduate programs of Seoul National University, and Trustee of the Association of Members of the Institute for Advanced Study, 1980-present.

MAA to Co-Sponsor Papers at NCTM Annual Meeting in Washington, D.C.

Several papers to be presented at the 64th Annual Meeting of NCTM in Washington, D.C., April 2-5, 1986, will be jointly sponsored by the MAA and NCTM. Ronald M. Davis, Northern Virginia Community College represented the MAA on the Program Committee. A complete program may be obtained by writing to NCTM, 1906 Association Drive, Reston, Virginia 22091, (703) 620-9840.

Calendar

National MAA Meetings

70th Annual Meeting, San Antonio, Texas, January 21-24, 1987.
66th Summer Meeting, August 1987.

71st Annual Meeting, Atlanta, Georgia, January 6-9, 1988.
72nd Annual Meeting, Phoenix, Arizona, January 11-14, 1989.

Sectional MAA Meetings

Allegheny Mountain, Clarion State University, Clarion Pennsylvania, April 18-19, 1986.

Eastern Pennsylvania and Delaware, Moravian College, Bethlehem, Pennsylvania, April 5, 1986.

Illinois, Augustana College, Rock Island, Illinois, April 25-26, 1986.

Intermountain and Rocky Mountain, Mesa College, Grand Junction, Colorado, April 25-26, 1986.

Iowa, University of Iowa, Iowa City, Iowa, April 11-12, 1986.

Kansas, Pittsburg State University, Pittsburg, Kansas, April 11-12, 1986.

Kentucky, Murray State University, Murray, Kentucky, April 11-12, 1986.

Louisiana-Mississippi, Mississippi University for Women, Columbus, Mississippi, February 27-28, 1987.

Maryland-D.C.-Virginia, Mary Washington College, Fredericksburg, Virginia, April 26, 1986.

Metropolitan New York, Queen's College, CUNY, Flushing, New York, May 4, 1986.

Michigan, Central Michigan University, Mount Pleasant, Michigan, May 9-10, 1986.

Missouri, Southwest Missouri State University, Springfield, Missouri, April 18-19, 1986.

Nebraska, University of South Dakota, Vermillion, South Dakota, April 11-12, 1986.

Ohio, John Carroll University, University Heights, Ohio, April 25-26, 1986.

Pacific Northwest, Southern Oregon State College, Ashland, Oregon, June 19-21, 1986.

Rocky Mountain and Intermountain, Mesa College, Grand Junction, Colorado, April 25-26, 1986.

Southeastern, Auburn University, Auburn University, Alabama, April 11-12, 1986.

Texas, Eastfield College, Mexquite, Texas, April 11-12, 1986.

Wisconsin, University of Wisconsin-Stout, Menomonie, Wisconsin, April 25-26, 1986.

Other Meetings

April 1986

2-5. **64th Annual Meeting of the National Council of Teachers of Mathematics**, Washington, D.C. There will be 495 program sessions, some sponsored jointly with the MAA. Contact: Betty Richardson, NCTM, 1906 Association Drive, Reston, VA 22091.

4-5. **Third Annual Rose-Hulman Conference on Undergraduate Mathematics**. Invited speakers: Peter Hilton, Jean Pederson. Contact: Conference on Undergraduate Mathematics, Department of Mathematics, Rose-Hulman Institute of Technology, 5500 Wabash Avenue, Terre Haute, IN 47803; (812)877-1511, Ext. 391.

24-25. **Seventeenth Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh. Contact: W.G. Vogt or M.H. Mickle, Modeling and Simulation Conference, 348 Benedum Engineering Hall, University of Pittsburgh, Pittsburgh, PA 15261.

May 1986

"Frontiers of Chaos" exhibit. The Department of Values, Technology, Science and Society, Building 370, at Stanford University, Stanford, California.

23-24. **Geometry and Topology Conference**, Lehigh University. Principal speakers: Robert Bryant, Rice University; Jeff Cheeger, SUNY at Stony Brook; Ralph Cohen, Stanford University; and Allen Hatcher, Cornell University. Contact: Donald M. Davis or David L. Johnson, Department of Mathematics, Christmas-Saucon Hall, #14, Lehigh University, Bethlehem, Pennsylvania 18015. (215) 861-3730.

June 1986

2-6. **MAA Maryland-DC-Virginia Section Summer Workshop—Mathematical Modeling**, Salisbury State College. (See FOCUS, January-February 1986.)

4-6. **Seventh National Educational Computing Conference**, San Diego, California. Contact: NECC 86, University of San Diego, School of Education, Alcala Park, San Diego, CA 92110.

9-13. **MAA Maryland-DC-Virginia Section Summer Workshop—Discrete Mathematics**, Salisbury State College. (See FOCUS, January-February 1986.)

16-20. **MAA Wisconsin Section Short Course—Algorithms of Discrete Mathematics**, Cardinal Stritch College, Milwaukee, Wisconsin. (See page 2 of this issue.)

July 1986

9-11. **NSF Workshop on Broadening the Base of Research in Operations Research** (for young faculty at predominately undergraduate institutions), Wellesley College. Contact: Dr. James E. Falk, Associate Program Director, Systems Theory and Operations Research, Division of Electrical, Communications, and System Engineering, National Science Foundation, Washington, D.C. 20550; (202) 357-9618.

15-16. **MAA Ohio Section Short Course—History of Calculus**, Ashland College. Contact: Alan Poorman, Mathematics Department, Ashland College, Ashland, Ohio 44805.

27-August 2. **The Eugene Strens Memorial Conference on Intuitive and Recreational Mathematics and its History**, The University of Calgary. Contact: Richard K. Guy or Bill Sands, Department of Mathematics & Statistics, The University of Calgary, 2500 University Drive N.W., Calgary, Alberta, Canada T2N 1N4.

August 1986

2. **USCMI Pre-Congress Survey Talks**, Berkeley, California. (See page 4 of this issue.)

3-11. **International Congress of Mathematicians**, Berkeley, California. (See FOCUS, October 1985, November-December 1985, January-February 1986, and page i of this issue.)

3-11. **Association of Women in Mathematics**, University of California, Berkeley (in conjunction with the International Congress of Mathematicians).