FOCUS

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A Comparison of University Entrance Examinations in the United States and in Europe

Chantal Shafroth

Improving mathematics education has been part of our agenda for a long time, but the "new mathematics era" and all the curriculum reforms that followed have not resulted in substantial improvements. In mathematics, average United States high school students continue to compare unfavorably with their counterparts. It is time we realize that the level of the national tests administered at the end of high school determines the way the material is taught, so that if a national test requires only a quick answer, presentation of results and correct reasoning will not be emphasized in most classrooms. Tests are not only an assessment tool, but also an important teaching tool.

In its December issue, FOCUS included a special section on the Japanese University Entrance Examination [1] in the hope "that a better understanding of the level of mathematics expected of Japanese students will give mathematics educators in the U.S. a basis for comparison when reviewing the U.S. secondary school curriculum and expectations of mathematics performance." Mathematics educators should also take a closer look at the level of mathematics expected of European students.

My study compares mathematics achievement tests administered in the United States at the end of high school to national (or state) examinations in five countries in Europe.

I concentrate on tests used to assess students' knowledge in mathematics before entering a college or a university and focus on the following:

A) Format of questions, time allowed per question and depth of understanding required

B) Types of questions

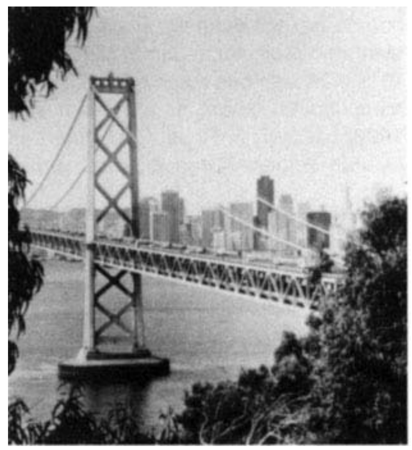
C) Correlation between consecutive questions and evaluations

For the United States, I look primarily at the College Board Mathematics Achievement Tests Level I and II [2], and the College Board Advanced Placement Test [3].

I also look at two tests sponsored by the MAA and designed to identify those students who have outstanding mathematics ability: the American High School Mathematics Examination (AHSME) [4] and the American Invitational Mathematics Examination (AIME)[5] .

*Please see **Examinations** on page 11*

1995 Winter Meeting to be held in San Francisco



As reported in the February issue of FOCUS, the governing bodies of the AMS and MAA, at the January Meetings in San Antonio, considered the issue of whether, in view of the decision by the voters in Colorado to remove legal safeguards protecting homosexuals, to move the AMS-MAA Joint Meeting scheduled for Denver in January 1995.

The decision was to find an alternative site for this meeting. With such short notice, the Joint Meetings Committee has been remarkably fortunate to be able to reschedule the meeting in San Francisco. The four day meeting will be held Wednesday through Saturday, January 4-7, 1995. The MAA Board of Governors will meet on Tuesday, January 3. As with previous meetings in San Francisco, the headquarter hotel will be the Hilton.

Inside this Issue ...

MAA Contributed Papers in Cincinnati

The Mathematical Association of America and the American Mathematical Society will hold their annual joint meetings from Wednesday, January 12, 1994 through Saturday, January 15, 1994 in Cincinnati, Ohio. The complete meetings program will appear in the October 1993 issues of Focus and the AMS Notices. This preliminary announcement is designed to alert participants about the MAA's contributed papers sessions and their deadlines.

Please note that the days scheduled for these sessions remain tentative. The organizers listed below solicit contributed papers pertinent to their sessions; proposals should be directed to the organizer whose name is followed by an asterisk (*). For additional instructions, see the Submissions Procedures Box on the facing page.

Sessions generally must limit presentations to ten minutes, but selected participants may extend their contributions up to 20 minutes. Each session room contains an overhead projector and screen; blackboards are not normally available. You may request one additional overhead projector, a 35mm slide projector, or a 1/2 inch or 3/4 inch VHS VCR with one color monitor. Persons needing additional equipment should contact, as soon as possible, but prior to November 5, 1993: Kenneth A. Ross, Department of Mathematics, University of Oregon, Eugene, Oregon 97403; e-mail: ross@math.uoregon.edu.

ACTUARIAL MATHEMATICS EDUCATION AND RESEARCH

Thursday afternoon

Prof. James W. Daniel (*)
Mathematics Department
University of Texas
Austin, TX 78712
phone: (512) 471-7168; FAX: (512) 471-9038
e-mail: daniel@math.utexas.edu

This session is sponsored by the Actuarial Faculty Forum. Papers are sought on both educational matters (how to structure problem-lab sessions for actuarial exams, how to use software in teaching interest theory, and the like) and research (the role of semi-hemi-groupoids in actuarial and financial modeling, or something more meaningful). Topics suitable for a general mathematical audience as well as for actuarial educators are especially welcome.

APPLIED GEOMETRY

Wednesday afternoon and Thursday morning

Walter Meyer (*)
100 Brook St.
Garden City, New York 11530
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e-mail: meyer@adelphi.edu

If you have taught geometry with an applied flavor, you are invited to speak about your experience. Because geometry is hard to separate from other areas of mathematics, topics from other courses, such as linear algebra, or from sister disciplines such as computer science, are welcome if there is a strong geometric point of view. Geometry has always been close to applications, but in the modern era new applications in robotics, graphics, computer vision, algorithms, fractals and the like have arisen. Modern and classical applications are equally encouraged.

THE BRIDGE TO CALCULUS

Saturday morning and afternoon

Marilyn Mays (*)
North Lake College
5001 MacArthur Blvd.
Irving, TX 75038-3899
phone: (214) 659-5328, FAX: (214) 659-5219
e-mail: mem7230%nlcl@pcmail.dcccd.edu

Linda Boyd
DeKalb College

The MAA Committee on Two-Year Colleges invites papers on topics related to reform in curriculum and pedagogy in the courses leading to calculus pre-college courses through pre-calculus. These presentations may give details of pilot or experimental programs which have been offered or may outline a vision for reform. Discussion of the implications of reform on the issues of assessment and faculty development are particularly relevant.

ENVIRONMENTAL MATHEMATICS

Wednesday morning and Thursday afternoon

Ben Fusaro (*)
Dept. of Mathematics and Computer Science
Salisbury State University
Salisbury, MD 21801
phone: (410) 543-6470, FAX: (410) 548-5597
e-mail: E3FAFusaro@SAE.Towson.EDU

Papers that deal with concepts or contents that can be used in introductory mathematics courses—Pre-calculus, Applied ("baby") Calculus, Math in Culture, etc. are especially welcome. However, all undergraduate applications of mathematics to the environment are welcome.

FAVORITE NON-TRADITIONAL CALCULUS ASSIGNMENTS OR PROJECTS

Wednesday morning and Thursday afternoon

Duane Blumberg (*)
College of Sciences
University of Southwestern Louisiana
Lafayette, LA 70504-3290
phone: (318) 231-6986, FAX: (318) 231-6195
e-mail: blumbergdd@ea.usl.edu

This session will feature papers describing non-traditional calculus assignments or projects. Papers should include a disscussion of the purpose of the assignment and the type of responses expected (perhaps illustrated by samples of work by students).

MATHEMATICS AND MUSIC

Friday morning and Saturday afternoon

Professor Robert Lewand (*)
Department of Mathematics and Computer Science
Goucher College
Towson, Maryland 21204
phone: (410) 337-6239
e-mail: blewand@umab.umd.edu

From the days of Pythagoras the relationship between mathematics and music has been noted and appreciated by mathematicians and musicians alike. In particular, mathematics and algorithms have influenced much of 20th century music. Papers submitted for inclusion in this session should address specific instances of (1) how mathematics has been employed in the creation, appreciation, or criticism of music, or (2) how music has informed and benefitted mathematics. Presentations illustrated by audio musical examples are especially invited.

NEW METHODS FOR TEACHING ELEMENTARY DIFFERENTIAL EQUATIONS

Friday morning and Saturday afternoon

T. Gilmer Proctor (*)
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Clemson University,
Clemson, SC 29634-1907
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e-mail: proctor@clemson.clemson.edu
Robert Borrelli
Harvey Mudd College

Teaching methodology in differential equations courses is changing significantly because of inexpensive graphical and computational tools and because the calculus reform movement has modified the prerequisite courses. This session invites papers on experiences in teaching differential equations, including creative use of graphical, symbolic algebraic and numerical tools to study this subject, and mathematical modeling problems containing differential equations which have been of particular interest to students. Papers on suggested changes to the normal syllabus made desirable by the use of supercalculators, microcomputers and workstations are welcome.

REASSESSING DISCRETE MATHEMATICS IN THE FIRST TWO YEARS

Friday and Saturday

Susanna S. Epp (*)
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DePaul University
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Chicago, IL 60614
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email: matsse@orion.depaul.edu

It has been more than seven years since the appearance of the final report of the MAA Committee on Discrete Mathematics in the First Two Years. This session invites papers describing current practice in teaching discrete mathematics to freshmen and sophomore students. What kinds of courses and approaches are working? Which ones are not? What are the major client departments and how well satisfied are they? How successfully is discrete mathematics being incorporated into other lower-level mathematics or computer science courses? Is software being used? If so, in what ways? What are the current issues?

RESEARCH IN UNDERGRAUATE MATHEMATICS EDUCATION

Friday afternoon and Saturday morning

Warren Page (*)
NYC Tech Coll, CUNY.
Mailing address: 30 Amberson Ave.,
Yonkers, NY 10705
phone: (914) 476-6446.

This session is sponsored by the Joint AMS/MAA Committee on Research in Undergraduate Mathematics Education. The organizing committee also includes John Selden and Ed Dubinsky. Presentations are invited that describe research on the teaching and learning of any aspect of undergraduate mathematics. Descriptions of courses taught must be in the context of investigations into questions such as how is mathematics learned, how mathematics is taught, how effective are the approaches, and similar issues.

RESTRUCTURING THE MATHEMATICAL PREPARATION OF TEACHERS

Friday morning and Saturday afternoon

Dr. Bettye M. Clark (*)
Clark Atlanta University
P. O. Box 171
Atlanta, GA 30314
phone: (404) 880-8188
FAX: (404) 880-6027

Marjorie Enneking,
Portland State University

Phillip Wagreich,
University of Illinois - Chicago

Over the past several years, the mathematics and mathematics education communities have recognized and are responding to the call for dramatic changes in school mathematics. Such substantive changes in school mathematics will require corresponding changes in the mathematical preparation of teachers. The content of collegiate level courses must reflect the changes in content and teaching style for the emerging school curriculum. These courses must model exemplary teaching methods and classroom environments. This session, sponsored by the Committee On the Mathematical Education of Teachers (COMET), seeks papers that address the critical need for change in how and what mathematics is taught to prospective teachers in collegiate courses and change in the amount of mathematics preparation now required for the certification of teachers of school mathematics at all levels. Model programs, creative partnerships, research, and position papers that address these issues are encouraged.

RESTRUCTURING TEACHING AND LEARNING IN LINEAR ALGEBRA

Wednesday afternoon, Thursday evening, and Friday afternoon

Donald R. LaTorre (*)
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e-mail: latorrd@clemson.clemson.edu

Steven J. Leon (for the ATLAST project)
University of Massachusetts at Dartmouth

Charles R. Johnson (for the LACSG)
College of William and Mary

The teaching and learning of linear algebra is undergoing fundamental change, brought about largely by the renewed interest in the subject occasioned by today's easy access to computational capability. This session invites papers on personal experiences with innovations in teaching linear algebra, including: (1) the creative use of computer algebra systems, supercalculators, or computer software; (2) experiences with materials from the ATLAST summer workshops; (3) experiences with the core curriculum recommended by the Linear Algebra Curriculum Study Group; (4) "gems" of linear algebra exposition; and (5) other innovative teaching or curriculum initiatives in linear algebra.

*Please see **Contributed Papers** on page 4*

TEACHING MATHEMATICS WITH A SPREADSHEET

Wednesday morning and Thursday afternoon

Robert S. Smith (*)
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e-mail: rssmith@miavx1.acs.muohio.EDU
rssmith@miavx1.BITNET

Since the late 1980s, there has been considerable interest in using spreadsheets in teaching outside the traditional business curriculum. In mathematics the electronic spreadsheet has made its presence known in both secondary and tertiary classrooms. This session invites papers which illustrate how the spreadsheet has been integrated into teaching in the mathematical sciences. Specifically, papers are invited which demonstrate how the spreadsheet can be used to prove theorems, create graphics, or illustrate mathematical concepts; or papers which describe courseware which is developed around the spreadsheet. Scheduling preferences should be communicated to the organizer.

Submission Procedures for Contributed Paper Proposals

After you have selected a session to which you wish to contribute a paper, forward the following directly to the organizer (the organizers are indicated with an *):

- **the name(s) and address(es) of the author(s); and**
- **a one-page summary of your paper.**

The summary should enable the organizer(s) to evaluate the appropriateness of your paper for the selected session. Consequently, you should include as much detailed information as possible within the one-page limitation.

Your summary must reach the designated organizer by Friday, September 3, 1993.

The organizer will acknowledge receipt of all paper summaries. If the organizer accepts your paper, you will receive a standardized abstract form. Use this form to prepare a brief abstract. Please return the completed form to the organizer by Friday, September 17, 1993. Abstracts received after the deadline will not be published in the 1994 Joint Annual Meetings Abstracts Journal. This Abstracts Journal will be available in the meetings registration area during the conference in Cincinnati.

DO NOT FORWARD COMPLETED ABSTRACTS TO THE MAA OR TO THE AMS. THEY ARE TO BE SENT TO THE SESSION ORGANIZER.

ELECTRONICALLY SUMBITTED ABSTRACTS WILL NOT BE ACCEPTED.

If you wish to obtain an abstract form in advance, please contact: The Executive Department, MAA, 1529 Eighteenth Street, NW, Washington, DC 20036, e-mail maahq@maa.org.

Call For Student Papers, Vancouver, British Columbia, Canada August 15–19, 1993

The fifth annual MAA Undergraduate Student Paper Sessions, in coordination with Pi Mu Epsilon, will be held at the joint MAA/AMS/CMS annual summer meetings in Vancouver, British Columbia, Canada in August. A limited number of awards to support student travel are available through a grant from the Exxon Education Foundation. Nomination forms for 15-minute papers from Sections of the MAA, Departments of Mathematics, and interested individuals, along with additional information may be obtained from Ron Barnes, Dept. of Applied Mathematical Sciences, University of Houston- Downtown, One Main St., Houston 77002-1094, or via e-mail from barnes@dt3.dt.uh.edu. Deadline for nominations and submission of abstracts: June 30, 1993.

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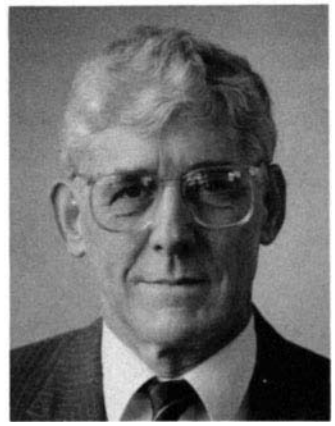
"Mathematicians Have Rediscovered Students" — An Interview with Donald L. Kreider

Donald L. Kreider has been president of the MAA since January. After completing his doctorate in mathematical logic at MIT, he stayed on for a postdoctoral year before accepting a position at Dartmouth College in 1960. He has been there ever since, serving twice as department chair and once as vice-president under President John Kemeny. He owes his involvement in the MAA to Kemeny, who in the fall of his first year at Dartmouth walked up to him and said: "Kreider, are you a member of the MAA?" When he said "no," Kemeny responded: "I'll give you three months!" Don quickly became an MAA member and involved to the point that he is now the president.

President Kreider in 1932.



President Kreider in 1993.

In his early years at Dartmouth, he and three colleagues wrote pioneering books linking linear algebra with analysis: *Linear Analysis*, with Kuller, Ostberg, and Perkins; and *Differential Equations with Linear Algebra*, with Kuller and Ostberg.

A few years after arriving at Dartmouth, Kreider fondly remembers getting seriously involved with computers and education. "When I went up to Dartmouth," he said, "I met two remarkable people, John Kemeny and Tom Kurtz, who had a project to bring computers onto the campus and into classrooms—to be used for educational purposes, as opposed to merely military and business purposes. They felt that every undergraduate should know quite a bit about computing. Tom Kurtz led me to a computer terminal that was connected to the original Dartmouth time-sharing system, and told me to sit down. In about 20 minutes we had written a program to find the fixed point of a Markov chain, and it worked! That was it; I was hooked." Since then Kreider has incorporated computers in his teaching and rarely travels today without his portable computer.

As a boy, he ran barefoot for much of the summer. Today he usually appears in shoes, but retains a great passion for the outdoors, especially the White Mountains of New Hampshire.

On the personal side, Don is the father of three sons and substitute father of a fourth. He is very proud of his six grandchildren and usually carries a wallet full of photos of them.

On the first day of February, 1993, Don Kreider chatted with Don Albers in the Washington office of the MAA about growing up in Pennsylvania and his hopes and dreams for the MAA.

Barefoot

DON ALBERS: Where were you born?

DON KREIDER: I was born in Lancaster County, Pennsylvania, and grew up as a depression child in Millersville, Pennsylvania, in a house that's to be demolished in the next year to make way for a new golf course of Millersville State College. I went out there this past Thanksgiving and walked around some of the places I ran around when I was six years old. It was a lot of fun reminiscing, but also shocking to see the change that was taking place.

I attended Millersville Training School, which was a training school for teachers of the then Millersville State Teachers College. When I was in seventh grade my parents decided to move out of their country existence, which I thought was the high point of my life, into a town, Lititz, Pennsylvania, where I went to high school.

As I think back on those early years I realize that we were, by today's standards, a poor, rural family. From my perspective, living in Millersville was the richest time of my life.

ALBERS: What made it so rich?

KREIDER: Well, one thing, for example, was the simple fact that during the depression my father had only one day of work per week. And so essentially he was able to spend time with his family, raising all the food and vegetables that were needed—amidst a setting of Pennsylvania Mennonite farms. It was a wonderful time, working in the tobacco field. It was a very nice place for young people to grow up.

ALBERS: When you say your father was working only one day a week, over what period of time did that extend?

KREIDER: Well, it's hard for me to tell. It probably ended when World War II began. Prior to that time, during the Thirties, I recall that he was at home most of the time and paid a lot of attention to his family.

ALBERS: What was your father like?

KREIDER: He was pretty stern, something of a taskmaster. And I now see much of him in myself; it's kind of shocking.

ALBERS: You don't come off as being stern.

KREIDER: Well, thank you. I'm sort of serious, though. I think I am calculating, and I like to plan things.

ALBERS: Anyone who's been around you very much during meetings sees a listener, someone who takes it all in, and then summarizes what people have said and proposes a course of action. I don't think that would be regarded as stern, but it might be regarded as serious. How about your mother?

KREIDER: My mother is still living, and I remember her far better than my father. I recall her as a happy-go-lucky person who played games with us, arranged treasure hunts, and welcomed us at the door when we appeared dressed up in old worn-out clothes posing as beggars asking for something to eat. She participated in the games my sisters and I would invent. My father spent his time in the garden, working and doing other things around the house. I have two special recollections from that period of my life. One of them is the real love of the out-of-doors. We went barefoot from May to September, at the end of the summer able to trample every thistle with abandon.

ALBERS: Wow!

KREIDER: It was great. We considered it perfect, except for Sunday

*Please see **Kreider** on page 6*

Kreider from page 5

morning, of course, when we all dressed up for Sunday school. That was the period of my life when I won awards for eight years of perfect attendance in Sunday school. I had a good, solid Pennsylvania German upbringing.

The other thing I remember vividly was my early interest in science. I read every book on science in the library of the Millersville Training School, which was an elementary school. It was not a big collection, but I got my hands on anything that related to building things and inventing things.

ALBERS: Where did those interests come from?

KREIDER: I don't have any idea.

Burglar Alarms

ALBERS: But you remember being in the library when you were very young?

KREIDER: I remember arguing with the librarian when I was in the third grade because I had gathered a stack of books that I wanted to take out of the library, and she wasn't convinced it was appropriate for a third grader to take out so many books that she said I wouldn't be able to read. So she made me sit down and read aloud to her, which I did, and then she let me borrow all the books.

They were not all science. *The Wizard of Oz* was one of them. And the science books were mainly the popular science sort of thing. But they were very stimulating. There was no mathematics involved yet in that period, and indeed I disliked arithmetic. The books were about inventing things, building gadgets, trying things out. Certainly in those days there was no television. Books were the source of excitement.

ALBERS: Did you go home and try to make things yourself?

KREIDER: Yes.

ALBERS: Do you remember any of the things you made?

KREIDER: Oh, I was a great expert with burglar alarms. I had two sisters, an older sister and a younger sister, and I felt a need to protect my prized possessions from intrusion. I managed to find ways to wire up my room in such a way that nobody could get in without setting off alarms or having something fall on them. In fact I remember one occasion when I had my room walled off as if it were a spider web. Nearly every part of my web was rigged so that it would set off alarms and lights. Unfortunately, in the middle of that night there was a thunderstorm and it fell to my father to come into my room to close the windows. He walked into a great uproar in the total darkness. I think that's when I learned that technology carries policy implications.

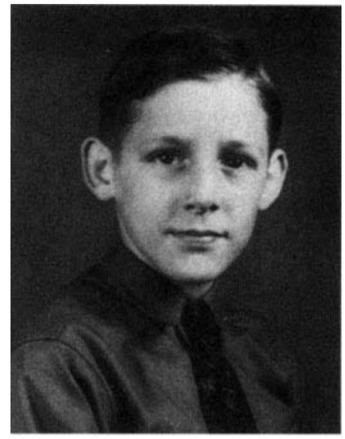
Don Kreider at age 6.

ALBERS: He wasn't pleased.

KREIDER: Not at all. This alarm business all started because one of my sisters came running into my room in the middle of the night on the occasion of an air-raid drill. She wanted to look out of my window to see whether the lights at the college, which was seven-tenths of a mile away, were going off as the air raid sirens went off. In the dark she stepped in the middle of my electric train set and broke the bakelite base of one of my favorite train accessories. That must have been in the early '40s, during World War II.

ALBERS: I didn't even realize that such drills occurred in the U.S.

KREIDER: Oh yes, if we hadn't turned the lights out or pulled the shades down a knock would come at the door. The neighborhood fire warden would instruct us to turn the lights out, NOW!



Don Kreider in 6th grade at Millersville Training School, Millersville, PA.

Green Shoes

ALBERS: What stands out from elementary school?

KREIDER: Probably the fact that I must have been a pain in the neck in school. I have many remembrances of my desk being put out into the corridor, because I evidently made such a nuisance of myself in the classroom.

ALBERS: You don't strike me as a troublemaker.

KREIDER: Well, evidently I was. But there was one student teacher from Millersville State College who solved the problem. She took me aside and told me that I really had a lot of interesting questions. She invited me to come up to Millersville State College on one Saturday morning. She gave me a tour of the campus. She showed me the science labs, the classroom facilities, and where she lived. I was most impressed.

ALBERS: About what age did this occur?

KREIDER: I was in the fifth or sixth grade. When the tour was finished she walked me to the edge of the campus, where my mother was waiting, and she said, "From now on, I want you to take a writing tablet to class, and every time you have a question I want you to write it down. We can go over them together later. None of the other students will be allowed to have a piece of paper on their desk, but from now on you may." I only realized in later years the extent to which she had co-opted me. She was wonderfully clever. After that I sat in class, feeling very important, and writing all my questions instead of making a nuisance of myself. She and I actually never got together again. But it was enough that I was able to write all my questions, always about science, on that tablet. And she would simply acknowledge my question-writing activity. In the middle of class, she would comment that I had asked such-and-such a question and that it was very interesting.

ALBERS: I wonder what happened to her?

KREIDER: I've wondered that too. I only remember that she wore green shoes. (Laughter.) On a serious level, that experience affected my teaching career. I realized the extent to which students might, through trying to feel greater worth or express themselves, step beyond the bounds of reasonable behavior. My grade school teacher in the green shoes simply reached out to an obnoxious young person, and it was totally effective. I've tried it on students over the years, and it works.

ALBERS: So by the sixth grade your interest in science was genuine; you were reading all of those books.

KREIDER: Yes, very much so.

ALBERS: And the questions that you were writing down were honest-to-goodness questions; they were questions that you didn't know the answers to.

KREIDER: Yes.

ALBERS: And some of them were being answered and some of them were not being answered. Did you work them out on your own? How were the questions getting resolved?

KREIDER: They were not all being resolved. But that didn't matter. The simple fact that my teacher accepted my questions, and occasionally brought one of them up in class, was enough. I felt she took me seriously.

Good teachers know the importance of this, of course, and not only for grade school students. One of my colleagues had an experience recently with a freshman college student making a nuisance of himself in a calculus lecture section. A disrupting voice would come from the rear of the room, purporting to speak for the class, and complaining about some aspect of the course. My colleague and I talked about the incidents, and I thought of myself back in that fifth grade classroom. I shared my remembrance of the teacher in green shoes. On the occasion of the next disruption my colleague walked to the back of the lecture hall and said to the student "Well, you know my name. I think it would only be appropriate if I knew your name, as well. Won't you tell me who you are?" He invited that student to his office after class and they talked about the complaints made in the class—complaints that had to do with open-ended explorations and group activities in which students were being asked to participate. What the student was saying in class was "I'm here simply to get my grade. I'm forced to take calculus, and I don't want all this Mickey-Mouse nonsense with open-ended problems. Don't tell me to think, just tell me how to do it." They talked for a long time, very likely not resolving the student's objections, but leaving him nevertheless with the feeling that he was being taken seriously. After that visit he dropped into my colleague's office from time-to-time to chat, and he never made a nuisance of himself in class again. Green shoes strike again.

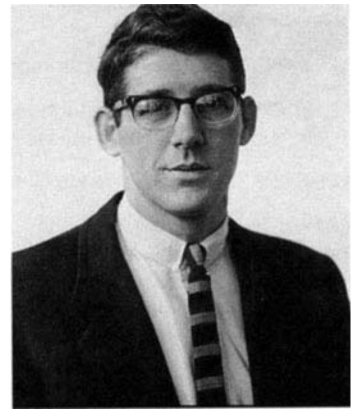
ALTERNATIVE TEACHING FLAVORS

ALBERS: You're regarded as a very good teacher. You've suggested some of the devices that you might use to communicate with students or make connections. You've been teaching for a few years now and probably have ideas about what works and what doesn't work.

KREIDER: Well, perhaps. But I, and I believe many people, feel uncomfortable these days as we talk about the evils of the lecture system—the impersonality of large lectures, the passiveness that they require of students, their failure to provide a learning environment suitable for all students. A lot of people, myself included, view themselves as good lecturers and feel that they have, in fact, gotten satisfactory responses and involvement from students in the past, even in this impersonal environment. But today we are made to feel distinctly uncomfortable with the somewhat unanalyzed discussions of whether the lecture mode of teaching is good or bad.

High school graduation from Lititz High School, Lititz, PA.

So I have done a lot of thinking about teaching modes, largely because I've felt that I have been successful as a lecturer but have been wondering whether I've been fooling myself. I really am interested in the question of what is the most appropriate mode of instruction in the colleges—how does it depend on level of maturity, cultural differences, learning styles, previous background, career objectives, and mathematical talent? Issues like these are what I find so interesting in our recent calculus reform efforts, identification of exemplary programs, and programs at our meetings where so many different people are reporting on their efforts to engage students actively. There's so much that we don't yet know. There's so much that has been done, and yet there's such a need to pull things together in ways that would help people, such as me, to decide what is the right balance between what I might call the lecturing mode and the involving mode.



Passport photo used for first trip to Africa as part of Entebbe Mathematics Project.

I am very much aware that when I teach a large lecture section, I have many students who feel the impersonality and whose learning suffers as a result. No amount of reaching out in this environment mitigates the impersonality that some students find to be a serious obstacle. Some students, to be sure, find it a blessing—"just leave me alone, give me mindless problems that I am good at solving, give me my grade, and let me go on my way." But other students need and respond favorably to more personal intervention. Closer human interaction with my teachers was certainly important for me as a student.

I think that the hard problem that departments face is an economic reality—how can we respond to the very diverse learning needs of our students while sustaining quality in upper-level course offerings and faculty scholarly activity? It is unlikely that any of us will have unlimited resources to apply to these competing parts of our missions. Yet we must find ways.

REBELLION

ALBERS: Was there any point where you knew that you wanted to teach or was it mathematics first and then teaching? Was it, "I want to study mathematics," and teaching usually goes with it, or "I want to be a teacher and this is the thing I'm most interested in?"

KREIDER: Interest in mathematics developed fairly late, and in teaching even later. My early interests were in science. And in my early years of high school, I was even sure I was going to be a minister in the Lutheran Church.

ALBERS: Where did that interest come from?

KREIDER: I don't really know.

ALBERS: You were the star of Sunday school with years of perfect attendance.

KREIDER: It probably was a matter of unanalyzed expectations brought to my plate by the people who raised me. Growing up in the insulated environment of a small town with a lot of influence from a Pennsylvania German background certainly contributed. Our neighbors were Mennonites, and my family was Lutheran, so religion was an influential part of my background. There certainly was tension between my interest in science and the dogmatic views of the world presented in Sunday school, especially those of the Missouri Synod Lutheran Church of that day. That didn't give me difficulties early on, but when I got to my later years of high school and wanted to rebel against someone, anyone, I found it easy to rebel against my associations with the church. So I went from actually seriously considering a career as a minister in the church to someone who was delighted to rebel against the church's tenets.

*Please see **Kreider** on page 8*

***Kreider** from page 7*

ALBERS: What form did your rebellion take?

KREIDER: Well, oddly enough, it actually took the form of making myself a model student in my last two years of high school.

ALBERS: That doesn't sound like rebellion.

KREIDER: But in fact it was. Many of my teachers told me in later years that I became a different person in the summer between my sophomore and junior years. I was truly obnoxious before then. But in my junior and senior years, I turned entirely to my studies and to music. It was a discontinuity in my life—I started to look beyond my environment.

ALBERS: And studying was a way to get out.

KREIDER: I wanted to be a physicist. I made the decision that I was not going to have much more to do with the environment and many of the people who brought me to that point. I regretted much of that in later years.

I was really interested in physics! Keep in mind, this was during the period in the late '40s when all of the exciting posters hanging on the classroom wall were urging us to take up science and physics. I wanted to be part of that.

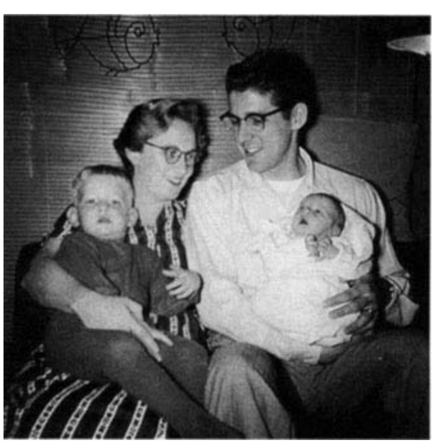
ALBERS: How did you choose a college?

KREIDER: By accident. When I went to Lebanon Valley College in 1949, it was a very small school of 440 students. I went there on the basis of a competitive full scholarship exam for which I presented myself in physics. I started out as a physics major, although there was only one professor of physics who was also treasurer of the college. His knowledge of physics had really stopped a few decades earlier, prior to the quantum and atomic eras.

But I still remained fascinated by physics. The physics course that he put me in initially was one in which he wanted me to learn how to handle laboratory instruments, and so I spent an entire term learning how to calibrate a ballistic galvanometer and take measurements with it. My mathematics professor was a retired engineer who advised "You don't want to take calculus as a freshman, you want to consolidate your background so that you will really appreciate calculus when you take it." I thought that was sound advice, and so I followed it.

TRIFLES

I took calculus as a sophomore and was enthralled. In my sophomore year, a gentleman whose name was Jean Paul Scholz came to Lebanon Valley College. He grew up in Vienna, escaped to Switzerland during World War II when Austria was occupied, came to this country after World War II, and ended up at Lebanon Valley College. He was a marvelous teacher. I spent many happy hours sitting in his living room, just doing mathematics with him.



Spring of 1958, Cambridge, MA. John, Mary Ellen, Don, and Paul

ALBERS: That's very unusual for a student to actually be doing mathematics in the living room of a professor.

KREIDER: It was marvelous. He was the first person that I had ever met who knew a lot of mathematics, and who spent his entire life just doing mathematical things. He simply spent all of his time doing mathematics. In his classes he was always challenging the class to do things. He really liked students and he was enthused by mathematics. In almost every class he'd go to the board at the end of the class and put up a 'trifle.' (He called short problems trifles.) I and my classmates would go to our rooms and spend endless hours working together on the trifles. If he didn't present a trifle during class, we insisted that he give us one at the end.

I asked Dr. Scholz in subsequent years how one becomes a good teacher. He said, "You need to know your subject, you need to be able to convey your subject to people, and you need to be willing to go the extra mile for your individual students. If your students know and believe that you know what you're talking about, if they're capable of understanding your way of communicating it, if you speak to them in their terms, and if they get the idea that you really care about their learning it, then you will be a good teacher."

I see those principles now reemerging in the National Council of Teachers of Mathematics (NCTM) Professional Teaching Standards, the standards that are being developed by the National Board for Professional Teaching Standards, and the MAA's Guidelines. And that is good.

THE REMOTENESS OF THE ADMINISTRATION

ALBERS: You have twice served as chair of your department and you were vice-president of Dartmouth.

KREIDER: I worked closely with Kemeny as vice-president when he was president of the College. It was an opportunity to see what administration at that level is really like and to what extent I might want to lead that kind of life. It was a wonderful opportunity that helped me make decisions about whether I wanted to seek further administrative positions. And I decided I did not.

ALBERS: Why?

KREIDER: Administration is for me too remote from the classroom. And it has an entirely different tempo. One of the marvels of academic life is the punctuation that it gives to each year. A semester comes to an end, you can say good-bye to your failures for that term, and you can set your sights on the good things you're going to do the next time. You can clean up the mess that has accumulated in the office and redirect your life. And you can do this several times each year. This is a very important kind of self-renewal. In administrative life, you are always dealing with problems that have no solution, where there's no right or wrong answer, where there's never an end to anything, where nothing is ever finished.

ALBERS: You have resisted the pulls to pursue higher administration and have been able to work with students. Your involvement with the MAA officially began in 1960. You've served on any number of committees, you've been the treasurer, and now you're the president. What do you want to do as president?

TEACHING — THE CENTER OF THE MAA

KREIDER: I would like to see the MAA accomplish something important in an area that I consider the very center of the Mathematical Association, the undergraduate teaching of mathematics. We have just completed our Guidelines which talk about, among other things, the way departments have structured themselves to carry on their educational missions, and what kind of resources they need to have good mathematics and mathematics teaching take place.

Since the annual meeting in Louisville a few years ago it is being said that mathematicians have rediscovered students. We are asking questions about the way in which we structure our teaching—basic questions about the lecture environment versus more interactive kinds of involvement of students. We are also asking questions about the students we expect to have in our mathematics classes over the next five to ten years. And we are seeking ways to attract more women and minority students to the study of mathematics and of science more generally.

We are going to be getting students into the colleges, especially very good students, who have come out of learning environments that are different, very different, from the ones they will meet in college. Colleges are already encountering students whose teachers have taken seriously the NCTM Standards and have involved their students in a very personal approach to mathematics.

ALBERS: Many have suggested that the kinds of changes that you would like to see occur are most likely to occur first in smaller, liberal arts colleges. The theory is simple; a small group of people can move more easily without the impediments that a large institution has. I don't know if you agree with that or not. If you do, then the next question is, how do you influence the larger institutions to change? We have recent examples of a few universities doing some very daring things with their calculus classes.

KREIDER: Yes. Michigan, for example, is testing the conventional wisdom in very interesting ways, returning to teaching in smaller sections when many institutions hold that that is not feasible.

The MAA's greatest influence has been in the four-year colleges, where it has supported the mathematical activity of its members and has made many curriculum recommendations of value to departments. But it has not reached fully into the larger research universities, and I think that it cannot do this on its own. Here it must work hand-in-hand with the American Mathematical Society (AMS) and the Society for Industrial and Applied Mathematics (SIAM). The objective should be to engage the broad undergraduate population in the large universities—encouraging them to study mathematics and science further rather than be filtered out. This will require the same attention to teaching and to the individual learning needs of students that is already acknowledged in many smaller colleges.

Examples being set by some of the largest and most prestigious institutions are very important. And it is very important also that the AMS has committed itself to greater involvement in education. It is apparent that there are enough problems to go around. And there are clearly discernible areas where joint action by MAA and AMS can succeed where neither organization can succeed alone. On the graduate level, there are problems that require the AMS to take the lead. And the MAA should be a strong player. And at the upper levels of the undergraduate program the MAA needs to take the lead in reexamining whether previous recommendations of the Committee on the Undergraduate Program in Mathematics (CUPM) need revision. Cooperation with the AMS and SIAM are needed here to ensure that mathematics majors are defined with sufficient breadth and options to meet the needs of students going into very different careers—those interested in graduate study in pure mathematics, those interested in applied mathematics and careers in industry, as well as all the other undergraduates who may well take mathematics just as an attractive liberal arts major. Many of these students will pursue careers in economics, medicine, law, or even business.

So my second goal is to have the MAA strengthen its traditional connections with its sister organizations to solve specific problems such as improving the preparation of graduate students for teaching, broadening options within the mathematics major, helping departments (including university departments) structure their majors to serve the needs of students with very different career objectives, and advising departments how to achieve such objectives when resources are limited.

Another area of interest to me is our relationship with two-year colleges, which we have tended to forget as we talk about the transition from high school mathematics to college mathematics. A significant number of people who graduate from four-year colleges began their study in community and two-year colleges, not in four-year colleges. So important questions arise about the two-year college curriculum, how it is articulated with the four-year college curriculum, and what kind of options are kept open for students. We also need to be mindful of the very much larger mission of the two-year colleges in addressing technical education, which is terribly important to the country.

Christmas 1980. Back: David, son; Mary Ellen, wife; Vickie, daughter-in-law; Sarah, granddaughter; John, son. Front: Don; Lena, daughter-in-law; Paul, son

My third goal is to open up some very substantial cooperation with NCTM, the American Mathematical Association of Two-Year Colleges (AMATYC), and other organizations in the area of contests. The MAA's contest program is very important to about half a million young people, and very important to a large number of teachers who participate in it each year. But there is much to suggest that not all students respond equally well to this sort of contest environment and that many good students are not able to demonstrate mathematical talent with existing tests.

What should we do about it? Should we introduce new forms of contests, perhaps along modeling lines? How would this fit with the present contests? Where does the role of technology come into all of this? To what extent are competitive examinations such as we are now administering consistent with the NCTM Standards? Do they indeed open up mathematics to all students or are they a barrier for some? These are very large questions that do not have easy answers, and I think it is essential that we address them. Again, I think that the MAA cannot do so alone. It must work hand-in-hand with all of its sister organizations, and in this case particularly with NCTM and AMATYC. We need to be sure that contest programs are setting the right tone as to what constitutes quality achievement in mathematics. And we must be sure that all students are well served, not just some.

My fourth goal is to greatly strengthen communication between the MAA sections and the national MAA. The MAA really gathers its strength constantly from its sectional structure. The 29 sections are very autonomous, providing people all over the country with opportunities to bring leadership into the mathematical community—to run meetings, hold mini-courses, and to contribute to the work of their Sections and of the national MAA. There are many ways in which we can strengthen the ties between all parts of our organization, and our ability to address both our local and our national goals will be enhanced. I want to initiate some programs that exploit the strength of our grassroots and that help our sections become a greater influence toward improving mathematics education in their regions.

Above all, we need to be sure that the MAA is a completely welcoming organization to all people who have an interest in mathematics and mathematics education. We dare not waste one single person who has potential interest in mathematics or teaching.

In Memoriam

Seyfettin Aydin, Ankara, Turkey, died on April 3, 1992. He was an MAA member for 2 years.

Charles H. Frick, Mathematician, U.S. Naval Weapons Laboratory, died on January 28, 1993, at 83. He was an MAA member for 59 years.

George B. Olsen, Fargo, ND, an MAA member for 3 years has died at 75.

Patrick O'Regan, Professor, Rhode Island College, died in January at 64. He was an MAA member for 33 years.

Emerson L. Grindall, Professor Emeritus, Penn State University has died. He was an MAA member for 43 years.

E.K. Haviland, Associate Professor Emeritus, Johns Hopkins University has died at 90. He was an MAA member for 63 years.

Allen E. Murray, Rochester, NY, died at 80. He was an MAA member for 30 years.

Otis E. Lancaster, State College, PA, died on November 17, 1992. He was 83. He had been an MAA member since 1941.

Ichiro Murase,retired, University of Tokoyo, died on October 21, 1992 at 82. He had been an MAA member since 1968.

Stanley P. Hugart, Retired Professor, California State University, died on January 1, 1993 at 74. He had been an MAA member since 1959.

Max V. Holley, Hamilton, AL, died on December 30, 1992 at 77. He had been an MAA member since 1986.

Henry E. Fleming, Mathematician, U.S. Department of Commerce, died at 62. He had been an MAA member since 1958.

Donald B. Gormley , Senior Engineer, Grumman Aerospace, died on July 21, 1992 at 46. He had been an MAA member since1967.

Antoni Zygmund, Professor Emeritus, University of Chicago, has died at 92. He had been an MAA member since 1949.

Nicholas D. Kazarinoff, Professor, SUNY-Buffalo, died on November 21, 1991 at 62. He was an MAA member for 34 years.

Robert H. Johnson, Professor, Sonoma State University, died at 85. He had been an MAA member since 1965.

Theodore Edison, West Orange, NJ, died at 94. He had been an MAA member since 1938.

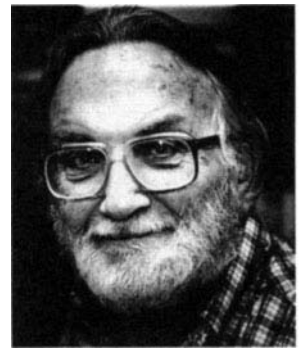
Robert J. Walker, Former Department Chair at Cornell, Dead at 83

Robert J. Walker, former Chair of the Mathematics Department at Cornell, died on November 25, 1992. Professor Walker was deeply involved in CUPM in the 1950s, chairing the Physical Science and Engineering Panel. He was also known for his book *Algebraic Curves* that was published by Princeton University Press in 1950 and reprinted by Dover in 1962.

Robert Walker became involved in the creation of CUPL (Cornell University Programming Language) in the '60s. This language was used for course work and had the advantage that if the compiler encountered an error it tried to correct the error rather than simply quitting.

Robert Walker was also the author of CRICASAM, total computer assisted calculus course that he wrote for use in Florida State in the mid 60's. It surely attempted to do some of the things that interactive texts and such are still trying to do years later.

Max Zorn, Known for Zorn's Lemma, Dies at 86



Max Zorn, whose name has long been associated with Zorn's Lemma, died on March 9, 1993.

Born June 6, 1906, in Krefeld, Germany, Zorn attended Hamburg University and received his Ph.D. in 1930 under the direction of Emil Artin. He was briefly an Assistant at the University of Halle, but fled the Nazis regime in 1933. From 1934 until 1936 he was a Sterling Fellow at Yale, and it was during this time that he published the principle that would later carry his name. He moved to UCLA in 1936 where he was Associate Professor until 1946. At that time, he moved to Indiana University where he was Professor of Mathematics until his retirement in 1971. Max Zorn was a member of both the AMS and the MAA and served the Indiana Section of the MAA as chairperson during 1952 - 1953.

In his retirement, Max Zorn became an essential part of the Department. He came to the office every day, seven days each week. He was at tea, at seminars, and at colloquia. His questions were often penetrating and sometimes enigmatic. Outside speakers were usually startled and then charmed by Zorn and his passion for mathematics.

While he was best known for Zorn's Lemma (which is not a lemma but rather a principle, and often attributed to Hausdorff and Kuratowski as well), Zorn did seminal work in Topology, Algebra, and Geometry throughout his career. Early in his career, he proved the uniqueness of the Cayley numbers (sometimes called Octonions, the 8-dimensional analogue of the quaternions): Every alternative, quadratic, real, but non-associative algebra without divisors of zero is isomorphic to the CAYLEY algebra. He also provided a description of alternative algebras which made it possible to do explicit computations for Cayley numbers.

In recent years, Zorn became fascinated by the Riemann Hypothesis and possible proofs using techniques from Functional Analysis. He read and studied and talked about mathematics nearly every day of his life.

From time to time, he published a slim newsletter, the Picayune Sentinel, devoted to cryptic remarks about mathematics and mathematicians. He was a gentle man with a sharp wit, who during nearly a half-century inspired and charmed his colleagues at Indiana University.

Fritz Steinhardt Dies at 71

Fritz Steinhardt, who taught mathematics at City College for 39 years died on April 14, 1993. He was 71.

Professor Steinhardt joined the college's mathematics department in 1954, advanced to full professor in 1969, and served as department chair in the early 1970's. In 1988, he received the City College Distinguished Teacher Award.

A native of Vienna, he fled Austria for Switzerland at the time of Austria's union with Nazi Germany. He studied in Zurich at the Federal Institute of Technology, and received his PhD from Columbia University in 1951.

*Please see **E.A. Cameron** obituary on page 24*

***Examination** from page 1*

I choose to compare United States with European countries or regions which enjoy a similar economic and cultural development. I look at state examinations in Scotland [6] and Germany (Hesse) [7] and at national examinations in Portugal [8], France [9], and The Netherlands [10]. All the exams were used between 1988 and 1991. Most countries have at least two levels of exams—a basic and a more advanced one. The Netherlands has a basic and an applied test. France has three or four different tests corresponding to different curricula: test AB corresponds to a liberal arts curriculum but test CE corresponds to a science curriculum. In most cases, the format is the same for both tests, but there is a fundamental difference in subject matter.

GENERAL COMPARISON - FORMAT OF THE QUESTIONS

Length of time allowed per question and depth of understanding

In TABLE I, I have indicated the time allowed, the exams administered, the formats of the exam and the average length of time allowed per question or per part.

Country	Duration of exam	Types of exams	Description of exam	Time per question or part
France (F)	180 minutes	AB(Lib Arts) CE(Science)	16 to 20 parts grouped in 3 problems	10 minutes
Germany (G) (Hesse)	180 minutes 240 minutes	Basic Advanced	12 to 15 parts grouped in 2 or 3 problems	14 minutes 16 minutes
Netherlands (N)	180 minutes	A (applied) B (basic)	16 parts grouped in 4 problems	11 minutes
Portugal (P)	150 minutes + 30 minute tolerance	1 2	12 to 14 parts grouped in 5 problems	11.5 minutes
Scotland (S)	105 minutes 150 minutes	O or H	40 multiple choice & 28 parts grouped in 13 problems	2.6 minutes 5.3 minutes
United States	60 minutes 90 minutes 90 minutes	Level I, II AP Test	50 multiple choice 45 multiple choice & 14-17 parts grouped in 6 problems	1.2 minutes 2 minutes 5.8 minutes

TABLE 1 GENERAL COMPARISON

This table reveals some fundamental differences:

1) Except in the United States and Scotland, all exams are composed of several independent problems (2-20), each made up of several parts (3-5 usually).

The Scottish and the American AP exam are composed of two parts, a multiple choice test and a test without answers which includes several independent problems made up of several parts. The U.S. Achievement Test is a multiple choice test only.

2) The second fundamental difference is the amount of time allocated per question. Germany allocates about 15 minutes per part, France, Holland and Portugal about 11 minutes per part, United States (AP) and Scotland only about 5 minutes per part.

On the multiple choice exam, Scotland allows 2.6 minutes per question. The United States allows 2 minutes per question on the AP test but only 1.2 minutes on the Achievement Test.

Clearly, the time allocated per question directly relates to the average depth of questions. If the time is short, speed becomes an important factor. Figure 1 illustrates this difference. For comparison, I have also included on this figure the time per question on both the AIME and the AHSME exam. It would appear that France, Germany, The Netherlands, and Portugal have more difficult questions while Scotland has easier questions, United States(AP) is somewhere in between. To judge the depth of understanding more accurately, a great deal more work is needed in order to set some standards and analyze each question.

TYPES OF QUESTIONS

I examine first tests without answers, then multiple choice tests.

Tests without answers

I classify the questions from the tests into 5 groups. (None of the examples I give is a complete question. The intention is simply to indicate the types of tasks the students are required to complete.)

Group 1 contains any computation or derivation which has a numerical or literal answer not given in the question.

Examples:

- Find the coordinates of the point of intersection of the two curves
- Find $f'(x)$

Group 2 includes questions which require the examinee to show a given result (numerical or literal).

Examples:

- Show that $(f \circ g)(x) = \cos 2x$
- Show that the equation of the tangent to the curve at point A is $y = 6 - 2x$
- Show that the probability of getting a six three times is $p = 1/6^3$

Group 3 includes all proofs (more difficult than questions in group 2)

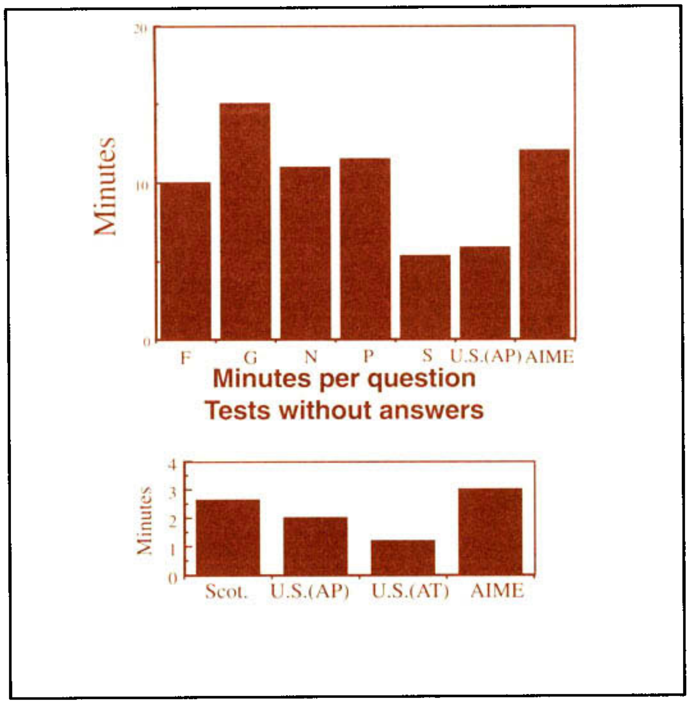
Examples:

- Prove that the volume of the tetrahedron is a constant
- Use the principle of induction to prove that:

- Show that the polynomials p_1 and p_2 are linearly independent
- Prove that the sequence is converging.

Group 4 includes all graphs, constructions and tables of variation.

*Please see **Examinations** on page 12*



Minutes per question
Tests without answers

Examples:

• Draw the graph of the curve *C*

• Study the variations of *f(x)* and write the results in a table

• Given that the line *BP* cuts the cylinder of axis *MN* and radius 3 at points *S* and *T*

• Draw *S* and *T* on figure 2.

Group 5 includes all "open answer questions."

Examples:

• What can you conclude from this study ?

• Explain how the teacher came to this estimate.

• Comment on the comparison

All results are approximate percentages based on specific tests. They are grouped together on Table II. I observe the following:

1) Proofs are important on tests for three of the six countries:

In Germany and in Portugal about one quarter of the questions are proofs; in France 10% of the questions on the AB test and 30% of those on the CE test are proofs.

2) All tests include some graphs, ranging between 3% of the AP test in the United States to 25% of the basic test in The Netherlands.

3) "Open answer questions" (which test thinking rather than rote learning) are still insignificant except in the newest Applied Test from The Netherlands.

Multiple Choice Tests

1) On the average, a little more than 10% of the questions involve graphs, but they do not require the student to graph a curve or make a geometric construction, simply to recognize the proper graph.

2) No proof or "open answer question" can be used in a multiple choice test.

3) About 80% of the questions on the multiple choice tests are computations or derivations, 10% relate to graphs and about 10% are miscellaneous questions, checking, for instance, whether or not sufficient information is provided to solve a problem or deciding how many of a number of given statements are true.

Correlation Between Consecutive Questions and Evaluation

Should there be correlation between consecutive parts? It is an important question.

Some educators argue that the correlation between consecutive questions is bad because it makes assessment more difficult. So most mathematics standardized tests in the United States are made up of independent questions. This incorrectly assumes that if questions (a) and (b) are related, then the student unable to answer (a) will also be unable to answer (b). But correlated questions do not necessarily imply dependent questions and it is often possible to phrase the questions in such a way that they are independent (see parts 1) and 2) in Appendix D).

Correlation between questions can be beneficial in a variety of ways:

A good test writer can guide the student through a proof or a long derivation and make the test a valuable learning experience. (Examples of this are shown in Appendices A and C.

Students can be asked to find a given result in 2 different ways. It gives them a better understanding of their work and a positive reenforcement.(See Appendix D, Problem from a Dutch Examination, parts (4) and (5).)

Solving a number of related questions on a given subject allows the students to learn to synthesize their work, determine whether or not all their answers are consistent and, if not, find their error.

Related questions allow the test writer to create interesting problems which will make the student appreciate mathematics. Two examples are the different approximations of the sine function in Appendix B and the verification of Archimedes' Theorem in Appendix A.

Table III shows the number of related questions on the average on each test. For Scotland and the United States (AP), only the portion of the test without answers was used. Clearly, multiple choice tests cannot use related questions.

Evaluation of those exams composed of free-response questions is done by most countries according to some well-defined standards to insure fairness. Often, two independent graders are used. In Germany and the United States (AP), published pamphlets describe in detail the

	France		Germany		Netherlands		Portugal		Scotland	United States
Tests	AB	CD	Bas.	Adv.	App.	Bas.	I	II		AP(88)
Group 1 Comput.	50	18	54	38	55	62	42	53	64	83
Group 2 Show that	17	32	8	19	18	16	13	21		
Group 3 Proofs	10	31	21	29		13	26	20	7	7
Group 4 Graphs	17	14	8	9	5	25	5	13	4	3
Group 5 Open Ans.	6	5	8	5	22		10		4	7

Percentages of questions of each type in tests without answers
Table II

Examination	Average number of related questions
France	6
Germany (Hesse)	5.4
Netherlands	4
Portugal	2.6
Scotland	2.1
United States (AP)	2.6

Number of related questions
Table III

grading of some specific questions. This allows teachers to better understand what to emphasize.

Some tests involve many students. In France, although about 60% of 18 year-olds are tested, the evaluation process seems to run smoothly.

CONCLUSION: This article is clearly only an introduction to the comparison between mathematics examinations in the United States and some European countries. It generated a great deal of interest among those colleagues abroad who helped me collect the information. In most countries, examinations are in a state of flux: whether or not to allow the use of simple calculators or programmable or graphing calculators often remains an open question. There is a need for more roundtable discusssion among people of various countries involved in designing national or state testing.

It is interesting to note that the UECE Japanese exam described in [1] is similar to the European exams in that it is composed of several independent problems, made up of several parts and does not use multiple choice questions. However, it differs in the fact that it includes neither proofs nor open answer questions and forces the student into a rigid mode of thinking.

In this country, recent work on the Advanced Placement Test has improved it, although more use of proofs and open answer questions would make it stronger still. On the other hand, Achievement Tests I and II have not changed substantially. They emphasize speed and recognition and show a lot of weaknesses.They do not include any proof, nor any construction or drawing of graphs. Further, the derivations are very short. There is no correlation between questions, and most questions are not interesting and the short time per question indicates lack of depth. These tests are purely an assessment tool, not a teaching tool!

Keeping in mind the fact that only about 1% of entering college students takes the AP test, the **Achievement Tests are very important.** Mathematics educators in the United States should try to clearly formulate their goals for students wishing to pursue various careers, design one, two or more tests which would attempt to attain these goals, and publish sample tests with grading scale and description of what each student answer should entail. They should worry less about the assessment process and more about creating good models which can guide the teachers in the classroom.

APPENDIX A

Problem from a French Examination *(A)*

(25% of total grade) (1988)

Archimedes has proved that :

The area of the segment of a parabola is equal to 4 times the third of the area of a triangle, having the same base and the same height as the segment.

We want to illustrate this theorem with an example:

1) Given the parabola of equation : $y = -(x-2)^2 + 9$, and the point S of coordinates (2,9), find the coordinates of A and B, the two points where the parabola intersects the x axis.

Let AB be the parabolic arc passing through S.

2) The segment of the parabola is defined to be all the points of the plane between the arc AB and the x axis. Compute the area of the segment.

3) Compute the area of the triangle SAB.

4) Show how this example illustrates Archimedes' Theorem.

APPENDIX B

Problem from a German Basic Examination

Approximations of the Sine Function.

a) The function $s(x) = \sin x$, such that $x \in [0,\pi]$ is bound by a polynomial function f of degree 2 which is defined in such a way that the extremas and the zeros of the two functions coincide. Find the equation of f.

b) Find g, a polynomial function of degree 2, defined on the interval $[0, \pi]$, such that its two zeros and the rates of change at the zeros are the same as those of the function s.

c) Compute $f'(0)$ and $f'(\pi)$ for the function f defined in a) and $g(\pi/2)$ for the function g defined in b). Sketch s, g and f. Include the points where f and g coincide with s. The graph will show two different approximations for s.

d) Find a polynomial function h of degree 2 defined on the interval $[0,\pi]$. The function h has the same zeros as the function s and is such that the area of the region included between the graph of h and the x axis is the same as the area of the region included between s and the x axis.

APPENDIX C

Problem from a Portuguese Examination

(25% of total grade) (1990)

Given the pair of sequences (u_n, v_n) defined by recurrence using the following formulas

$$u_1 = 0,\ v_1 = 1,\ u_{n+1} = \frac{u_n + v_n}{2},\ \ v_{n+1} = \frac{u_n + 3v_n}{4} \quad n = 1,2,\dots,$$

a) Prove the following :

i. $v_n - u_n = \frac{1}{4^{n-1}}$ for all $n \in N$

ii. u_n is an increasing sequence

v_n is a decreasing sequence

iii. $u_n = \frac{2}{3} - \frac{1}{6} \cdot \frac{1}{4^{n-2}}$ (use the principle of induction)

b) Show that parts i and ii allow you to prove that the sequences are both convergent.

c) Find the limit of the sequence *vn*.

*Please see **Examinations** on page 14*

APPENDIX D

Problem from an applied Dutch Examination (1989)

A bridge is constructed on a river. One arch of the bridge is represented by the formula : $h = c - 10(e^{0.05x} + e^{-0.05x})$, where h is the distance in meters from the point on the bridge above AB to the line AB, and x is the distance PO in meters.

T is the highest point on the arch AB. (Figure 2)

1) Show that given $AB = 40\ m$, $c \approx 30.9\ m$.

2) Given $c = 30.9$, find the maximum value for h.

3) Compute h for several values of x and sketch the graph of the arch, using a scale of 1cm for 2 meters.

4) In the summer, usually the line AB is in shallow water. In the winter, the level is commonly considerably higher. Use your graph to determine approximately for what level under the bridge the distance between T and the water level is 4 meters.

5) Use a calculation to check your answer to 4.

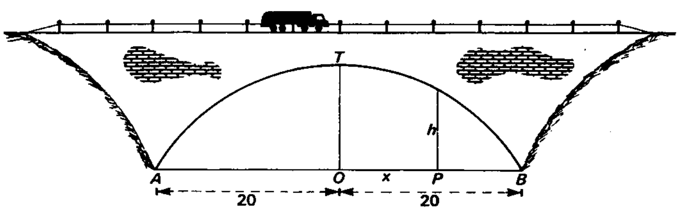


Figure II

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EDITORIAL

Since Ed Aboufadel's Job Search Diary first appeared in September 1992, it has been the first thing many readers turned to when their copy of FOCUS arrived. So I will not be spoiling this month's denouement by congratulating Ed on finding a position—readers will have read the diary before they get to this editorial!

Doubtless everyone will be as pleased as I am at the outcome—a happy outcome that was not at all certain when Ed first agreed to my suggestion that he keep a diary as his job search progressed. The ending could have been altogether different. Presumably, for many of Ed's fellow job-hunters last year, it was different. The 'job-crunch' is still with us, with no end in sight.

Having myself entered the job market at the start of another major job shortage, in Britain at the start of the Seventies, I feel considerable empathy for those currently trying to land that first regular position. In my case it took six years of temporary positions, in Europe and North America, before I came off the temp-roster, and I know of a number of similar instances today in this country.

For most of us, there is little we can do to solve this problem. In time, it will doubtless go away, in all likelihood to be replaced by a chronic shortage of mathematics faculty. In the meantime, a lot of young mathematicians will hang on to their dream with a series of temporary positions, or positions at places they feel are not really suited to their ambitions or abilities, while others will leave the profession, most likely never to return.

But while we cannot solve the problem, those of us who are department chairs or serve on department hiring committees are in a position to help those who currently find themselves victims of the job shortage. In his diary, Ed has made a number of observations on the way a job search appears to the candidates, and ways the process could be improved. Having been privy to the entire diary-series before the first episode appeared in FOCUS, some of the things Ed said affected the way I ran my own faculty search at Colby this past year, and I can see ways to improve matters still further in future years.

For instance, in this month's installment, Ed mentions how, given the time and effort he had put in to craft his letter of application, he felt he deserved, at the very least, an acknowledgment that his application had been received, and, at the end of the search, more than a scrappy, uninformative letter or, even worse, no letter at all. More to the point, he stresses that an informative, sympathetic letter really does help, both psychologically and in terms of trying to figure out what, if anything, could be done to improve the chances in any future search.

As a department chair, I know how difficult, and expensive, it is to cope with many hundreds of applications. But, as college educators, we spend a large part of our time trying to encourage more students to major in mathematics and to go on to graduate school in the subject, so it is surely only reasonable that, if we are not able to welcome them into the profession at the end of their educational odyssey, we can at least find a couple of hours to compose a letter, a day of a secretary's time to personalize it on a word-processor, and a few hundred dollars for stationary and postage to send it out. (The anecdotal evidence suggests that the large producers of mathematics PhDs are often the worst offenders in this regard. Ed's experience seems to confirm this, though to avoid turning the job diary into an 'expose,' FOCUS asked him to avoid identification of particular institutions where his comments were particularly critical.)

I doubt that it would be possible to go as far as Ed suggests, and provide each candidate with reasons as to why his or her application did not make it to the interview stage. But it is surely worth the effort to send all unsuccessful candidates a simple, sympathetic letter explaining the outcome of the search.

Again, in an earlier installment, Ed suggested that it would help for the initial position announcement to be more specific about the required qualifications, experience, and areas of specialty, though I have to say that, in my own experience as a department chair, large numbers of applicants seem to ignore everything about the advertisement save the fact that there is an opening.

One point that future job applicants might do well to take note of is the benefit of taking part in the Employment Registry at the January Mathematics Meetings. Not so much because this is likely to lead to an offer of a position—according to the anecdotal evidence it probably will not. But, as Ed observes, it does provide an opportunity to gain some experience at being interviewed. Doubtless, such usage of the Employment Registry is unlikely to encourage employers to take part, but work is underway to try to increase the effectiveness of the Registry, so perhaps in future years it can serve both purposes well, securing positions for some and providing interview experience for others along the way.

One further piece of anecdotal evidence. Towards the end of August last year, a sudden illness of one of my own colleagues at Colby meant we had an unexpected, one-year opening. We had to find someone within a space of a week or so, to start teaching early in September. We had carried out a search for three visitors earlier in the year, and so I had a sizeable list of likely candidates about whom we knew enough to be in a position to hire one of them at short notice, namely, all those who had made our short list, some 20 or so in all. Though I was not able to contact them all, every one that I did manage to reach had, in the end, found a job. In some cases, this had occurred well into the summer. Admittedly, none of these late openings were really the kind of position that the candidate had been hoping for. But still, a position is a position, something to keep them in the game another year. The obvious moral to this story is: don't give up; even July or August could bring something.

Finally, for those of you who have eagerly followed Ed's job saga in each issue, don't despair now that that particular episode has come to a happy end. This fall sees the start of Ed's 'New Job Diary,' in which he describes his experiences in his first full- time teaching position.

Keith Devlin

The above are the opinions of the FOCUS editor, and do not necessarily represent the official view of the MAA.

The Mathematical Association of America

Guidelines

for Programs and Departments in Undergraduate Mathematical Sciences

February 1993

Table of Contents

GUIDELINES FOR PROGRAMS AND DEPARTMENTS IN UNDERGRADUATE MATHEMATICAL SCIENCES

A. Introduction

In 1989, the National Research Council published the report, *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, [26]. That report characterized undergraduate mathematics as the "linchpin for revitalization of mathematics education." In addition, the mathematical sciences are central in liberal education and the success of students in science and engineering depends critically upon mathematics.

Since 1989, several other reports of national organizations included recommendations for strengthening this linchpin role of undergraduate mathematics. These documents include *Moving Beyond Myths: Revitalizing Undergraduate Mathematics* [27]; *Challenges for College Mathematics: An Agenda for the Next Decade* [4]; *The Undergraduate Major in the Mathematical Sciences* [14]; *A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics* [22]; *Professional Standards for Teaching Mathematics* [25]; and *Heeding the Call for Change: Suggestions for Curricular Action* [36]. The Guidelines that follow incorporate many of these recommendations.

This document supports the many curricular reports by presenting a set of recommendations which deal with a broad range of structural issues that face mathematics departments and their institutional administrations. The document includes statements on planning and periodic review, faculty and staffing, curriculum and teaching, institutional and departmental resources, physical facilities, libraries, and student issues such as advising and co-curricular activities for majors. As such, these Guidelines deal with all aspects of the undergraduate mission -- general education, teacher education, mathematics courses serving other disciplines, and the mathematical education of majors. They are intended to address mathematics programs in two-year colleges as well as programs in four-year colleges and universities. The American Mathematical Association of Two-Year Colleges (AMATYC) is also developing a guidelines document which complements this document. The AMATYC guidelines will extend and address more specifically concerns of two-year institutions.

These Guidelines apply to programs in pure or applied mathematics, mathematical sciences, or mathematics education when included within departments of mathematics or mathematical sciences. Options or tracks in computational mathematics, computer science, statistics, and operations research offered within a mathematics or mathematical sciences department should also meet these guidelines.

Important comparative data can be found in the MAA publication, *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences and Computer Science in the United States, 1990-91 CBMS Survey* [2].

Professional associations representing many Arts and Sciences fields have published standards for departments in their disciplines. These include the American Chemical Society, the Computer Sciences Accrediting Commission, the Modern Language Association, the National Council of Teachers of English, and the American Association of Physics Teachers.

These Guidelines are intended to be used by mathematical sciences programs in self studies, planning, and assessment of their undergraduate programs, as well as by college and university administrators and external reviewers. Mathematical sciences programs and their administrations can use the recommendations included in these Guidelines as a basis for resource allocation decisions and in planning for the future. It is the joint responsibility of institutional administrations and mathematical sciences programs to provide and use properly the resources necessary to meet these guidelines.

Definitions and Conventions:

Throughout the document, the phrases "mathematical sciences" and "mathematics" are used interchangeably to refer to undergraduate programs in pure and applied mathematics. Mathematics education, computer science, probability and statistics, and operations research may be facets of such programs as tracks, options, or concentrations within the mathematical sciences major. However, application of the guidelines to major programs in departments of computer science, operations research, statistics, or mathematics education is not intended. The phrase "college level" refers to mathematics courses at or above the level of precalculus, "hours" will mean semester hours, and a "course" will be considered to carry three semester credit hours. Appropriate adjustments should be made in the Guidelines for quarter hours or for courses carrying credit hours other than three. At many institutions mathematics programs are not organized into traditional departmental structures. Nevertheless, in this document we use the word "department(s)" to include these non-departmental programs as well.

B. Planning and Periodic Review

1. In cooperation with its dean, each mathematical sciences department should participate at regular intervals in a

process of periodic planning and evaluation. Participants in the process should include faculty, students, alumni, client departments, external mathematical sciences reviewers, and deans or other administrators. The process should lead to a strategic plan, acceptable to the department and to its dean, for remedying deficiencies and enhancing strengths identified in the planning and evaluation process.

2. The major components of the planning and evaluation process should be:

   a. A clearly defined statement of program mission.

   b. A delineation of the educational goals of the program.

   c. Procedures for measuring the extent to which the educational goals are being met. These measures will, of necessity, be multi-dimensional since no single statistic can adequately represent departmental performance with respect to most departmental goals.

   d. A process for regularly reviewing (and revising, if necessary) departmental and academic program components in light of measurements of program success.

   e. A departmental and institutional plan to allocate, over time, the resources needed to implement the strategic plan agreed to by the department and its dean.

   We urge that this guidelines document be used as the starting point for the planning and evaluation process. Professional societies in the mathematical sciences can provide advice for the review process and on the selection of external reviewers. Another source of information is the publication of the American Association of Colleges, *Program Review and Educational Quality in the Major* [5].

3. Periodic reviews should examine both the quality and the effectiveness of all aspects of the department's undergraduate academic program. Reviewers should consider the departmental mission and goals statements, the extent to which the department's curriculum is consistent with those statements and with the needs of the students being served, evidence that indicates the extent to which the department's program is successful in enabling students to meet the department's educational goals, the effectiveness of the department's advising practices, and the success of the department in recruiting and retaining students, including students from groups which are underrepresented in the current personnel pool of mathematical scientists. Curricular quality and effectiveness should be judged in comparison with mathematical sciences programs at peer departments, and in comparison with the most recent CUPM recommendations on the mathematics curriculum. Further indicators of program quality may include student performance in seminars, departmental comprehensive examinations, course imbedded assessment, undergraduate research activities, and on national competitions and examinations (such as the COMAP modelling competition, the Putnam competition, the first actuarial examinations, and the GRE Mathematics Examinations), and student evaluations as gathered through surveys and interviews. Reviewers should also consider the accomplishments of the graduates of the department's programs and, where appropriate, the number of mathematical sciences majors produced, compared to peer departments and to national averages, the percentage of bachelors recipients who later receive mathematical sciences doctoral degrees, and the employability of the department's bachelors graduates in occupations close to their major field of study.

   In this document, we focus on the several aspects of the department needed to support an undergraduate mathematical sciences program. When evaluating the undergraduate academic program, reviewers should consider the extent to which departments meet these broader guidelines.

C. Program Faculty and Staffing

1. Educational Background

   a. Except as indicated in item c below, those who teach mathematics courses in two-and four-year colleges should have a minimum of a master's degree including the equivalent of at least one year of full time graduate work in the mathematical sciences.

   b. A doctoral degree in the mathematical sciences is the expected and appropriate educational credential for tenure track faculty members in baccalaureate institutions.

   c. Even though they may not meet the above criteria, mathematical sciences graduate students may teach or assist with the teaching of mathematics courses provided they are closely supervised by faculty members. Since they are the future faculty members of our colleges and universities, it is important that these graduate students serve as apprentice teachers. However, before being assigned as the instructor of record in a course at the calculus level or above, a graduate student should have completed the equivalent of at least one year of graduate study in mathematical sciences. Activities that are suitable for graduate teaching assistants with less than one year of graduate study in the mathematical sciences include grading papers, staffing laboratories, conducting discussion or recitation sections, holding office hours, and teaching courses at the level of pre-calculus and below.

d. If undergraduate students are used in undergraduate instruction, their efforts should be restricted to classroom organizational duties such as collecting papers, reading and commenting on homework assignments, assisting in mathematics and computer laboratories, mathematics workshops, and recitation sections.

2. Maintaining Teaching Quality

Further advances in pedagogical research will give us greater insight into teaching practices which foster student learning, but there are certain fundamental steps which are within a department's control and which should be taken at the present time.

a. Teaching ability and potential should be key factors in all appointments to the teaching staff.

b. Orientation and training programs should be provided to familiarize new staff members with the expectations of the department and the needs of students.

c. Supervision and evaluation procedures should regularly monitor faculty progress with respect to maintaining and improving quality of teaching.

d. The undergraduate courses assigned to newly hired faculty with limited teaching experience should be courses with a high degree of structure and supervision (e.g., multisection courses with fixed syllabi and with common examinations).

e. Full-time faculty should be available to assist adjunct and part-time faculty in resolving problems and in meeting responsibilities, and to familiarize them with the procedures and expectations of the department.

f. Mathematics programs, over time, should decrease their use of adjunct or part-time faculty and avoid excessive reliance on such faculty. A larger percentage of full-time faculty can improve the overall quality of student advising and instruction. The temporary status of part-time faculty may imply less involvement in the department's overall effort. These individuals, because of their other commitments, may not be readily available for office visits by students in their classes, student advising, textbook selection, curriculum development, or other teaching related activities. Where used excessively, such temporary teaching staff can contribute to overloading the full-time faculty who, in addition to their other duties, have to orient and supervise these temporary staff members and assume most of the out-of-class duties of the adjunct faculty. However, the use of adjunct faculty may be warranted when those individuals bring special expertise and breadth to the department's program.

g. The instructional staff should strive continually to improve their teaching. A suggested outline for improvement can be found in the CTUM report, "*A Source Book for College Mathematics Teaching*," [31] and in the first nine pages of "*A Call for Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics*,"[22].

h. Senior faculty should assume a leadership role in the undergraduate program by participating fully in the teaching, course development, and mentoring of junior faculty and teaching assistants. Both senior and junior faculty should teach at all undergraduate levels.

3. Professional Development Activities

a. A regular program for maintaining and improving disciplinary expertise is essential for all academic mathematical scientists. Departments should support professional development of faculty members to enable them to remain current with the most recent advances in the field. Appropriate development opportunities include participation in seminars, graduate level mathematical sciences courses, conferences, symposia, short courses, and professional meetings. All full-time faculty members should participate regularly in such activities.

b. A regular program for maintaining and improving teaching expertise is essential for all academic mathematical scientists. Departments should provide regular opportunities for faculty members to learn of the most recent findings about the teaching and learning of mathematics and of the most recent developments in technology that support teaching and learning. All full-time faculty members should participate regularly in such activities.

c. Departments should provide long-term structured opportunities for acquisition and improvement of teaching skills by all teachers. This might be accomplished through demonstrations of pedagogical approaches and strategies for good teaching which may include videotaping and peer critiques, or by observations of classes taught by outstanding teachers, team teaching with these teachers, or working with faculty mentors. When instituting such programs for teaching assistants and part-time instructors, consideration should be given to the characteristics of the model programs and the remarks presented in the introduction of the MAA publication, "*Keys to Improved Instruction by Teaching Assistants and Part-time Instructors,*" [11].

d. All full-time faculty members should engage in sustained scholarship, broadly defined to include the discovery of new knowledge, the integration of knowledge, the application of knowledge, and scholarship related to teaching. Successful scholarship includes the obligation of timely communication of results to peers. Departments should encourage, recognize and value the diverse nature of faculty scholarship that is directly related to the department's mission and program goals.

e. Mentoring programs and faculty development opportunities designed specifically for new faculty should be available and all new faculty should be encouraged to take advantage of these opportunities.

f. In order to foster a sustained commitment to scholarship among faculty, departments and their institutions should provide sabbatical or research leaves at appropriate intervals and should have generous policies allowing leaves without pay for research and scholarly activities.

g. All full-time faculty members should be formally involved in their professions as demonstrated through membership and participation in professional organizations.

4. <u>Assignment of Duties</u>

a. Institutional and departmental missions vary considerably. Work assignments for faculty should reflect institutional and departmental missions as well as locally defined expectations for promotion and tenure and comparisons to assignments in peer departments at other institutions.

i. Faculty for whom personnel decisions are based upon assessment of substantial scholarly accomplishments in conjunction with doctoral level teaching and research supervision should have teaching assignments that do not exceed two courses per semester.

ii. Faculty for whom personnel decisions are based upon assessment of contributions in teaching, scholarship, and service should have teaching assignments which reflect these multiple expectations and allow for attention to non-classroom responsibilities. Teaching assignments above three courses per semester, when combined with other teaching-related responsibilities, do not allow the time needed to develop and maintain a program of continuing scholarship with the result that tenure and promotion might be effectively unattainable. For such faculty, teaching assignments above the level of three courses per semester must be avoided.

iii. Faculty for whom personnel decisions are based predominantly upon assessment of teaching and service responsibilities must have sufficient time for class preparation, course development, conducting office hours, advising, and other duties in service of the profession in addition to formal classroom teaching. Teaching assignments that exceed 15 contact hours or a maximum of three distinct class preparations do not allow sufficient time for these responsibilities. Faculty require time for class preparation, course development, conducting office hours, advising, and other duties in service of the profession in addition to formal classroom teaching.

b. Appropriate reductions from the normal teaching assignments described above should be made for extensive involvement in any one of the following professional activities: committee or administrative assignments; course, courseware, program, or computational technology development; laboratory supervision; graduate teaching or thesis direction; and scholarly publication.

c. In the assignment of duties, departments must exercise careful monitoring of an individual faculty member's total responsibility to the program. Total responsibility for a large number of students in a single course or supervision of course assistants can add as much to work assignments as an additional course. In making teaching assignments, departments must take into consideration not only the number of contact hours assigned, but also the number of students enrolled in those classes and, if teaching assistants are used, any additional supervisory responsibility.

d. Senior faculty from the mathematics department should seek and accept institution-wide committee assignments and other positions of responsibility in the institution and in the profession.

5. <u>Teaching Resources</u>

a. Mathematics cannot be learned passively. Departments must have resources adequate to provide teaching that is based upon substantial faculty involvement, academic challenge, collaborative learning, and personal interactions between students and instructors.

b. Departments should facilitate personal interactions among students and teachers by avoiding reliance upon the lecture method and on large class formats (in which students become a passive audience). Student-teacher interactions can be encouraged through a variety of methods, including skillful questioning of individual students, student chalkboard work, student class reports and projects, computer sessions, mathematics laboratories, mathematics tutorials, and small group sessions or study groups. The best way to ensure that these interactions can occur is to provide a small-class environment (fewer than thirty students per class).

c. The instructional staff assigned to each course should be sufficient to allow for regular and frequent feedback between students and instructors. This feedback can take the form of critically reviewed short and hour quizzes, critically reviewed homework or writing assignments, individual interactions in class or in a mathematics laboratory or workshop, or critiqued presentations of student projects or seminar presentations.

6. Staffing

Department staffing levels should be sufficient to allow personal interaction between student and instructor to occur in all courses, to allow opportunity for tenure-track faculty to have adequate time to meet tenure expectations, to allow faculty to engage in sustained scholarship, and to meet work assignment expectations comparable to those of peer departments at other institutions.

7. Securing and Sustaining a Diverse Faculty

All mathematics departments should have procedures to secure and sustain a diverse faculty, including minority, female, and physically disadvantaged mathematicians. Departmental recruiting practices should include advertising in minority publications, sending notices of position vacancies directly to institutions which are known to graduate large numbers of female or minority Ph. D. students, using minority candidate data banks, and establishing minority and female representation on faculty search committees (even if those representatives are selected from other departments).

A positive departmental atmosphere is critical. Equitable and fair treatment of all members within the departmental community is essential to allow full and free participation by all. The physical environment should be accessible to all individuals and the department should be on record as endorsing and enforcing institution approved personnel policies, including policies on sexual harassment and non-discrimination. If relevant policies do not already exist, departments should seek, through faculty governance channels, to establish the necessary personnel policies needed to foster positive departmental atmospheres. Samples of relevant policy statements appear in Appendix C.

8. Evaluation

a. The department should have written procedures for evaluating its faculty members on the basis of teaching, scholarship, and service. These departmental procedures should be periodically reviewed.

b. Evaluation of teaching should be multi-faceted, to include self-evaluation, student evaluations, and peer evaluation.

c. Tenure-track non-tenured faculty should be counseled regularly as to progress toward tenure. Quality of teaching, scholarship, and service should be integral in tenure and promotion considerations.

9. Support Staff

Clerical and technical staff should be sufficient to support the teaching and scholarly activities of the department. Computer support is a particularly important technical staff requirement. The technical staff provided for this aspect of the department's program must be sufficient to maintain and support computer laboratories and the needs of clerical staff.

D. Curriculum and Teaching

1. Curricular Planning and Review Procedures

a. The department should have established procedures which involve faculty in the regular review of course syllabi and in the selection of texts and other curricular materials.

b. The department's faculty should have the primary and most influential voice in setting the prerequisites, the course content, and the exit competencies for the department's courses. Faculty should be encouraged to experiment with new modes of instruction, course innovations, and new technology.

c. There should be established procedures for periodic review of the curriculum. These reviews should include attention to the goals and structure of the curriculum and to its relevance and appropriateness for the students being served. These reviews can be expected to lead to revision, addition, and deletion of courses.

d. Many courses within the mathematics program are organized sequentially and characterized by a series of prerequisites. Course prerequisites should be clearly stated and should be sufficiently flexible to allow students of exceptional ability to be admitted to courses for which their abilities qualify them. A current syllabus for each course should be on file for review by faculty colleagues and by students. Catalog course descriptions should be kept up-to-date.

e. The development and review process for courses that support other programs should involve faculty members from those programs. In addition, informal contacts with faculty from other departments can provide useful information concerning mathematics courses which service programs of those departments. Working collaboratives with faculty colleagues in mathematics education should be established to strengthen programs preparing teachers of school mathematics.

f. Colleges and universities which enroll significant numbers of transfer students from two-year colleges and those two-year colleges should cooperate in facilitating student transfers. Mathematical sciences faculty at the institutions should work together to ensure compatibility of appropriate courses, and course equivalencies should be published. Faculty should ensure that the courses taught at the two- and four-year colleges are consistent in content and focus.

2. Curricular Access

The curriculum should reflect departmental and institutional missions and be responsive to the needs of students. Course and program offerings should provide suitable academic challenge while based on the expectation that all students can learn mathematics. Departmental faculty should foster, both in and out of the classroom context, an atmosphere that promotes interaction among students. The spectrum of beginning courses should be broad enough to offer appropriate choices and placement in mathematics for all students entering the institution.

3. Mathematics and General Education

Mathematics is important in the life of every citizen and, in particular, in the life of every college graduate. Colleges and universities should strive to ensure that every graduate has achieved quantitative literacy in the sense of being able confidently to analyze, discuss, and use quantitative information; to develop a reasonable level of facility in mathematical problem solving; to understand connections between mathematics and other disciplines; and to use these skills as an adequate base for life-long learning. College graduates should derive from their mathematics experiences an appreciation of the contributions made to society by mathematicians and the discipline of mathematics. In pursuit of this goal, mathematics departments should provide leadership in the development, execution, and maintenance of the quantitative components of a general education program.

4. Mathematical Support of Other Disciplines

Mathematical sciences departments have a special responsibility to provide mathematical support to other disciplines and to meet the reasonable mathematical curricular needs of other departments. There should be formalized mechanisms to ensure that other departments can communicate their students' mathematical needs to the mathematics department.

5. Program Recommendations

a. The mathematical sciences bachelor's degree program should be consistent with the current recommendations of the MAA Committee on the Undergraduate Program in Mathematics (CUPM) Guidelines. At the time of this report, the current guidelines appear in the 1991 MAA Report, "The Undergraduate Major in the Mathematical Sciences," [14]. This report is reprinted in [36]. Departments should provide for majors the experiences described in the section, "Completing the Major," of that CUPM Report. Programs with no curricular track which conforms to the CUPM guidelines should be justified by a detailed and persuasive rationale for departing from those guidelines.

b. If the institution offers a program of study leading to certification of elementary and secondary mathematics teachers, that program should be consistent with the current guidelines of the MAA Committee on the Mathematical Education of Teachers (COMET), "*A Call for a Change: Recommendations for the Mathematical Preparation of Teachers of Mathematics*," [22] published in the MAA Notes and Reports Series, and with the recommendations contained in the National Council of Teachers of Mathematics (NCTM) publication, "*Professional Standards for Teaching Mathematics*," [25].

6. Research in Teaching and Learning

Departments should be aware of the results of research on the teaching and learning of mathematics, and should make use of those results in improving instruction. Through the activities of its faculty or through invited speakers, departments should stay current with the literature and with presentations at national meetings. Departments should facilitate the use of alternative teaching techniques and learning modes which appear to have merit. These include insights about ethnic and gender differences in learning styles and the cooperative learning methods or organized study groups common among the many student professional development programs now in place in colleges and universities.

7. Impact of Technology

   a. Departments should examine carefully new ways of presenting material, with particular attention given to the use of computers, graphing calculators, or other modern technology in teaching, learning, and applying mathematics.

   b. Certain areas in the mathematical sciences make extensive use of computer software. Courses in these areas should familiarize students with software tools.

8. Course Scheduling

   A department should have a stated policy on the frequency of course offerings that is determined by the program's curricular needs and responsibilities.

E. Physical and Library Facilities

1. Office Space

   All full-time mathematics faculty members should have a private office. All part-time faculty should have access to office space which allows them to confer confidentially with students outside of the classroom.

2. Classroom Equipment

   Classrooms should be equipped with such traditional teaching aids as adequate chalkboard space and projector equipment and screens. Other teaching aids such as CDROMs; videodisc, videotape, or slide projection equipment; and computer projectors and monitors should be available as needed.

3. Computer Resources

   a. The department's access to computer resources for teachers and students should be consistent with the MAA policy statement contained in Appendix A.

   b. For electronic mail communication, the department faculty should have access to bitnet or internet.

4. Informal Gathering Space for Majors

   There should be dedicated space for use by mathematics majors for informal and casual learning.

5. Library Facilities

   a. Library holdings should include the publications labeled "Essential," "Highly Recommended," or "Recommended," in the MAA publications "*Library Recommendations for Undergraduate Mathematics*," [37] or "*Two-Year College Library Recommendations*," [38], as appropriate.

   b. Library holdings should be sufficient to provide mathematics enrichment materials for undergraduate student projects and to meet the scholarly needs of the program faculty. If specific library materials are not available on site, then they should be readily available through a process of interlibrary loan.

   c. The institution's libraries should be staffed, scheduled, and located in such a way that their mathematical sciences holdings are readily available to all faculty members and students.

   d. Library holdings of books and periodicals in the mathematical sciences should be reviewed periodically by committees which include representatives of the mathematical sciences departments.

F. Students

1. Advising

   a. Departments should have established policies and procedures for placement in introductory mathematical sciences courses. It is important that these policies be well understood and disseminated across the institution.

   b. The effectiveness of these placement procedures for entering freshmen should be reviewed periodically by the mathematical sciences faculty, admissions personnel, and other freshman/sophomore advisors.

   c. Advisement of transfer students should involve cooperative efforts of mathematical sciences faculty of both sending and receiving institutions.

   d. Departments should provide majors and other students with information about careers in the mathematical sciences and should make qualified students aware of further educational opportunities, particularly in the mathematical sciences. In particular, students should be encouraged to take advantage of summer programs at other institutions including programs that provide undergraduate research experience.

   e. Every student who declares a mathematical sciences major should be assigned an advisor from the mathematics faculty. Advisors should meet regularly with their advisees. The CUPM Statement on Advising, contained in Appendix B, provides a model for departments to follow in their advising programs.

2. Broadening the Student Base in Mathematics

The nation's work force is becoming increasingly dependent on substantial mathematical preparation, and demographics indicate that women and minorities constitute a growing percentage of new entrants to the work force. Department faculty must address a changing student body whose experiences, cultural backgrounds, and learning styles may be significantly different from those of current mathematics faculty members.

Appropriate programs and courses in the mathematical sciences should be available to all students who are admitted to the institution and have an interest in mathematics. Further, in both curricular and co-curricular activities, there should be concentrated efforts on the part of the department's faculty directed to assuring that courses, programs, and the departmental climate are inviting and supportive to all students regardless of their gender or cultural background.

To achieve these goals, it is recommended that departments:

a. Have explicit policies and related practices to attract and retain members of groups currently under-represented in the mathematical sciences;

b. Distribute career information on mathematics and science based careers that actively encourages these choices by students, especially minorities and women;

c. Develop policies and articulation agreements with two-year colleges to facilitate student transfers between two-year and four-year institutions;

d. Work to increase the presence of women and minorities in academia and other mathematics-based careers by encouraging women and minority students to pursue graduate study in the mathematical sciences.

e. Initiate intervention projects whose participants include pre-college students in minority communities and work with predominantly minority organizations to encourage persistence of minority students in their study of mathematics;

f. Include more opportunities for student interaction as might take place in mathematics laboratories, tutorial sessions, or structured small group learning sessions;

g. Ensure that all departmental facilities and activities are accessible to students who are physically disadvantaged.

h. Enforce university or departmentally approved policies, including those addressing sexual harassment and non-discrimination, as they apply to relationships among students and between students and faculty. If relevant policies do not already exist, departments should seek, through appropriate governance channels, to establish the necessary policies needed to foster positive departmental atmospheres. Samples of relevant policy statements appear in Appendix C.

3. Co-curricular Activities

a. Department faculty should be involved with undergraduates in co-curricular activities designed to create an atmosphere of cohesiveness among mathematics majors and a sense of participation in the department. This atmosphere should be attractive to all majors but especially to women and those of diverse cultural backgrounds. Mathematics clubs, honorary societies such as Pi Mu Epsilon, MAA Student Chapters or student chapters of other professional societies are possible options, as are the formation of teams for the Putnam and Modeling competitions and scheduled departmental social activities which include undergraduates.

b. Special colloquia appropriate for undergraduates should be regularly held.

c. Departments should encourage faculty to work with undergraduate students in research projects.

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APPENDIX A

Providing Resources for Computing in Undergraduate Mathematics

Computers and calculators are transforming the world in which students will live and work. Moreover, technology is changing the way mathematicians work and teach, as well as enhancing the potential for learning mathematics. These changes present both opportunities and challenges for college and university departments of mathematics.

The Mathematical Association of America urges colleges and universities to respond aggressively to the changing needs of their students. In particular, all mathematics departments should prepare students to use mathematics in a technological environment. To achieve this objective, faculties, departments, and institutions must work together:

- To ensure that all students have sufficient access to computing resources appropriate to the needs of their mathematics courses.
- To provide mathematics faculty members effective access to appropriate computing equipment.
- To provide faculty members with adequate time, opportunity, and professional incentives to use technology effectively.
- To provide the resources required for a computer-enriched teaching environment.
- To provide effective technical support to departments of mathematics.

Faculties and administrations must together devise appropriate local solutions to the many problems that arise as mathematics departments adapt to the new role of calculators and computers. These problems include hardware (cost, access, location, ownership), software (effectiveness, licensing, hardware environments), space (laboratories, classrooms, offices); personnel (installation, maintenance, consulting); management (central vs. distributed); and work loads (course development, laboratory instruction).

Further information on development of effective calculator and computer environments for undergraduate mathematics can be obtained from The Mathematical Association of America, 1529 Eighteenth Street, NW, Washington, DC 20036.

Statement by the Board of Governors of the Mathematical Association of America January 15, 1991, San Francisco, California

APPENDIX B

Advising

Unlike an earlier, simpler day when all mathematics majors took the same sequence of courses with only a few electives in the senior year, the typical undergraduate mathematical sciences department today requires students to make substantial curricular choices. As a result, departments have advising responsibilities of a new order of magnitude. Students need departmental advice as soon as they show interest in (or potential for) a mathematics major. Advisors should carefully monitor each advisee's academic progress and changing goals, and together they should explore the many intellectual and career options available to mathematics majors. Career information is important. If a "minor" in another discipline is a degree requirement or option, then achieving the best choice of courses for a student may necessitate coordination between the major advisor and faculty in another department.

Advisors should pay particular attention to the need to retain capable undergraduates in the mathematical sciences pipeline, with special emphasis on the needs of under-represented groups. When a department offers a choice of several mathematical tracks within the major, advisors have the added responsibility of providing students with complete information even when students do not ask many questions. Track systems may lead students to make life-time choices with only minimal knowledge of the ramifications; therefore, departments utilizing these systems for their majors must assure careful and timely information. One requisite of an individualized approach to advising is that each advisor be assigned a reasonable number of advisees.

Committee on the Undergraduate Program in Mathematics. "*The Undergraduate Major in the Mathematical Sciences*," Page 5. A Report of CUPM. Washington, D.C.: Mathematical Association of America, 1991.

APPENDIX C

Sample Policy Statements

I. On non-discrimination:

It is the policy of this institution that no person, in whatever relationship with the institution, shall be subject to discrimination on the basis of age, religion or creed, color, disability, race, ethnicity, gender, sexual orientation, marital or military status.

II. On sexual harassment[1]:

It is the policy of this institution that no member of the academic community may sexually harass another. Sexual advances, requests for sexual favors, and other conduct of a sexual nature constitute sexual harassment when:

1. Any such proposals are made under circumstances implying that one's response might affect such academic or personnel decisions as are subject to the influence of the person making such proposals; or

2. Such conduct is repeated or is so offensive that it substantially contributes to an unprofessional academic or work environment or interferes with required tasks, career opportunities, or learning; or

3. Such conduct is abusive of others and creates or implies a discriminatory hostility toward their personal or professional interest because of their sex.[2]

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[1] For the state of the law as it pertains to sexual harassment in the employment context, see *Meritor Savings Bank, F. S. B. v. Vinson, 477* U.S. 57 (1986).

[2] Faculty members and staff are cautioned against entering romantic or sexual relationships with their students; so, too, is a supervisor cautioned against entering such relationships with an employee. Faculty and staff should be cautious in assuming professional responsibilities for those with whom they have an existing romantic relationship. (See also the AAUP statement on *Faculty Appointment and Family Relationships.*)

[American Association of University Professors, 1990]

APPENDIX D

The Mathematical Association of America
ad hoc Committee on Guidelines

Robert Bozeman, Department of Mathematics, Morehouse College, Atlanta, GA

Chair **John D. Fulton**, Dean, College of Arts and Sciences, University of Missouri - Rolla, Rolla, MO

James R. C. Leitzel, Department of Mathematics and Statistics, University of Nebraska Lincoln, Lincoln, NE and The Mathematical Association of America, Washington, DC

David J. Lutzer, Dean, Faculty of Arts and Sciences, College of William and Mary, Williamsburg, VA

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Marilyn E. Mays, Department of Mathematics, North Lake College, Irving, TX

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PERSONAL OPINION

Professor Leonard Klosinski, Director
53rd William Lowell Putnam Mathematical Competition

Dear Professor Klosinski,

At a recent 10K run, I noticed various classes of competition. There were categories for men, men over 30, men over 40, women, women over 30, women over 40, etc. This seems appropriate. Although no one said so, everyone expected the top man in the over 40 group to lose to the top man over 30. It was worthy of extra praise when one man won both classes. Similarly, competitions are classified by weight. People accept this as appropriate. But neither contest is partitioned by race of left/right handedness. If I ask myself why not, I conclude that no one expects race or handedness to be related to performance in running or wrestling. We only invent categories to handicap competition between groups that are perceived to be unequal. So why have I told you this parable? This year for the first time the following paragraph has been added to the announcement for the William Lowell Putnam Exam:

"The Elizabeth Lowell Putnam Prize will be awarded periodically to a woman whose performance on the Competition has been deemed particularly meritorious. This prize would be in addition to any other prize she might otherwise win. Women contestants, to be eligible for this prize, must specify their gender."

I imagine that the intent is to encourage women to excel in mathematics, but instead I received the message that we are going to handicap this contest because we do not expect women to perform as well as men. The effect, I am afraid, is to reinforce any lack of confidence a woman may have. I do not want to ignore or trivialize the discrimination that women have faced in our society, but they are not the only ones. Surely homosexuals have faced discrimination and very much need encouragement and role models. And blacks. And the obese. Will we next see prizes for meritorious homosexuals, blacks, and obese people? Of course, participation will be voluntary and only contestants who identify themselves as a member of the appropriate group will be eligible for prizes.

Isn't it clear that, when we judge a characteristic to be irrelevant to performance (weight for math competition, left/right handedness for wrestling) we ignore it when classifying contestants. But when we allow for it we are silently expressing our expectations that one group will outperform another?

I find the Elizabeth Lowell Putnam Prize to be offensive to both our male students and our female students. Imagine the scene when we announce that a certain male scored 67 points and was not nationally recognized, but a female scored 65 and is receiving a national award. How should that young man feel? And how does the young lady feel? Doesn't the creation of this award say, "We all know women are not capable of competing with the big boys, so we'll create a second tier of prizes so they will have a chance"? I find this to be offensive, just as I would be offended if the National Basketball Association announced a new "White MVP" in addition to the currently existing MVP.

It is true that women have been woefully underrepresented among the winners over the history of the exam. I don't pretend to know the reasons why. One can imagine explanations based on discrimination, poor counseling, lack of interest, or native differences in ability. I contend that this unfortunate history is not the issue. What should we do if a search reveals that very few left-handers have won? Establish a "lefty Lowell Putnam Prize"? Or very few redheads? Or very few Swedes over 6 feet tall? Don't you agree that any attempt to guarantee equal success for all groups only diminishes the valid accomplishments of those very same groups? Discrimination, however well intended, is bad policy.

I have already concluded that I cannot in good conscience support, participate, or even lend my passive and silent approval to this issue. I take this stand with great sadness since I have been a fan and a supporter of the Putnam Exam for 25 years. Moreover, Western Michigan University has a strict policy of nondiscrimination on the basis of race, sex, sexual preference, age, etc.

Considering all of the reasons given above, we will not register any students for the Putnam Competition for 1992. We hope the MAA will review its policy and return next year to the old, rigorously unbiased, format.

I understand the frustration of women who feel they have seen a long history of discrimination, but I must point out that when this country belatedly abolished slavery, it didn't say that since blacks had been victimized for 200 years, we would now undergo 200, or 100, or 50 years of white slavery in order to balance the effects. If we have come to recognize discrimination in our past, the solution is to go forward and sin no more. Not go forward and sin on the opposite side until it seems we have balanced the injuries.

Respectfully,

Allen J. Schwenk
Western Michigan University

November 16, 1992

Professor Allen J. Schwenk
Western Michigan University

Dear Professor Schwenk,

I was sorry to learn from your letter dated October 14 of your objection to the newly established Elizabeth Lowell Putnam Prize for a high ranking woman participant in the William Lowell Putnam Mathematical Competition. The decision to introduce such an award was made after considerable discussion and consultation involving the Trustees of the Putnam Fund for the Promotion of Scholarship, some of the officers of the MAA, and myself.

The reasons for introducing the new prize were essentially twofold: George Putnam wanted to recognize the contribution that his grandmother, Elizabeth Lowell Putnam, made in establishing this Fund, and he wished to take a significant step towards encouraging more women to participate in the Competition. We all agreed that increased participation is a worthy aim and we are attempting through this Prize to encourage this. If you have alternate ideas about how we might proceed, we would be interested in hearing them.

I regret that you feel that your students at Western Michigan cannot participate in the Putnam this year because of the existence of this new prize. It seems unfortunate to penalize them for actions of others over which they have no control. Perhaps you could reconsider your stand on this particular issue. If you decide to do so—and, of course, if you feel that you cannot act as supervisor, perhaps there is someone else in the Department who could—then we could make arrangements here to get to Western Michigan the contest materials, even though the deadline for requesting such materials has passed.

We have appreciated your support of the Putnam Competition in the past and hope that we can count on your continuing support in the future.

Sincerely yours,

Leonard F. Klosinski

The Job Search Diary

Part 4.

Ed Aboufadel

April 12: On Thursday, I travelled to New Haven, Connecticut, for my interviews at Southern Connecticut State University. Southern, as they call this New England campus, will reimburse me for the costs of the trip.

My day started with an interview with the hiring committee at 8:00 in the morning. The interview focused completely on teaching. The faculty at Southern teach four courses a semester, and the committee, I suppose, wanted to see if I was fit for that. I was asked questions about my past teaching experience, my aspirations for my career, the texts I've taught from, how I usually distribute grades in a class, the organization of the courses at Rutgers, and the letter I had published in *UME Trends*. (I've mentioned this in almost every application letter that I sent out, and I was pleased to discover that Dr. Meck actually had the issue in his files. Considering the small circulation of *UME Trends*, this is a good sign about Southern.)

Next was my interview with Dean Smith. Actually, I wouldn't characterize it as an interview. Dr. Smith explained to me how hiring and tenure works and gave me a rough estimate of how much I would be making if I was hired. He didn't ask me questions about myself.

At 10:00 AM was my campus tour. Southern has a small campus (compared to Rutgers), and there were not many buildings to see, but I took a close look at the computers that are available for faculty and for students.

After lunch, I gave a lecture on my dissertation. I was asked before hand to keep it at a level that a junior or senior math major could understand. I'm not sure if I was able to do that, but, in the same manner as when I teach, I stopped at times and asked if everyone understood what I was talking about. I was a bit nervous, tripped over some of my words, and I think I could have used the chalkboard better, but at the end of my talk, I was asked a number of questions which suggests to me that most of the faculty understood what I was trying to communicate.

After the lecture was informal discussion with faculty. It was interesting that when I chatted with Dr. Helen Bass, she referred to my lecture as "when I was teaching" rather than "when I was lecturing." I talked to faculty about my research some more, and about graphing calculators in the classroom. The informal time passed quickly, and soon I was on my way back to New Jersey.

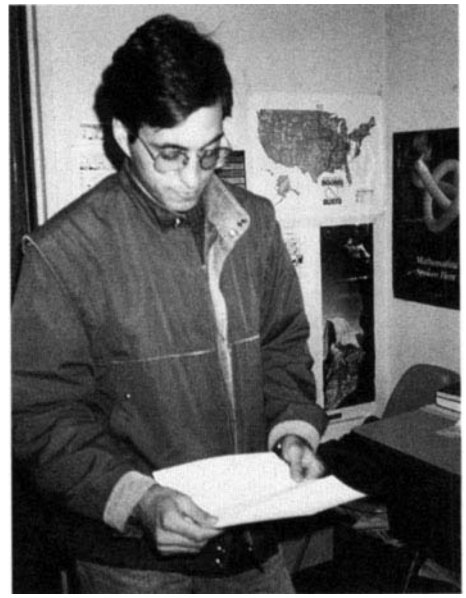
On reflection, I think I may be happy at Southern. I like to talk about teaching and it appears that the faculty there also likes to talk about teaching. Many of them have aspirations about this course or that course, and I felt during the day like they were studying whether or not I could help with their aspirations.

They started with 500 applications, and I am one of the three finalists. As I was the last of the three they interviewed, they will be making a decision soon about hiring.

One last note about Southern for now: a few times on Thursday, I was told that if I was offered a position, I must insist on a new computer for myself as a part of the package.

When I got home Thursday night, there was a message on my answering machine from Middlebury College. I applied for a one year position there, and they would like to talk to me about it. I had trouble on Friday getting through to them, so I will try again tomorrow.

I also talked to a representative of the Peace Corps on Friday. She was enthused that someone with a PhD in Mathematics would be interested, and said that if I was placed anywhere, it would probably be at a university in Eastern Europe or Russia where I would teach mathematics. What irony! Of course, the Peace Corps requires a 27-month commitment, but at this point I will consider it. The recruiter told me that I should apply soon as it takes a few months for all the processing to occur.



Edward Aboufadel reads a rejection letter.

April 14: Yesterday I got a call from Dr. Meck at Southern. After meeting on Friday, they have decided to offer me the position there! Success at last!

So, the new question is whether or not I will take the position. The answer is "most probably," but first I want to see exactly what they are offering me, in writing. Dr. Meck has already sent me the AAUP contract and information about retirement benefits (nothing like worrying about the year 2030), and tonight we are going to talk in depth about their hiring process.

My family and friends are excited. I'm excited!

There are a number of schools that I applied to that I have not heard from yet. I plan this week to contact a number of them to find out about the status of my application. At this point, I almost hope that I experience a sequel to last month's rout, as it will make it perfectly clear that this is the only offer I am going to get.

I'm not sure what is going on with Middlebury College. I contacted the Chair there yesterday morning to let him know that I am still interested in the position there.

April 15: Last night I talked to Dr. Meck about the job at Southern. He outlined the responsibilities of the position. They want to hire me as "the Applied Math person," and expect me to take an active interest in the courses which are considered applied math: numerical analysis, math modelling, etc. If I accept the position, the first day I need to be at Southern is August 24, although classes do not start until the 31st.

As far as the details of the offer (length of contract, salary, etc.), the dean is going to call me tomorrow to talk about that. Dealings of this sort are handled through the dean's office. I look forward to this conversation.

Of course, in order to take this position, I have to graduate first. While all of this has been going on with Southern, I have also been attempting to finish my dissertation. It is not easy, and yesterday my advisor found a troubling flaw in part of my work. People tell me that when you reach this point in the program, little flaws begin to look like big ones.

April 17: I'm not sure why, but the dean did not call me yesterday. This being the beginning of the Easter/Passover weekend, I probably will not hear from him until Monday.

I have not received a rejection letter all week, which I think is curious since there are still 49 departments out there that I haven't heard from. I have to assume that some of these places have hired people by now, particularly those whose deadlines for applications were in December. I have been wondering how many of these departments I will never hear from in any way.

April 18: Today I talked to Dean Smith. He gave me a salary figure, which was a bit lower than I expected from talking to him last week. We then talked about what he was going to do to find more money for me.

I also said that since I was going to be the lead person in Applied Mathematics, I should have a good personal computer either in my office or available to me in the mathematics computer room. By good, I imagine something with a co-processor and decent graphics. Dean Smith said he would consider it and sounded optimistic. Apparently money for computers for new faculty is in a different pot from money for salaries for new faculty.

I asked him about the formal hiring process. Once he and I verbally agree on some terms, some papers are shuffled and I am to get a letter from the president of Southern formally offering me a position. The letter will contain the terms of my employment (i.e., salary, benefits).

I decided today which other schools I will contact on Monday to determine the status of my applications there. It helped me to take another look at the acknowledgement letters that I have received so far. About a half dozen imply that they will not send me a rejection letter if they, in fact, reject me. I say "imply," since I am reading statements such as "If we need more information, we will contact you."

I noticed that Southern's deadline for applications was November 13, 1991, yet they still haven't completed their process yet since I have yet to commit to them. I wonder if other schools who had early deadlines and who I haven't heard from are in this situation.

April 20: Today I contacted some of the departments that I haven't heard from yet.

First I talked to Ohio State. They hired three instructors this year, but, due to budget cuts, they did not hire any tenure-track positions.

Next I talked to the combined Indiana University/Purdue University campus in Indianapolis. They hired three people this year. The secretary apologized for the fact that rejection letters haven't been sent out yet, but she said they had over 1000 applications, and it has been difficult keeping up with the paperwork.

UNC-Charlotte has done some hiring, but I was not on their "finalist" or "semifinalist" list. The chair there also said that they will probably do some more hiring next month, because of some recent resignations. When I mentioned my name, he immediately asked for my area of specialization, which suggests to me that their process was organized by grouping applicants by area of specialization.

Ithaca College is in the last stage of their process, and their deadline for applications was December 16. They have had several people interview on campus. If they decide not to hire any of the candidates they have interviewed, then they will go back to their pool of applicants, but I rate this possibility as unlikely.

The University of New Hampshire reports that they have hired one person for a tenure-track position. They also apologized for not sending out rejection letters yet.

On reflection, I have found practically everyone I have talked to on the phone, both today and last month, to be friendly and open about how many people they hired or the status of their process.

April 21: There is a very troubling article in the new issue of Science. During the 1980s, the NSF, under the direction of Erich Bloch, predicted that there was an impending shortfall in the number of scientists and engineers. Now, a congressional investigation has suggested that this shortfall was purposely overstated in order to promote increased R&D funding.

At this point, it is not clear what the truth is. Perhaps next week's issue of Science will have more details. It is becoming apparent, though, that NSF's predicted shortfall has not occurred, at least not in Mathematics. This may be the result of increased federal funding of graduate students over the last few years, an increase that was influenced in part by NSF's predictions.

If the NSF did cook the books seven years ago, then this is something to get angry about.

April 22: I got this rejection letter today from a Big Ten school:

> *The Personnel Committee of the Department of Mathematics has completed the process of reviewing and ranking applications for faculty postions. A number of factors are taken into consideration during the screening and hiring process. I regret that we cannot offer you a suitable appointment for next year. Thank you again for applying to Big Ten University.*

This letter begs the question: what are these factors? Gender? The reputation of my thesis advisor? Whether or not I have bad breath?

Besides, given this year's job market, any appointment would be "suitable" to someone looking for a job.

This has gotten me thinking about what I feel is the ideal rejection letter. I have grumbled a lot in this diary about poorly written rejection letters. How would I do better?

Given the numbers of applications, a form rejection letter makes some sense, although with today's word processing programs, it would not be hard to personalize these letters. For example, "We received over 500 applications, <some number> in your specialty, <some specialty>."

I would invest some time to write a decent letter. I think applications deserve more than the disorganized paragraph written above. In retrospect, letters which express empathy with the applicant for trying to find work this year have been appreciated. Letters which gave a glimpse of the process that a personnel committee followed have also been appreciated. (I applaud Macalester College in this regard.)

I recognize that some hiring committees have felt absolutely overwhelmed this year by the number of applications that they have received, and I can imagine that at the end of a hiring process, there may be a desire to just get it over with and to not spend much time with the rejection letters. But that is no excuse. I have looked at rejection letters for clues as to why I was rejected, where I was deficient. These letters could be an opportunity to educate, which is one of our goals.

April 23: This morning there was a message for me from East Stroudsburg University requesting that I call. I applied for a tenure-track position there last month. I also received an e-mail message from Dr. Meck, the Chair at Southern, saying that Dean Smith would call me this afternoon, probably with a final offer.

I had a decision to make. I imagined that East Stroudsburg wanted to interview me. Should I go there for an interview, or should I just accept the job at Southern? At Southern, I would be involved with the Applied Mathematics courses. East Stroudsburg, according to the job advertisement, was looking for someone to improve their general mathematics courses. To be honest, this made Southern more attractive. Also, Yale and its research library is right next to Southern. I decided to hear what Dean Smith had to offer.

*Please see **Job Search Diary** on page 20*

Job Search Diary from page 19

So, this afternoon I talked to Dean Smith. He was able to offer me a little bit more than when we talked on Saturday. He was also able to set aside money to purchase a new computer for my use.

I accepted the job offer.

Then I called East Stroudsburg. They really did want to invite me out for an interview. I felt very odd telling them that I had already accepted another offer and that I would have to decline the invitation.

According to Dean Smith, within the next four weeks I should receive some formal paperwork concerning my employment, including a written statement of my salary.

May 4: This is my last entry, as my job search is complete. Southern has requested official transcripts from Michigan State and from Rutgers. They will be sent as soon as I finish with Commencement here at Rutgers in a few weeks.

I'd like to share a rejection letter from Kent State:

> *Dear Position Candidate:*
>
> *The departmental search committee has completed its review of the more than 500 applicants, and had reduced the list to six finalists, when the positions we were authorized to fill for the academic year '92-'93 were frozen by the University, in response to severe higher education budget cuts threatened by the State of Ohio. We were fortunate to have a number of extremely strong candidates apply. The six finalists have visited our campus, and the search is now complete. We thank you for your interest in Kent State University.*

This letter is another snapshot of the problems in this year's job market. It is also confusing. I think it says that they had gotten to the point where they interviewed six candidates and then the hiring freeze set in, but I am not sure. Is the search complete or just suspended until the hiring freeze is over? I would like to know.

Let me review the past seven months. I ended up applying to 90 different schools. (My running count was 87, so at some point I miscounted.) That's over $26.00 just for postage.

One school contacted me to find out if I was still interested, and two schools invited me for interviews. I only interviewed with Southern Connecticut State University, and I was offered a position there.

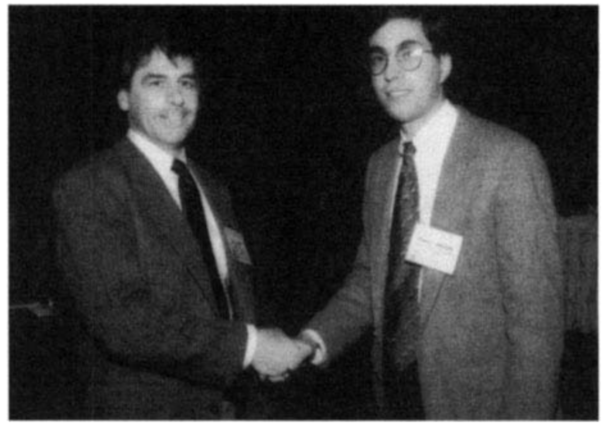
Forty-three schools sent me either a letter of rejection or else an announcement of a hiring freeze. Through telephone or e-mail conversations, I learned of rejections from nine other schools. Seven schools implied in their letters acknowledging my application that I would not hear from them again unless they wanted to interview me.

Of the 28 other schools, I received a letter acknowledging my application from 16 of them. The other 12 schools have yet to contact me in any way.

Twenty-five schools requested that I complete some sort of Affirmative Action survey.

I also tested the non-academic waters, but had nothing substantial develop.

I have been thinking about the effects of the Baltimore interviews on my job search. I interviewed with eight different schools, and none of them invited me for an interview on campus. Does the AMS compile statistics on the effectiveness of the Employment Registry? How many of the interviews in Baltimore led to job offers, or at least a more in-depth interview? If that number is low, then perhaps the expected outcome of participating is not worth the cost.



FOCUS Editor Keith Devlin and Edward Aboufadel.

The interviews in Baltimore were good experience for me. I got some idea of what kind of questions are asked by representatives of search committees. I'm willing to believe that this made the interviews at Southern less intimidating. I also got an idea that members of search committees are real people.

Finally, let me reiterate some of my comments about the wording of advertisements: I think that search committees should be as specific as possible about who they are looking for. If you want someone who has published at least three papers, then say so. I don't think it is fair to say, "Well, there is a chance that we would hire someone who hasn't had anything published," if that chance is rather small. For example, I did not apply to any school that said, "Submit a preprint of your latest work with your application," since I did not have any preprints to submit.

From what I hear, next year will be worse than this year. There will be more people looking for jobs, there might be more positions available, if we're lucky. Nevertheless, I predict more tidal waves of applications to drown secretaries and search committees.

And, you know, I'll probably be on one of those search committees next year. Then I'll be able to see this process from the other side.

The Job Search: The Numbers Aspect

Number of schools applied to: 90

Distribution of schools by state:

New York	16
Pennsylvania	10
Illinois	9
Ohio	6
North Carolina	6
Indiana	6
Connecticut	4
Massachusetts	4
3 states had	3
Canada had	3
5 states had	2
7 states had	1

Location of advertisements that I responded to:

AMS Notices	31
e-math	25
Flyer posted in dept.	17
MAA FOCUS	11
First learned in Baltimore	3
SIAM News	2
First learned at a job fair	2
Chronicle of Higher Ed.	1
New York Times	1

Types of positions appplied for:

Tenure-track	70
Two-or-three year position	10
One-year position	10
Other (non-academic)	4

Month that rejection letter was received:

December 1991	1
January 1992	5
February	10
March	23
April	10
May	12
June	8
July	3
Never	18

For those positions that announced due dates, the average amount of time between the due date and the rejection letter was 2.8 months.

Networks in FOCUS

The Internet

Getting Started

WORLDWIDE NETWORKING OFFERS THE PROMISE OF UNIVERSAL ACCESS TO STORED INFORMATION.

Users already strain the databases of publicly available on-line vendors such as CompuServe and Prodigy. But now the higher education community in the United States and other parts of the world can use an even more powerful source of information: the Internet.

The term "internet" in lowercase can apply to any collection of linked networks, but the Internet with a capital "I" denotes a specific system: a supernetwork of networks connecting universities, research organizations, companies, and government installations.

The Internet is not managed by any one organization. It is a system of nearly 10,000 computer networks linked together in cooperative, non-centralized collaboration. The system has more than 1 million host computers and in excess of 4 million individual users accessing its resources from more than three dozen countries. Internet size is expected to double by the end of 1993.

HISTORY AND ARCHITECTURE

The Internet grew out of the ARPANET, a research network created by the U.S. Department of Defense Advanced Research Projects Agency (ARPA) in 1969. Its purpose was to link various government installations with university, industrial, and research organizations. In the mid-1980s, the Department of Defense moved its military operations machines to a separate network called MILNET, leaving ARPANET to be used by researchers. In 1990, ARPANET itself was dissolved and its workload picked up by the federal government's National Science Foundation (NSF) through NSFNET.

Today, NSFNET connects networks and Internet service providers with other parts of the Internet worldwide, including major backbones such as EBONE in Europe. In 1987, Merit Network Inc., a consortium of Michigan universities, won a competitive bid to manage NSFNET, with the support of IBM Corp. and MCI Communications Corp. In 1990, the three organizations formed a not-for-profit corporation to manage the network. Advanced Network & Services Inc. (ANS) currently oversees the NSFNET, which now rides on the ANS high-speed T3 network and has 19 major nodes.

Although no single organization manages the entire Internet, groups exist which influence its development. One notable organization is the Internet Society (ISOC). Formed in January 1992 as a nonprofit professional society with a mission to support and promote the evolution and growth of the Internet, ISOC provides a focus for the collaboration among the diverse groups operating and using the Internet. Through its Internet Architecture Board (IAB) and Internet Engineering and Research Task Forces, ISOC fosters research into multiprotocol internetworking and the integration of new protocol suites into the present Internet architecture. Such research, with input from ISOC members from 43 countries, will help to provide a sound technical basis for the expected rapid Internet growth.

For additional information about ISOC and membership information for current Internet users, contact the Internet Society, 31895 Preston White Dr., Ste. 100; (703) 620-0913; e-mail ISOC@ISOC.org.

WHAT'S IN A NAME?

Internet addresses are known for the "@" sign buried within a string of other seemingly cryptic initials and dots. However, there is a recognizable pattern to this string of characters, and it is normal to become comfortable using these addresses with some practice, and quite possible even to memorize a few!

The characters to the left of the "@" indicate who the message is going to once it arrives at the designated Internet host. The characters to the right of the "@" include the host name, with the characters after the last dot indicating the type of user. In the United States these are normally: .edu (educational), .org (non-profit organization), .com (commercial), .mil (U.S. military), .gov (other U.S. government), .net (network administrative hosts or service centers), or .int (international organizations).

For example: John.L.Jones@ Dartmouth.edu. (Note: Using the uppercase letters is for readability only and is not necessary.)

INTERNET CAPABILITIES

The main capabilities on the Internet are FTP, or File Transfer Protocol, a means of exchanging files between host computers or downloading files from a foreign host; telnet, a remote log-on procedure for accessing programs on remote computers as though they were local; e-mail, allowing exchange of electronic mail messages between Internet users on the Internet and through gateways with many networks outside the Internet; and public access areas such as newsgroups, discussion lists, and electronic serial publications.

Though there are costs involved in setting up and maintaining an Internet connection, normally including fees to a service provider or regional center, most of the services just mentioned are free to Internet users. There are exceptions, but in most cases vast amounts of information and computer services are free, once you are connected to the Internet.

A SAMPLING OF INTERNET RESOURCES

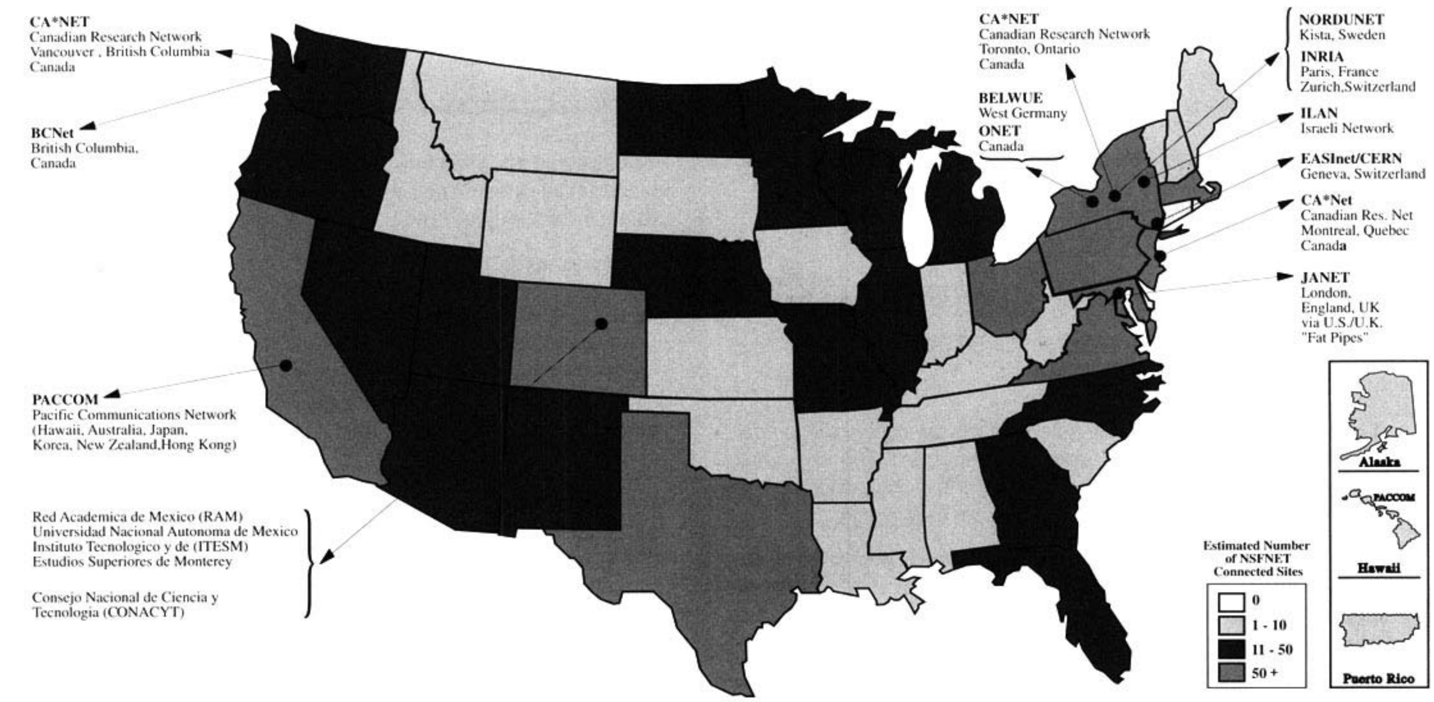
Campus-Wide Information Systems
The University of North Carolina at Chapel Hill has a database of information on grants, scholarships, and funding opportunities, which can be accessed by telnet info.acs.unc.edu. For more information, e-mail hallman@unc.bitnet.

Colorado Alliance of Research Libraries (CARL)
Internet-accessible card catalogues, a database of journals searchable by subject, and lists of other libraries on the Internet. Access via telnet pac.carl.or. For more information on CARL, e-mail help@carl.org.

Cleveland Free-Net
Free, open-access community computer system operated out of Case Western Reserve University. Includes USA Today Headline News, a Courthouse and Government Center Database, a Legal Clinic Q&A, and more. For more information, send e-mail to aa001@cleveland.freenet.edu.

This article first appeared in the Higher Education Product Companion, and is reprinted with permission from Syllabus Press.

Please see ***Networks*** *on page 22*



STATE	SERVICE PROVIDERS	STATE	SERVICE PROVIDERS	STATE	SERVICE PROVIDERS	STATE	SERVICE PROVIDERS
Alabama	SURAnet	**Illinois**	CICNet, netIllinois	**Nebraska**	MIDnet	**South Carolina**	SURAnet
Alaska	NorthWest Net	**Indiana**	CICNet, INet	**Nevada**	NevadaNet	**South Dakota**	MIDnet
Arizona	Westnet	**Iowa**	CICNet, MIDnet	**New Hampshire**	NEARnet	**Tennessee**	SURAnet
Arkansas	MIDnet	**Kansas**	MIDnet	**New Jersey**	JvNCnet	**Texas**	SESQUINET, THEnet
California	BARRNet, CERFnet, CSUnet, SDSCnet, Los Nettos	**Kentucky**	SURAnet	**New Mexico**	Westnet	**Utah**	Westnet
Colorado	CO Supernet, Westnet	**Louisiana**	SURAnet	**New York**	NyserNet	**Vermont**	NEARnet
Connecticut	NEARnet	**Maine**	NEARnet	**North Carolina**	CONCERT, SURAnet	**Virginia**	SURAnet, VERnet
Delaware	SURAnet	**Maryland**	SURAnet	**North Dakota**	NorthWestNet	**Washington**	NorthWestNet
District of Columbia	SURAnet	**Massachusetts**	NEARnet	**Ohio**	CICNet, PSCnet, OARnet	**West Virginia**	PSCnet, SURAnet, WVNET
Florida	SURAnet	**Michigan**	CICNet, Merit/MichNet	**Oklahoma**	MIDnet	**Wisconsin**	CICnet, WiscNet
Georgia	SURAnet	**Minnesota**	CICNet, MRNet	**Oregon**	NorthWestNet	**Wyoming**	NorthWestNet, Westnet
Hawaii	PACCOM	**Mississippi**	SURAnet	**Pennsylvania**	PSCNET, PREPnet	**National and International Service Providers**	
Idaho	MIDnet, NorthWestNet, Westnet	**Missouri**	MIDnet	**Puerto Rico**	SURAnet	Alternet, ANS, ICM, JvNCnet, PSInet	
		Montana	NorthWestNet	**Rhode Island**	NEARnet		

***Networks** from page 21*

Dartmouth University Library catalog, DARTMED index, MLA Bibliography, American Heritage Electronic Dictionary, and Grolier's Academic American Encyclopedia

Telnet lib.dartmouth.edu. E-mail questions to PUBLIC-admin@ dartmouth.edu.

Gandalf, from the Institute for Academic Technology

Includes newsletter articles, technical papers, events, and descriptions of free IAT publications.

FTP gandalf.iat.unc.edu.

Genbank from University of Houston and U.S. Department of Health

Send a message with the subject line "help" to gene-server@bchs.uh.edu.

Geographic Name Server (University of Michigan)

Data from U.S. Geodetic Survey and the U.S. Postal Service. Telnet martini eecs.umich.edu 3000. For more information, e-mail libert @eecs.umich.edu.

Geographic Name Server (University of Michigan)

GraphicsFTP to wuarchive.wustl.edu and go to either the /info-mac.gif or /gif in the graphics directory.

Library of Congress cataloging records from Data Research Associates Inc., at Rutgers University

This is not the Library of Congress catalog itself, but a collection of MARC records from the Library of Congress Cataloging Distribution Service. Telnet to dra.com and follow the instructions.

Macintosh programs and files from Stanford University

Utilities, fonts, sounds, demos, graphics, and other software and files in the public domain available.

FTP sumex.stanford.edu and change to the /info.mac directory.

MELVYL

The holdings of the University of California Library. Telnet to melvyl.ucop.edu.

NASA's Ames Research Center

FTP to ames.arc.nasa.gov and change to the /pub/SPACE directory.

Ocean Network Information Center

Telnet delocn.udel.edu and log in as info.

Science and Technology Information System from NSF

The National Science Foundation (NSF) has established the Science and Technology Information System (STIS), an electronic dissemination system providing access to all NSF publications, including The NSF Bulletin, Guide to Programs, The NSF Telephone Book, grants booklets, program announcements, and descriptions of research projects funded. Telnet stis.nsf.gov.

Supreme Court Decisions (from Case Western Reserve University)

FTP to ftp.cwru.edu and change to the /hermes directory.

How to Get on the Internet

Internet access can be obtained through a variety of plans available from service providers and vendors.

The widest range of Internet capabilities can be accessed by users who have their own node and are Internet hosts. These users can maintain an Internet server with FTP and telnet available to guests. They obtain their own domain name and IP numbers and provide mail service to individuals as needed. They also can provide netnews services and other services requiring a direct connection to the Internet, as well as access to all the public resources of the Internet. This degree of involvement means that an organization must be able to lease a line to the nearest Internet connection point, obtain service from an Internet service provider, provide the hardware and software for the Internet server, and have the technical staff to maintain the host machine—which usually means some degree of UNIX knowledge.

The Network Information Center (NIC) assists new users and potential subscribers in obtaining pertinent network information. Costs for installing and maintaining an Internet host vary tremendously. It is worthwhile to spend some time comparing costs through various service providers and checking out hardware and software costs. Organizations interested in obtaining information can contact the NIC to get a listing of service providers and to apply for domain name service. Contact the NIC, GSI Government Systems Inc., 14200 Park Meadow Dr., Ste. 200, Chantilly, VA 22021; (703) 802-8400; Fax (703) 802-8376. Internet: NIC@NIC.DDN.MIL.

The NSF Network Service Center also maintains a list of NSFNET mid-level network contacts. To find out about the regional NSF networks near you, contact the NSF Network Service Center, c/o BBN Systems and Technologies, 10 Moulton St., Cambridge, MA 02138; (617) 873-3400. E-mail nnsc@nnsc.nsf.net.

There are alternatives to a full-blown network connection. Some service providers and vendors are now offering various reduced levels of Internet access.

These fall in roughly three categories: (1) a dial-up host service, where space and service on a host machine are maintained for you at the service provider's site for a monthly fee; (2) dial-up access through a shared host usually billed based on usage; and (3) e-mail only through various on-line vendors with Internet gateways.

These limited services may be useful to organizations that need to restrict their commitment to an Internet connection. Costs can be dramatically lower with a limited connection rather than a full Internet connection. But be careful to understand the limitations, because none of these services is equivalent to a full Internet connection.

Future of the Internet

As the Internet grows, policy issues will be confronted along with technical ones. Today, NSFNET sets the tone for acceptable use, but expects other networks to maintain their own acceptable use policies. Broadly stated, any information going through the NSFNET should be in support of education and research. Commercial hosts are allowed as long as their Internet activities reflect these goals.

The commercial service providers have formed a Commercial Internet Exchange which supports the free interchange of traffic without any usage restrictions.

In 1991, Congress passed legislation covering the National Research and Education Network (NREN), providing some funding to NSFNET for leading-edge technology. Commercial interest in the NREN raises questions about the commercialization and privatization of the Internet in the future.

In the next issue, we'll cover the various resources found on the Internet and specialized software packages that allow you to access these resources.

Internet Gateways for E-Mail

Several major commercial vendors provide dial-up access to Internet e-mail along with their other on-line services. Such services offer a relatively low-cost alternative for accessing the Internet for those interested in e-mail only. For additional information, contact the services listed below.

America Online

8619 Westwood Center Drive, Vienna, VA 22182-9806; (703) 448-8700.

AppleLink

Apple Computer, Inc., P.O. Box 10600, Herndon, VA 22070;
(408) 974-3309; Internet ALink.mgmt@AppleLink.Apple.com.

AT&T Mail

5501 LBJ Freeway, Suite 1015, Dallas, TX 75240; (800) 242-6005.

CompuServe

CompuServe Incorporated, 5000 Arlington Centre Blvd., Columbus, OH 43220; (800) 457-MAIL.

MCI Mail

1133 19th St. NW, 7th Floor, Washington, DC 20036; (800) 444-6245.

SprintMail

12490 Sunrise Valley Drive, Reston, VA 22096; (800) 736-1130.
Vendors and Service Providers Who Offer Limited Internet Access Plans

The following are examples of vendors and service providers who offer limited access plans as an alternative to full network services. You may be able to locate others in your region who have such plans. For contact information on full Internet service providers, contact the Network Information Center (NIC) or the NSF Network Service Center.

California Education & Research Federation (CERFnet). (Full and limited service.) Host dial-up services and tollfree dial-up access. P.O. Box 85608, San Diego, CA 92186-9784; phone: (619) 455-3900 or (800) 876-CERF; Fax: (619) 455-3990; e-mail: help@cerf.net.

Cooperative Library Agency for Systems and Service (CLASS). Toll-free dial-up access through a library co-op. 1415 Koll Circle, Suite 101, San Jose, CA 95112-4698; (800) 448-4559.

JvNCnet. Dial-up services and toll-free dial-up access. Global Enterprise Services, B6 von Neumann Hall, Princeton, NJ 08544; phone: (800) 358-4437 or (609) 258-2400; e-mail: market@jvnc.net.

NetCom Online Communications Services. Inexpensive dial-up access for companies and individuals at a fixed monthly rate. Recently expanded services outside California. 4000 Moorepark Avenue #209, San Jose, CA 95117; phone (408) 544-8649; e-mail ruthann@netcom.com.

Performance Systems International, Inc. (PSI). (Full and limited service.) Host dial-up servces. 11800 Sunrise Valley Drive, Suite 1100, Reston, VA 22091; phone: (703) 620-6651; Fax: (703) 620-4586, e-mail: info@psi.com.

*Please see **Networks** on page 24*

INTERNET BIBLIOGRAPHY

There are numerous published guides to establishing, maintaining, and using an Internet connection. The following is a list of selected books and other resources that provide information on the Internet.

Exploring the Internet: A Technical Travelogue, by Carl Malamud (ISBN 0-13-296898-3). Literally a travelogue, the author travels to 21 countries and 56 cities, exploring the Internet as an "emerging global village." Technically sophisticated descriptions of networking efforts in an easy-to-understand and entertaining narrative style. $26.95. Contact: PTR Prentice Hall, 113 Sylvan Avenue, Route 9W, Englewood Cliffs, NJ 07632; (201) 592-2348.

The Internet Companion: A Beginner's Guide to Global Networking, by Tracy LaQuey and Jeanne C. Ryer (ISBN 0-201-62224-6). A concise guide to Internet basics: what the Internet is; how to obtain a connection; e-mail; FTP; telnet; finding information with Archie, WAIS, and Gopher; and descriptions of other Internet tools and resources. $10.95. Contact: Addison-Wesley, One Jacob Way, Reading, Mass 01867; (617) 944-3700.

Internet: Getting Started, by SRI International (ISBN 0-944604-15-3). Covers basic information on what the Internet is, how to get a connection, and how to use the Internet. Clarifies terminology and includes listings of practical information such as service provider contacts. Includes a section on Internet organizations. $39. Contact SRI at (415) 859-6387.

Internet: Mailing Lists, by SRI International (ISBN 0-944604-16-3). How to access Internet, BITNET and USENET mailing lists, how to start mailing lists, and a compilation of lists. $39. Contact SRI at (415) 859-6387.

The Internet Message: Closing the Book With Electronic Mail, by Marshall T. Rose (ISBN 0-13-092941-7). Presents the basic technology of providing electronic mail services on the Internet, protocols, naming and addressing, message formats, mailbox services, privacy-enhanced mail, mail gatewaying, and more. $44. Contact: PTR Prentice Hall, 113 Sylvan Avenue, Route 9W, Englewood Cliffs, NJ 07632; (201) 592-2348.

Internet Resource Guide. An on-line reference describing services available on the Internet. Contact the NSF Network Service Center, c/o BBN Systems and Technologies, 10 Moulton Street, Cambridge, MA 02138; (617) 873-3400. E-mail resource-guide-request@nnsc.nsf.net.

Internet System Handbook, edited by Dan Lynch (ISBN 0-201-56741-5). Chapters contributed by 22 well-known experts. Covers Internet evolution, infrastructure, protocols, major applications, tools, security, and changing architecture. Includes annotated bibliography. $59.25. Contact Addison-Wesley, One Jacob Way, Reading, MA 01867; (617) 944-3700.

The Matrix: Computer Network and Conferencing Systems Worldwide, by John S. Quarterman (ISBN 0-13-565607-9). An in-depth treatment of internetworking on a global scale, with major coverage of the Internet. $49.95. Contact Digital Press, P.O. Box CS 2008, Nashua, NH 03061; (603) 884-6660 or (800) 234-2298.

NNSC Tour of the Internet. A HyperCard stack that explains the purpose, history, and practical tips for navigating the Internet and getting help. FTP to nnsc.nsf.net and download the file "Internet-Tour" or contact the NSF Network Service Center, c/o BBN Systems and Technologies, 10 Moulton Street, Cambridge, MA 02138; (617) 873-3400. E-mail nnsc@nnsc.nsf.net.

The Simple Book: An Introduction to Management of TCP/IP-Based Internets, by Marshall T. Rose (ISBN 0-13-812611-9). Covers the concepts and mechanisms for managing networks built with the Internet suite of protocols (TCP/IP). Describes the Simple Network Management Protocol (SNMP) and includes sections on networking history and the Internet-standard Network Management Framework. $54. PTR Prentice Hall, 113 Sylvan Avenue, Route 9W, Englewood Cliffs, NJ 07632; (201) 592-2348.

The Whole Internet User's Guide & Catalog, by Ed Krol (ISBN 1-55558-033-5). Discusses the Internet and its history; how the Internet works; and an exhaustive treatment on how to use the Internet, what's allowed on the Internet, and how to deal with network problems. Contact O'Reilly & Associates, Inc., 103 Morris St., Ste. A, Sebastopol, CA 95472; 1-800-998-9938 or (707) 829-0515.

Zen and the Art of the Internet: A Beginner's Guide, by Brendan P. Kehoe (ISBN 0-13-010778-6). An introduction for the novice Internet user. Covers basic Internet features such as electronic mail, FTP, telnet, newsgroups, various tools, and how to find out more. $22. Contact: PTR Prentice Hall, 113 Sylvan Avenue, Route 9W, Englewood Cliffs, NJ 07632; (201) 592-2348.

Edward Alexander Cameron, 1907-1992

E.A. Cameron of the University of North Carolina died in November 1992 at the age of 85. He was a major participant in the expansion of mathematics and the MAA which followed World War II.

Edward Alexander Cameron was born in Manly, North Carolina on November 10, 1907. He received all of his university degrees from the University of North Carolina at Chapel Hill (A.B. 1928, A.M. 1929, Ph.D. 1936). He became a member, as an instructor, of the faculty of the University of North Carolina in 1929, and he retired, as a professor, in 1972.

Edward Cameron directed, at the University of North Carolina, one of the first NSF institutes in mathematics in 1954. From that time on, Ed Cameron was engaged in directing NSF summer institutes and in developing and teaching honors courses in mathematics in his department. As a result, he was appointed, in 1959, chairman of the MAA's Committee on Institutes; he held this position through 1965. This committee gave advice to NSF, and it held a series of conferences which gave help to future directors and instructors of institutes.

E.A. Cameron was elected a member of the MAA Finance Committee in 1958, and he was re-elected in 1962 and in 1966. By 1967 the MAA was making plans to move its headquarters from Buffalo to Washington, D.C., and Cameron was made chairman of the Committee on the Future Administrative Structure of the Association. Cameron served only two years of his last term on the Finance Committee, because in 1968 he became Treasurer of the MAA. In this position he was in charge of moving the headquarters to Washington; he personally selected office space at 1225 Connecticut Avenue as the first Washington headquarters. The time was a difficult one: there was violent national unrest; the MAA was undergoing growth and change as it moved its headquarters; and the NSF was beginning to withdraw support for major MAA programs. As Treasurer, Cameron served ex officio on the Board of Governors (as he had for many years), and on the Executive Committee, the Finance Committee, and the Committee on Publications. He retired from the treasurership at the end of 1972, but even then his services to mathematics and the MAA did not end. He served several terms on the Investment Committee (1973-1981), on the Committee on Special Funds (1973-1981), and on the Committee on the Membership of the Association (1973-1977).

The MAA's Great Packages

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Calculus Reform

Priming the Calculus Pump
Innovations and Resources

Thomas W. Tucker, Editor

In the six years since the Tulane conference issued a call for a "lean and lively calculus," the mathematics community has responded with energy and imagination in rethinking from top to bottom what should go into a calculus course. Many mathematics departments are changing what they teach, and how they teach.

The ten featured projects in this book, together with abstracts of more than sixty other projects and a collection of reference materials and resources, are designed to give individuals and departments a concrete idea of what they can do, as well as information on how to do it, what to use, and whom to contact.

328 pp., Paperbound, 1990, ISBN 0-88385-067-2

List: $22.00

Catalog Number NTE-17

Toward a Lean and Lively Calculus
Report of the Conference/Workshop to Develop Curriculum and Teaching Methods For Calculus at the College Level

Ronald Douglas, Editor

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 answer from this four-day Sloan Foundation-sponsored conference on calculus instruction is that change is possible.

249 pp., Paperbound, 1987, ISBN 0-88385-056-7

List: $16.00

Catalog Number NTE-06

Calculus For a New Century
A Pump Not a Filter

L.A. Steen, Editor

Proceedings of the Colloquium held in October 1987 in Washington, D.C. to discuss calculus reform. These proceedings, with contributions from over eighty authors, show the full sweep of concerns and approaches of all the groups involved in calculus reform, including those currently teaching traditional and innovative courses, those whose students or employees need to use calculus as a tool, and the department chairs, deans, and others who must mobilize the resources needed for this reform.

272 pp., Paperbound, 1987, ISBN 0-88385-058-3

List: $20.00

Catalog Number NTE-08

The Laboratory Approach to Teaching Calculus
Revised Edition

Carl Leinbach, Joan R. Hundhausen, Arnold M. Ostebee, Lester J. Senechal, and Donald B. Small, Editors

Every reader will find in this volume at least one example of a setting that is adaptable to their institution. All of the ideas presented in this book have been tried, tested and evaluated, and you will learn what worked and what did not.

If you are presently using the laboratory approach to teaching calculus, have been considering using this approach, or are merely curious about how the approach can be implemented, then this volume will provide you with information that you can use in the classroom.

290 pp, Paperbound, 1991, ISBN 0-88385-074-5

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Catalog Number NTE-20R

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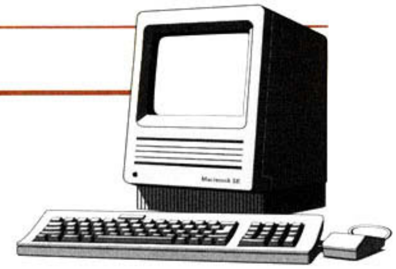
Computers



NEW

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Arthur Engel

Today's personal computer gives its owner tremendous power which can be used for experimental investigations and simulations of unprecedented scope, leading to mini-research. This book is a first step into this exciting field. This is a mathematics book, not a programming book, although it explains Pascal to beginners. It is aimed at high school students and undergraduates with a strong interest in mathematics and teachers looking for fresh ideas. It is full of diverse mathematical ideas requiring little background. It includes a large number of challenging problems, many of which illustrate how numerical computation leads to conjectures which can then be proved by mathematical reasoning. You will find 65 interesting and substantial mathematical topics in this book, and over 360 problems. Each topic is illustrated with examples and corresponding programs. The major goal of the book is to use the computer to collect data and formulate conjectures suggested by the data. It is assumed that readers have a PC at their disposal.

312 pp., Paperbound, 1993, ISBN 0-88385-636-0

List: $38.00 MAA Member: $26.50

Catalog Number NML-35

A 3.5" IBM-compatible disk containing the Pascal programs in the book is packaged with this volume.

Visualization in Teaching and Learning Mathematics

Walter Zimmermann and Steve Cunningham, Editors

The twenty papers in this book give an overview of research, analysis, practical experience, and informed opinion about the role of visualization in teaching and learning mathematics, especially at the undergraduate level. Visualization in its broadest sense is as old as mathematics, but progress in computer graphics has generated a renaissance of interest in visual representations and visual thinking in mathematics.

230 pp., Paperbound, 1991, ISBN 0-88385-071-0

List: $22.00

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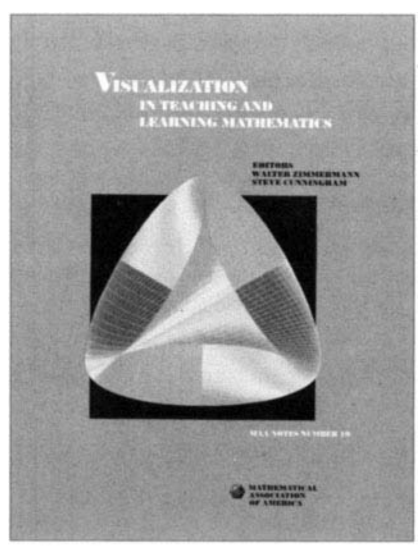

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Pólya

Mathematical Methods In Science

George Pólya
Leon Bowden, Editor

Pólya begins with Greek geometry applied to such practical problems as tunneling. He then shows us how geometry was used to estimate the Earth's diameter (Eratosthenes) and work out the distances in the Earth-Moon-Sun system (Aristarchus). Pólya continues this theme, showing how the geometry of the solar system was determined more and more accurately. This brings him to solutions by successive approximations (Newton's method, etc.). Next Pólya gives some brief chapters from the history of mechanics (work of Archimedes, Stevin, Galileo, Newton), which leads naturally to a deep discussion of differential equations and their use in science. If you have ever wondered how the laws of nature were worked out mathematically, this is the book for you. Above all, it captures some of Pólya's excitement and vision. That vision is expressed in a quote from Galileo on the cover of the book: "The great book of Nature lies ever open before our eyes and the true philosophy is written in it...But we cannot read it unless we have first learned the language and the characters in which it is written. It is written in mathematical language and the characters are triangles, circles, and other geometrical figures." From I/Saggiatore.

234 pp., Paperbound, 1977

ISBN 0-88385-626-3

List: $15.00 MAA Member: $12.00

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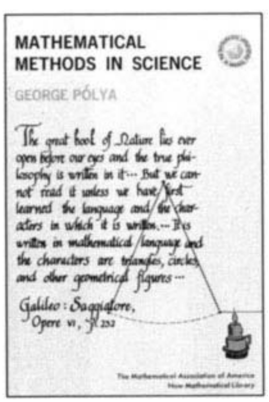

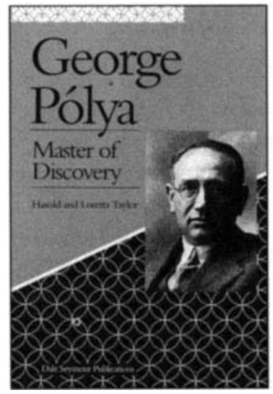

NEW George Pólya Master of Discovery

Harold and Loretta Taylor

George Pólya (1887–1985) was recognized throughout the world as a premier math educator and the founder of heuristics. His book on heuristics, *How to Solve It,* has sold over a million copies.

George Pólya, Master of Discovery chronicles the life of Pólya in a way that reveals the warmth of his personality and the genius of his teaching ability. Using many interesting anecdotes, this biography describes Pólya's family background, his youth and education, his growth as a mathematician and teacher in Europe before World War II. His life in the United States as a professor at Stanford and his continued involvement in mathematics education after his retirement are also depicted.

176 pp., Paperbound, 1993

ISBN 0-86651-611-5

List: $31.00 MAA Member: $24.00

Catalog Number POLYA

Order both books: MAA Member: $32.50 List: $41.00

CURRICULUM REFORM AND MATHEMATICS EDUCATION

A Call For Change:

Recommendations for theMathematical Preparation of Teachers of Mathematics

James R. C. Leitzel, Editor

Committee on the
Mathematical Education of Teachers

How can we improve the teaching and learning of mathematics in our schools to better prepare our students for the future? We can begin by making some changes in the way our teachers learn and teach mathematics. **A Call For Change**, an MAA Report, offers a set of recommendations that come from a vision of ideal mathematics teachers in classrooms of the 1990's and beyond. The report describes the collegiate mathematical experiences that a teacher needs in order to meet this vision. **A Call For Change** discusses standards common to the preparation of mathematics teachers at all levels: Elementary School (K–4), Middle School (5–8), and Secondary School (9–12).

64 pp., Paperbound, 1991, ISBN 0-88385-072-9

List: $7.00

Catalog Number CFC

Heeding The Call For Change

Suggestions for Curricular Action

Lynn Arthur Steen, Editor

In 1991 the MAA Board of Governors issued the publication of an MAA Report, **A Call For Change**, which heralded sweeping reform in all aspects of collegiate mathematics. **Heeding The Call For Change** shows how some of the challenges offered in **A Call For Change** can be accomplished. Each chapter in this volume highlights many options for constructive change; most also offer specific suggestions for improvement in curriculum or instructional practice. They provide not a blueprint but a general framework within which much needed improvement in undergraduate mathematics can take place. Departments that begin to explore the ideas found in the chapters of this volume will indeed be heeding the call for change.

260 pp., Paperbound, 1992, ISBN 0-88385-079-6

List: $22.00

Catalog Number NTE-22

Reshaping College Mathematics

Lynn Arthur Steen, Editor

A project of the Committee on the Undergraduate Program in Mathematics

*Thank you for sending the prepublication copy of Lynn Steen's **Reshaping College Mathematics**. It seems to offer just the kind of guidance we needed for our assessment project.*
—*David C. Smith, Central Connecticut State University*

In this volume, Lynn Steen brings together a decade of reports to the Committee on the Undergraduate Program in Mathematics. He has edited these and made them a coherent whole. The result is a basis for curricular plans that build toward the year 2001 and the new century.

135 pp., Paperbound, 1989, ISBN 0-88385-062-1

List: $16.00

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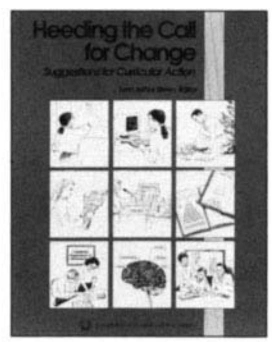

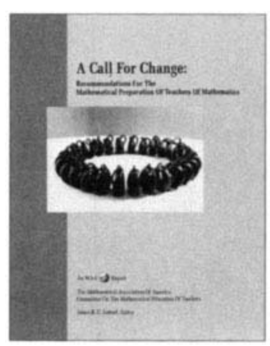

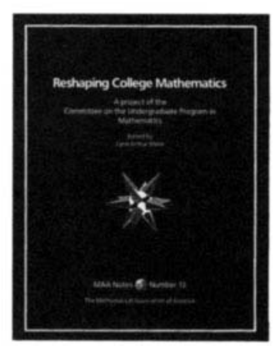

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Attention Students and Faculty!

MATH HORIZONS

MATH HORIZONS

A Call for Submissions

MATH HORIZONS, the MAA's new magazine for students (and faculty), is looking for contributions. We need your help in launching our new magazine. More than 100,000 copies of the fall and spring issues will be distributed to college and university departments free of charge for the benefit of students (and faculty) during the first year of publication. The first issue also will be sent to all MAA members as a FOCUS insert.

STUDENTS—

From you we would like:

- Cartoons
- Puzzles & Problems
- Verse
- Graphics that tell a good mathematical story or illustrate a mathematical point
- Reviews of books about mathematics books in which mathematics figures in a prominent way, e.g.,
  A Mathematicians Apology, by G.H. Hardy
  The Mind Body Problem by Rebecca Goldstein
  Mathematical Cranks by Underwood Dudley
  Problems for Mathematicians Young and Old by Paul Halmos
  The Calculus of Murder by Eric Rosenthal
- Movie reviews in which mathematics plays a role—e.g., Sneakers
- Humor in and out of the mathematics classroom

FACULTY—

From you we would like:

- Your help in getting students involved with MATH HORIZONS
- Contemporary applications of mathematics
- Famous personalities who majored in mathematics—do you know any?
- Your help in locating recent mathematics graduates to write profiles about their work experiences
- Humor in and out of the mathematics classroom

Articles should not exceed 1,500 words in length. Book reviews and movie reviews should be no longer than 600 words. The deadline for submissions for the first issue is October 1, 1993. Mail your submissions for MATH HORIZONS to Carol Baxter, Managing Editor, MATH HORIZONS, Mathematical Association of America 1529 Eighteenth Street, NW Washington, DC 20036 or you may e-mail it to: (cbaxter@maa.org). Prospective authors with questions about submissions should contact Don Albers, Editor, MATH HORIZONS, Mathematical Association of America, 1529 Eighteenth Street, NW, Washington, DC 20036 (e-mail dalbers@maa.org)

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INTERACTIVE MATHEMATICS PROGRAM

SEEKS SITE AND DIRECTORS FOR ADDITIONAL REGIONAL CENTER

The Interactive Mathematics Program (IMP) has received a five-year grant from the National Science Foundation to evaluate, refine, and disseminate its innovative, problem-based, high school mathematics curriculum. One component of this project is the establishment of regional centers to direct the implementation of the curriculum in individual high schools.

Three centers now exist. The largest is a statewide project in California, which expands on work begun in 1989. Two further centers, in Minneapolis and Philadelphia, began planning in Spring 1993, and will begin classes in Fall 1993. Current funding provides for one additional center beginning in Spring 1994. Funds will continue through the end of the grant in August 1997.

IMP invited teams of mathematics educators to apply to set up and direct this new center. Funds for the direction of the center will come primarily from the NSF grant. Substantial matching funds (ranging from 40-95% over 3+ years) are required for teacher support at the local level.

It is anticipated that the center will include a team of three half-time directors and intensive involvement of three "focus" high schools with varying student populations. Support of administrators and teachers at these schools is crucial to the success of the program. Other "satellite" schools would be brought into relationship with the center in subsequent years.

To receive a detailed RFP, call IMP Outreach Coordinator, Linda Witnov at 510-658-6400. Deadline for preliminary application: October 1, 1993.

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Procedure: Candidates should submit a resume, teaching evaluations, copies of syllabi, and course materials and three letters of recommendation to:

Dr. Charles H. Stolze, Chair
Mathematics
Manhattan College
Manhattan College Parkway
Riverdale, NY 10471

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For more information, contact: J. William Friel, Mathematics Department, University of Dayton, Dayton, OH 45469-2316, e-mail: FRIEL@UDAVXB.OCA.UDAYTON.EDU, or FRIEL@DAYTON. BITNET, or call (513) 229-2099.

Calendar

National MAA Meetings

August 15-19, 1993 Sixty-eighth Summer Meeting, Vancouver, (Board of Governors, August 14, 1993)

January 12-15, 1994 Seventy-seventh Annual Meeting, Cincinnati (Board of Governors, January 11, 1994)

January 4-7, 1995 Seventy-eight Annual Meeting, San Francisco (Board of Governors, January 3, 1995)

Sectional MAA Meetings

Eastern PA & Delaware Cedar Crest College, Allentown, November 13.

Indiana Indiana University-Kokomo, October 15-16.

New Jersey Union County College, Elizabeth, NJ, November 13.

Northeastern Westfield State College, MA, November 5-6.

Seaway Onondaga Community College, Syracuse, November 5-6.

Other Meetings

July 2-4, 1993 The Global Awareness Society International Annual Meeting, "Global Interdependence" at the Marriott Marquis in New York City. For additional information please contact Jim Pomfret, Department of Mathematics and Computer Science, Bloomsburg University, Bloomsburg, PA 17915.

July 23-24, 1993 The Fourth Annual Conference on Technology hosted by San Jacinto College Central will be held at Hotel Sofitel, Houston. For more information contact: Sharon Sledge, San Jacinto College Central, 8060 Spencer Highway, P.O. Box 2007, Pasadena, TX 77505-2007.

April 13-16, 1994 Seventy-second Annual National Council of Teachers of Mathematics Meeting, Indianapolis. For more information, contact: NCTM, 1906 Association Drive, Reston, VA 22091-1593.

October 8-9, 1993 Twenty-first Annual Mathematics and Statistics Conference, Miami University, Oxford, Ohio. Theme: The Teaching and Learning of Undergraduate Mathematics. Abstracts for contributed papers should be sent by June 21, 1993 to John Skillings, Chair, Department of Mathematics and Statistics, Miami University, Oxford, Ohio 45056. Conference programs with information concerning preregistration and housing will be available after July 15, 1993.

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