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John Stillwell, Monash University, Clayton, Victoria, Australia
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J. Amorós, I-UPEC, ETSIEB, Barcelona, Spain, M. Burger, Université de Lausanne, Switzerland, K. Corlette, University of Chicago, Chicago, IL, D. Kotschick, Université Basel, Switzerland, and D. Toledo University of Utah, Salt Lake City
For the first time ever, this book collects together all the results obtained in the last few years which aim to characterize those infinite groups which can arise as fundamental groups of compact Kähler manifolds.
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The American Mathematical Association

Why does American mathematics need a second professional organization? Most American Mathematical Society members would probably agree that they already belong to a society which "stimulate[s] interest in mathematics by providing expository books and articles on contemporary mathematics and on recent developments at the frontiers of mathematical research, and by exchanging information about important events in the mathematical world," as the Mathematical Association of America describes itself. On the other hand, MAA members could just as easily feel that they already belong to an association which "fulfills its mission with programs that promote mathematical research, increase[s] the awareness of its value to society, and foster[s] excellence in mathematics education," as the AMS describes itself. Wouldn't there be some synergies and economies of scale in a merger/acquisition creating a powerhouse 50,000-member American Mathematical Association that could speak with one voice for mathematicians employed in American higher education?

Like Time/Warner and Disney/ABC, an AMS/MAA merger would inevitably involve certain clashes of organizational culture: the AMS tradition of at-large governance is at odds with the geographically based MAA system, for example, and economies of scale also means staff downsizing. But from the membership point of view, it certainly seems worth doing.

There is a reason, of course, that no such merger has taken place, and that is found in the conflict between research and teaching. I hasten to add that there is no theoretical conflict between teaching and research and that all mathematicians are sincerely interested in mathematical discovery, mathematical understanding, sharing mathematics with colleagues and students, and nurturing student mastery of mathematics. Part of being a real mathematician is thinking mathematics is so important that you want to spend a lifetime learning it yourself, and anything you think is important you're certainly going to work hard at getting others, especially students, to understand and master also.

But not all of us get to hold these values in the same environment. To restate the obvious, most American institutions of higher education fall into two broad clusters: research institutions, which require their employees to do research and make time for it by limiting their teaching assignments, and teaching institutions, which require their employees to have a high level of student contact and make time for it by limiting or eliminating their research time. The working conditions of faculty in these two kinds of institutions are hardly the same, and the support and development aid they need from a professional organization is quite different. Generally speaking, the AMS has taken on the task of representing the faculty at the research institutions and the MAA of representing those at the teaching institutions, and, generally speaking, both have done it successfully.

Could a merged organization do as well? Probably not. Despite the theoretical continuity of research and teaching in the mathematical career, the practical needs for representation really require (occasionally conflicting) voices from both institutional communities. But there is an option. AMS members who work in the research world can join the MAA and, besides receiving the membership benefits of publications and meetings, thereby express their solidarity with mathematicians from the teaching institutions. MAA members can express their solidarity (and receive the membership benefits) similarly by joining the AMS. About 7,000 mathematicians are members of both organizations; many more of us should be.

—Andy Magid
Letters to the Editor

**Corrections on Mac Lane’s Article**

Saunders Mac Lane’s memories of mathematical life in Göttingen immediately after January 30, 1933 (Notices, vol. 42, October 1995, 1134–1138), when he was a foreign student there, are inevitably interesting, as he is one of the few surviving mathematicians from that time. However, either Professor Mac Lane, or more likely the Notices editor responsible, should have done a better job of editing these reminiscences. To wit:

"Richard Pohl" should be Robert Pohl.

"Hans Freudental" should be Hans Freudenthal.

"Edward Tornier" should be Erhard Tornier.

"Karl Ludwig Siegel" should be Carl Ludwig Siegel.

Under the picture (p. 1137) “Schwertfager” should be Schwerdtfeger (his first name was Hans).

"Erna Barrow" should presumably be Erna Bannow, who, incidentally, later followed Witt to Hamburg, became his first doctoral student (degree awarded in 1939), and married him in 1940.

In this context it is not worth mentioning the missing accents on Brüning and Pólya or the curious spelling “Bertold” for Bertolt (Brecht).

Mac Lane also gets some historical things wrong.

(i) Moritz Geiger did not serve in the First World War—he was dismissed on September 26, 1933 (one month after Mac Lane’s departure).

(ii) Mac Lane must have misunderstood Martin Kneser about his father-in-law. It was a great-great-grandmother of Hasse who was Jewish (her name was Itzig). I was shown this documentation by Martin Kneser in 1988. The “non-Aryan rules” for being a member of the NSDAP were far stricter than for anything else and required no non-Aryan ancestor alive in 1800. Hasse’s great-great-grandmother in question was born in 1775. The story of Hasse’s application for Nazi Party membership is very complicated. Suffice it to say here that he had a brother, Albrecht Hasse, living in Berlin who had been allowed to join the Party, and so Helmut Hasse had reason to believe he might be able to do so as well.

(iii) Max Dehn was never in Berlin as a professor, but was “habilitated” in Münster, and then was successively in Kiel, Breslau, and Frankfurt (where he succeeded Bieberbach in 1921). He fled in 1939, first to Denmark, and in a very arduous way finally came to the United States.

(iv) Richard Brauer was not in Berlin; his elder brother, Alfred (a well-known number theorist, though not as famous as his younger brother), was. When Richard emigrated in October 1933, he was a professor at Königsberg. Mac Lane may have been confused by the fact that both Alfred and Richard did doctoral dissertations in Berlin.

(v) I believe Hans Freudenthal left Berlin in 1931. He certainly did only narrowly escape the Nazis, but that was in Holland.

(vi) Hanna Neumann was not Jewish (her maiden name was vonCaemmerer). In January 1933 she met Bernhard Neumann, who was Jewish and who emigrated in August of that year to England. She became secretly engaged to him in 1934; she passed the Staatsexamen while still at Berlin and in 1937 actually started work on a
Letters to the Editor

doctorate at Göttingen, to be supervised by Hasse. She did not leave Germany until July 1938 and married Bernhard secretly later that year. For more detail, her obituary in volume 17 of the Journal of the Australian Mathematical Society should be consulted.

(vii) Concerning the story about Pólya, since various versions of it circulate (e.g., see also p. 26 of the recent book George Pólya, Master of Discovery, by Harold and Loretta Taylor), the truth is perhaps worth presenting. On January 18, 1921, Pólya wrote Bieberbach (then in Frankfurt) a lengthy letter from Zürich (a copy is in my possession) in which the incident alluded to by both Mac Lane and the Taylors (following a taped interview with Pólya’s nephew) is described. Incidentally, the context of this letter is that Pólya might be considered (the chance, in fact, was very remote) as Bieberbach’s successor when he went to Berlin. Presumably Pólya in 1921 is rather more accurate about something that happened in 1913 than other people’s secondhand memories many years later. So far as I know this is the first time this story has become public.

Christmas 1913, Pólya was travelling from Zürich to Frankfurt and had an exchange of words with the young man sitting opposite him in the train compartment over Pólya’s trunk, which had fallen down. Pólya, who was in an “overly irritated state”, challenged the fellow to a duel. He refused, whereupon Pólya punched him. It turned out that this unwilling opponent was the son of an important man and a student in Göttingen. Pólya had to leave Göttingen as a consequence. Pólya says, “privately the story is also not worth a defense.” Thus, there were no anti-Semitic remarks as in the Taylors’ version, and Pólya was the one who demanded a duel rather than the other way around. Pólya blames himself completely for the incident. Incidentally, Pólya does mention anti-Semitism elsewhere in the letter, so there is every reason to believe this version. Of course, neither Mac Lane nor Martin Knese could have known about this.

In this connection, one must also mention Mac Lane’s letter in the same issue of the Notices, when he hints that his “good friend” Gerhard Gentzen “disappeared” when the Russians arrived in Prague. In fact Gentzen refused to voluntarily give up his university position early in April 1945; arrested in May, he was placed in a detention camp, where apparently he was murdered by Czech (not Russian) soldiers.

Sanford L. Segal
University of Rochester

(Received December 13, 1995)

P.S. In Mac Lane’s recent piece in the Mathematical Intelligencer (vol. 16, no. 3 (1994), 9–10) an error relevant to this letter also occurs. The “mathematical anti-Semite” who said “Princeton ist ein kleines Negerdorf” was not in Berlin and was not insignificant. He was the great geometry Wilhelm Blaschke, who was in Hamburg.

Innovations in Mathematics Education

The AMS has been presented with an opportunity for positive action and change by Steven Krantz. He has presented readers of AMS publications with a collection of singularly unprofessional diatribes opposing change in the way we teach mathematics and attacking those who promote change. The most recent, in “Math for Sale”, the editorial in the October 1995 issue of the Notices, carries the authority of the Society, since it was written by an editor and published by the Society.

Do you know that the Society has a Committee on Education? Do you know what it is doing? You can find out by going to the AMS home page on the World Wide Web. Do you know that the Society has a listserv for discussion of calculus reform issues? Will you find reference to it on the AMS home page? Not as this is being written. Is the Society serious about addressing problems in the teaching of mathematics?

I believe that the Society and its membership have a vital interest in questions about teaching mathematics. The questions are difficult, and points of view vary, but there is strong evidence to suggest that general improvement is possible.

I propose that the AMS take a stronger, more visible role in the discussion of the problems of teaching mathematics. I suggest the following action:

1. The Notices editorial board should invite a series of feature articles highlighting the kinds of change which are being implemented. There are many serious mathematicians who have taken a deep interest in this activity in recent years. Why have they done that? Why do they continue to do it? Is it, as Professor Krantz suggests, because that’s where the big bucks are? I don’t think so. Let’s find out.

2. The Society should schedule mediated discussions at AMS meetings on the issues of change. The participants should represent various positions on the questions of change, and these should not simply be panel discussions. They should also not degenerate into debates, since debate implies confrontation, and in debate, victory tends to go to the glib participant. The goal should be information for the membership. I suggest discussion mediated by persons who are trained for that activity.

3. The Committee on Education should better highlight the Society’s activities related to education at its Web site, and the Committee on Education should attempt liaison with other organizations interested in the same problems.

Seven years ago Jerry Uhl and Horacio Porta decided to try using new tools and ideas in teaching calculus to undergraduates. The CalculusMathematica project was born. I came along shortly after they started. We tried these things and were very excited by what we saw: first-year undergrads (and not just honors students) talking about mathematics in ways we hadn’t seen before, students taking charge of their own explorations into mathematics, and students who could and did explain in their own terms what the calculus does and is. We were hooked. We have continued to invent and pursue change, and we are still excited by what we see happening.

Changing the way we teach mathematics is a serious enterprise and should not be demeaned by an opinionated, uninformed member of the Notices editorial board. Much of what
is going on is being done by mathematicians with long and respected service to the profession and to the society. Those people deserve the support and respect of the organization, not what Steve Krantz would give them.

William J. Davis
The Ohio State University
(Received January 1996)

Comments on Lorch’s Letter

Obituaries published in JDMV have recently become a topic in letters published in the Notices of the AMS and the Mathematical Intelligencer [1], [2], [3]. We do not want to contribute to this discussion, which appears overly emotional and, by the quality of the arguments used, not suited for publications addressing a scientific community. Since our obituary [4] for Vojislav G. Avakumović has been dealt with at length, we feel obliged, however, to explain at least a few relevant facts.

1. Lorch [3] criticizes the fact that we do not supply information on the life circumstances of Avakumović during the German occupation of Yugoslavia. The reason for this is very simple: we do not know anything substantial about this period of his life nor does any friend or family member we were able to ask; all of them, including his wife, met Avakumović only after the war. He himself talked about his life at various occasions, but he did not mention this particular period either. Thus, all we can say is that Avakumović moved from the family estate in Semlin to Belgrad, where he lived in [the] house [owned by his brother], who was then ambassador of Yugoslavia to the United States. We can infer, though, that he was suffering like everybody else under the German occupation—a well-known fact of history which we have no intention to defend.

2. Lorch finds “quite a few personal and political remarks” in our text. Those which could be called “political” in the widest sense of the word are exactly two. The first one mentioning Tito is quoted by Lorch as follows: “Das Kriegsende brachte mit der kommunistischen Machtergreifung unter Tito in Jugoslawien auch für die Familie Avakumović tiefgehende Einschnitte” [4, p. 145]. Lorch does not quote, however, the explanation that follows: “Der Vater starb, die Familie verlor durch Enteignung den größten Teil des Besitzes, der Bruder emigrierte nach London.” We maintain that expatriation of the family, emigration of the brother, and denial of the right to emigrate to Avakumović’s wife and children could be rightly termed “deep incisions in the life of the family”, but it escapes us how this could be read as “derision of the post-war Tito regime in Yugoslavia.”

The second remark mentions “die weltoffene Liberalität, die er (Avakumović) seiner noch von der Donaurnachrie geprägten Erziehung verdankte.” We have experienced Avakumović’s “weltoffene Liberalität” many times in personal encounters, and this personal trait could easily and convincingly be related to his education, which happened to take place in the days of the Habsburg monarchy—that is what we are saying, and we do not see what is wrong here.

3. Lorch’s criticism culminates in the passionate question, “What impression of history are the authors attempting to convey?” This reveals a basic misconception of what an obituary should be about: we see it as information for the mathematical community, concentrating on mathematical achievement and leaving a little room for homage paid by the authors, usually friends or students. Correctness of the facts communicated is a necessity; a critical evaluation of life and achievement in the context of the scientific and political background of the century certainly is not—it is beyond what a mathematician can usually do and must be left to the professional historian. In this respect we fully subscribe to the sober statements in [5].

Concerning Avakumović’s mathematical achievements we feel it necessary to emphasize again that we hold them in high esteem. Of his 31 papers, published between 1935 and 1956, at least two (reference numbers 11 and 30 in [4]) have been truly influential and have earned a distinguished place in the history of their subject.

4. With no visible relation to their respective arguments, both Booss and Lorch feel obliged to remark that J. Brüning had some presumably important task in the restructuring of science in [the] former GDR after 1990, entrusted to him by the German federal government. Booss describes this task as “the liquidation of the academy of sciences of the former GDR.” Lorch refers to Booss (in a postscriptum) but does not hesitate to magnify the “official responsibilities” into a full-fledged “restructuring of the former German Democratic Republic.” Well, the fact is that the academy was indeed dissolved but, in its substance, by no means liquidated (a strong and lively Karl-Weierstrass-Institut, as its mathematical part, exists to this very day), and it is also a fact that Brüning had no part in these decisions. He was serving, though, on a committee appointed by the state of Berlin to rebuild the mathematics department of Humboldt-Universität. Every colleague can easily inform himself about the outcome.

One wonders about the motives of scientists who find it necessary to abuse the facts—readily available as they are—in such an irresponsible way.

References


J. Brüning
Berlin
W. Eberhard
Duisburg

(Received January 5, 1996)
Letters to the Editor

From Barbados on Ethnicity

I wish to applaud Raymond Johnson for his informative and thought-provoking article "Conference for African American Researchers in the Mathematical Sciences at MSRI" (AMS Notices, December 1995). The socio-mathematical agenda of the conference and the personal commitment on the part of the participants are a source of encouragement and inspiration. There are interesting similarities and differences in a number of university/mathematical issues here in Barbados and some of those highlighted in the article. At the outset, I hope my letter makes a small contribution to sustaining the positive momentum generated at the conference.

Upon hearing the country name "Barbados", one probably imagines a tropical, sun-drenched island paradise. While this picture is quite accurate, there are a few facts about the country which are of particular significance. Upwards of 90 percent of the total population here is of African descent, and essentially all of my students share this identical lineage. It is not at all uncommon to hear the label "Afro-Caribbean" when they are referring to themselves. As in North America, there exists a pervasive quest, particularly in young people, to seek identity, community, and affirmation in a rapidly changing society. Of course, such a desire is by no means unique to mathematics students. The "community concept" (p. 1496) is positive, defining, and a prominent feature of both the very small mathematics group at this campus and the almost infinitely larger group of African American students and researchers in North America. I find it encouraging that my observations in Barbados on this issue were distantly confirmed by participants at the conference.

Johnson writes about the mentorship concept (p. 1498). As a white Canadian male mathematician, the information I read on this topic has made me wonder to what extent and on what personal level my students can identify me as a mentor. Our campus is small, and as a country Barbados is miniscule. It is not difficult to imagine that the mentorship program here could well make a fine contribution to a student's mathematics education. For a variety of reasons though, very few mentees seek out a mentor who works in the natural sciences, and fewer yet in mathematics. A participant at the conference at MSRI, when commenting on one of its successes, revealed that, "...meeting people who could help me attain my goals of becoming a Ph.D. in mathematics. Gaining inspiration from those who have succeeded" (p. 1497). I ask again whether mathematics students here experience an "osmosis effect" with regard to motivating their potential in mathematics by way of any of their interactions with me? If they don't, are any of the reasons for this due to my ethnicity?

There are a number of indicators suggesting that Barbados will mature sufficiently over the next few years and hence attain formal developed-nation status within a decade or so. Implicit in this assertion is the necessary consumption of computer technology and ultimately a greater dependence on the expertise of its people in basic sciences and mathematics. In this sense and numerous others, the reality here and that in North America are vastly different. However, the issue of the environment in which one learns mathematics is universal. In Johnson's paraphrasing of some questions due to Lenore Blum, he recounts a particular aim of the conference (p. 1496). I also paraphrase by suggesting, as they do, that we "...create an environment where [West Indians] have a chance to do and learn mathematics in a way that most successful [white] male mathematicians take for granted" (p. 1496).

Each year a few of our final-year students make plans to pursue graduate studies in mathematics and computer science at a North American university. I was surprised, and felt somewhat naïve, when several of these students revealed that an important factor that would influence their choice of school is its reputation as a "black university". The importance of an ethnically similar and accepting [university] community is emphasized in several places in Johnson's article and in mine. The comments on this issue from the conference, as well as from my own students, will definitely enhance my understanding of and sensitivity to just how important the notion of community really is.

Raymond Grinnell
University of the West Indies
(Received January 17, 1996)

Teaching from a Twentieth-Century Perspective

Recent letters and articles in the Notices seem to imply that calculus reform is the work of mathematical charlatans after soft money and superficial results. In your January 1996 issue, we were told by Greenman that "Mathematics is losing its soul. Its priests are pawning it off to a different god." In an editorial in an earlier issue of the Notices, Krantz declared that "It is time for pure mathematicians to close ranks and stand up for the integrity of our discipline." Indeed, as evidenced by the renewed popularity of traditional textbooks, the ranks may be closing already—reform might soon become a thing of the past.

If so, then McCallum's letter in your January 1996 issue may be prophetic where it states that "the academic mathematical community is in danger of having many of its responsibilities taken away from it, particularly its teaching responsibilities." Our students understand less and less of our traditional curriculum, and our graduates are less and less able to find meaningful work. More and more, the mathematical ideas used by scientists, businessmen, and engineers are being taught by scientists, businessmen, and engineers. If our response is to bury our heads in the sand, then it is only a matter of time before society buries the rest of us as well.

The problem is that mathematics has refused to change for so long that it now must regard progress as a crisis rather than as an opportunity. In a world that has been revolutionized by twentieth-century mathematics and science, mathematicians are committed to ignoring the mathematics and science of the twentieth century. Economics has benefitted
greatly from game theory, but have our undergraduates? An undergraduate chemistry curriculum would be laughable if it did not include spectroscopic methods, but even the simplest concepts of spectral theory are withheld from our students. In fact, our students graduate having never encountered the classification of the simple groups, having never numerically verified an analytical result, and having never encountered fixed point theorems, spinors, the simplex method, the traveling salesman problem, graph colorings, Hilbert's tenth problem, the Riemann zeta function, knots, etcetera, etcetera.

"Students must learn the old stuff first," we say. "Such ideas are too advanced for them." Thus we continue to produce nineteenth-century mathematicians who are completely unprepared for the twentieth century. And thus we ourselves continue to be little more than nineteenth-century mathematicians with a twentieth-century specialty. In contrast, John Winthrop of Harvard began teaching the works of Newton less than fifty years after the publication of the Principia. Our second president, John Adams, testified that "Mathematics and natural Philosopy attracted the most of my Attenion" while in college, and many of our other founding fathers have made similar statements.

Like Winthrop, we must also find ways to teach mathematics from a modern perspective, and that means we must regard teaching as more than the ability to plod through a book section by section. It means more than adding a course or two or modifying a syllabus here or there. As some of us have discovered, mixing the new and the old leads only to compromise, superficiality, and a great deal of frustration.

Instead, we must learn to teach all of our courses from a twentieth-century perspective. Measure theory is the proper setting for defining integrals, so we should drop Riemann's definition altogether. He certainly will not mind if it means including more of his geometry or number theory. My own experience has been that both my popularity and effectiveness as a teacher have increased in direct proportion to my efforts to reach a modern perspective. Even freshmen seem to prefer Lesbeuge's definition, even though it really "blows them away". They like iteration and fixed point theorems. They can handle suprema and infima, and they prefer them to epsilon and deltas. They even get excited about integration by parts when it is used to derive a simple version of Heisenberg's uncertainty principle. And my students have been successful in obtaining positions in both industry and academia, primarily because they were willing to work very hard on very hard ideas when those ideas seemed modern and relevant to the world around them.

As I mentioned earlier, I sense a strong urge in the mathematical community to return to the status quo. We seem to be asking ourselves, "If we just do things the way we have always done them—with a few new wrinkles, of course—then are we really failing our students?" In a society that cannot engage in a meaningful discussion of its economic health, in a time when most of our students will never encounter the letters FFT, in an age when the technology we rely on is based on mathematics our graduate students will never see, and in an international climate where mathematicians and scientists rarely contribute to international opinion, I believe the answer is an undeniable "Yes, we are failing our students."

In fact, I cannot help but think of the Librarians of Alexandria, who, according to H. G. Wells, were within two hundred years of the Library's inception "...shy, eccentric, unpractical, incapable of essentials, strangely fierce upon trivialities of literary detail, ... For him no method of copying was sufficiently tedious and no rare book sufficiently inaccessible....For many precious generations the new-lit fires of the human intelligence were to be seriously banked down by this by-product." If we are indeed becoming the new Librarians of Alexandria, creating a vast wealth of knowledge that to the society we live in is increasingly strange and meaningless, then history tells us it will be our ruin.

**Erratum**

The March 1996 issue of the Notices carried an article entitled "Downsizing at Rochester: Mathematics Ph.D. Program Cut". On page 303, the article states that, as part of the formulation of the Rochester Renaissance Plan, administrators interviewed three faculty from each department at Rochester. The article erred in saying that only two faculty from the Mathematics Department were interviewed; three mathematics faculty members were in fact interviewed. After the three interviews took place, the chair of the Mathematics Department asked the administration to interview a fourth member of the department, and although the administration agreed to do so, this fourth interview never took place.

**Jeff Knisley**

East Tennessee State University

(Received January 10, 1996)
Group representations and harmonic analysis play a critical role in subjects as diverse as number theory, probability, and mathematical physics. A representation-theoretic theorem of Langlands is a vital ingredient in the work of Wiles on Fermat’s Last Theorem, and representation theory provided the framework for the prediction that quarks exist. What are group representations, why are they so pervasive in mathematics, and where is their theory headed?

**Euler and His Product Expansions**

Like much of modern mathematics, the field of group representations and harmonic analysis has some of its roots in the work of Euler. In 1737 Euler made what Weil [4] calls a "momentous discovery", namely, to start with the function that we now know as the Riemann ζ function $\zeta(s) = \sum_{n=1}^{\infty} \frac{1}{n^s}$ and to realize that the sum could be written as a product

$$\zeta(s) = \prod_{p \text{ prime}} \frac{1}{1 - p^{-s}}$$

for $s > 1$. In fact, if each factor $(1 - p^{-s})^{-1}$ on the right side of (1) is expanded in geometric series as $1 + p^{-s} + p^{-2s} + \cdots$, then the product of the factors for $p \leq N$ is the sum of those terms $1/n^s$ for which $n$ is divisible only by primes $\leq N$; hence a passage to the limit yields (1).

Euler well knew that the sum for $\zeta(s)$ exceeds the integral

$$\int_{1}^{\infty} \frac{dx}{x^s} = \frac{1}{s - 1}.$$

This expression is unbounded as $s$ decreases to 1, but the product (1) cannot be unbounded unless there are infinitely many factors. Hence (1) yielded for Euler a new proof of Euclid’s theorem that there are infinitely many primes. In fact, (1) implies, as Euler observed, the better theorem that $\sum 1/p$ diverges.

Euler later went on from this proof to deduce that there are infinitely many primes $4n + 1$ and infinitely many primes $4n + 3$, and that is where the story of harmonic analysis really begins. To understand why the above analysis does not handle these cases, it is helpful to see in more detail how $\sum 1/p$ enters the above kind of argument. Consideration of series expansions of the exponentiated functions shows that

$$\log(1 + x) < x < \log \frac{1}{1 - x}$$

for $0 < x < 1$, and it is easy to see that the right side is no more than twice the left side if $0 < x \leq \frac{1}{2}$. Consequently it follows from (1) that...
(2) \[ \log \zeta(s) = \sum_{p \text{ prime}} \frac{1}{p^s} + \text{bounded term} \]
as \(s\) decreases to 1. Meanwhile, multiplication
of the series for \(\zeta(s)\) by \(2^{-s}\) reproduces the
even-numbered terms of the series, and therefore
(3a) \[ (1 - \frac{1}{2^s}) \zeta(s) = 1 + \frac{1}{3^s} + \frac{1}{5^s} + \cdots \]
and
(3b) \[ \frac{1}{2^s} \zeta(s) = 1 + \frac{1}{3^s} + \frac{1}{5^s} + \frac{1}{7^s} + \cdots \]
The left side of (3b) is \((s - 1)\zeta(s)\) times some­
thing that tends to \(\log 2\) as \(s\) tends to 1. Euler
knew Leibniz's test for convergence and could
see in (3b) that the series on the right is con­
vergent for \(s > 0\) with a positive sum. It follows
that \(\zeta(s)\) near \(s = 1\) is the product of \((s - 1)^{-1}\)
and a function with a finite nonzero limit. Com­
bining this result with (2) gives
(4) \[ \sum_{p \text{ prime}} \frac{1}{p^s} = \log \frac{1}{s - 1} + \text{bounded term} \]
as \(s\) decreases to 1.

In handling primes congruent to 1 or 3 mod­
ulo 4, it is tempting to replace the sum over all
primes of \(1/p^s\) in the above argument by
(5) \[ \sum_{p \equiv 1 \text{ mod 4}} \frac{1}{p^s} \quad \text{or} \quad \sum_{p \equiv 3 \text{ mod 4}} \frac{1}{p^s}, \]
trace backwards, and see what happens. What
happens is that the expansion of the corre­
sponding product of \((1 - p^{-s})^{-1}\) as a sum does
not yield anything very manageable. Euler's key
new idea was to work with the sum and differ­
ence of the two terms in (5), rather than the two
terms separately, and then to recover the two
terms (5) at the end. This is full-fledged har­
monic analysis on a 2-element group.

The essence of harmonic analysis is to de­
compose complicated expressions into pieces
that reflect the structure of a group action when
there is one; the goal is to make some difficult
analysis manageable. Tracing backwards with the
earlier argument as a model, Euler found two
manageable series with product expansions. The first was
(6) \[ \sum_{n=1}^{\infty} \frac{\chi^+(n)}{n^s} = \prod_{p \text{ prime}} \frac{1}{1 - \chi^+(p)p^{-s}}, \]
where \(\chi^+(n)\) is 0 for \(n\) even and 1 for \(n\) odd. The
second series was
\[ L(s) = 1 - \frac{1}{3^s} + \frac{1}{5^s} - \frac{1}{7^s} + \cdots = \sum_{n=1}^{\infty} \frac{\chi^-(n)}{n^s} \]
where \(\chi^-(n)\) is 0 for \(n\) even, 1 for \(n \equiv 1 \text{ mod 4}\),
and \(-1\) for \(n \equiv 3 \text{ mod 4}\). The log of \(\frac{1}{1 - \chi^-(p)p^{-s}}\) is
approximately \(\chi(p)p^{-s}\) even if \(\chi(p)\) is negative.
Arguing by taking the log of the product for­
mulas in (6) (or simply copying the result from (4))
gives
(8) \[ \log \frac{1}{s - 1} + \text{bounded term} \]
as \(s\) decreases to 1. Comparing (8) and (9) shows
that each of the series in (5) is unbounded as \(s\)
decreases to 1. Hence there are infinitely many
primes congruent to 1 modulo 4 and also infi­
nitely many primes congruent to 3.

**Role of a Group in Euler's Products**

Where is the group and what is its role? The
property of the two functions \(\chi^+\) and \(\chi^-\), call
either of them \(\chi\), that allows the sums in (6) and
(7) to be rewritten as products is that
\(\chi(mn) = \chi(m)\chi(n)\) for all positive integers \(m\) and
\(n\). Nowadays such functions are called Dirichlet
characters modulo 4. We can think of \(\chi^+\) and \(\chi^-\)
as lifts to the integers of functions on the mul­
plicative group \(\{1, 3\}\) of integers modulo 4 and
prime to 4, with 0 used as the value on integers
that are not prime to 4. The two functions on the
group \(\{1, 3\}\) are
\[ \omega^+(1) = \omega^+(3) = +1 \quad \text{and} \quad \omega^-(1) = +1, \omega^-(3) = -1. \]

These functions \(\omega\) on this 2-element group are
multiplicative characters, i.e., homomorphisms
to the multiplicative group of nonzero complex
numbers, and they are the only multiplicative
characters for this group. They form a basis for
the complex vector space of all complex-valued
functions on the 2-element group. Essentially
Euler had two functions to study, the char­
acteristic function of each 1-element set for
this group:
Leonhard Euler

\[ I_1(1) = 1, \quad I_1(3) = 0 \quad \text{and} \quad I_3(1) = 0, \quad I_3(3) = 1. \]

The series under study in (5) may be written as

\[ \sum_{p \text{ prime}} \frac{I_1(p)}{p^s} \quad \text{and} \quad \sum_{p \text{ prime}} \frac{I_3(p)}{p^s}. \]

Euler's proof worked because he expanded the functions \( I_1 \) and \( I_3 \) in terms of the basis of multiplicative characters

\[ I_1 = \frac{1}{2}(\omega^+ + \omega^-) \quad \text{and} \quad I_3 = \frac{1}{2}(\omega^+ - \omega^-), \]

succeeded at some computations for the individual terms

\[ \sum_{p \text{ prime}} \frac{\omega^+(p)}{p^s} \quad \text{and} \quad \sum_{p \text{ prime}} \frac{\omega^-(p)}{p^s} \]

of the expansion, and reassembled his functions by means of

\[ \omega^+ = I_1 + I_3 \quad \text{and} \quad \omega^- = I_1 - I_3. \]

This is the process of harmonic analysis.

Although the harmonic analysis in this work may be regarded as trivial linear algebra, the point is that the particular linear algebra is a vehicle for taking advantage of a group structure. This example is in a way too simple for understanding the basic principle. In fact, it was more than one hundred years before Dirichlet saw through it and proved his own theorem about primes in arithmetic progressions.

The above work of Euler is of more than historical interest. It is the direct ancestor of a large amount of current research in algebraic number theory, including the representation-theoretic input from the Langlands program into Fermat's Last Theorem. In addition, it illustrates the principle that although harmonic analysis may be at the core of the solution of a problem, several layers of ingenious ideas may lie between the statement of the problem and the use of harmonic analysis.

Multiplicative characters played a rather incidental role in mathematics from 1737 until about 1807. Cramer introduced determinants in 1750, defining the sign of a permutation and proving what we now call Cramer's Rule. The sign of a permutation is a multiplicative character on the permutation group on \( n \) letters, and determinant is a multiplicative character on nonsingular matrices of a fixed size. But the harmonic analysis aspect of these characters played no role in Cramer's work. Gauss, in expanding on Euler's work representing integers by binary quadratic forms, introduced his own notion of character, which corresponds roughly to what we now call a Dirichlet character. But again harmonic analysis was not involved.

**Fourier Series**

The next big development in the subject of group representations was the subject of Fourier series. The account here is taken from Grattan-Guinness [1]. In 1747 d'Alembert presented his work on the vibrating string problem: He found the differential equation

\[ \frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}. \]

specified initial conditions, and obtained the solution \( y = \frac{1}{2} f(x + ct) + f(x - ct) \). Although Euler in 1748 considered trigonometric functions as examples of solutions of the equation, no one expected that such functions would offer any generality until d'Alembert in 1750 introduced the method of separation of variables into the solution of partial differential equations. Daniel Bernoulli argued philosophically that a trigonometric sine series should be general enough to express all solutions, but Euler rejected that argument on other philosophical grounds. Research into trigonometric series made little progress for the remainder of the eighteenth century. In 1777 Euler did discover the familiar motivating argument for the formula for Fourier coefficients, consisting of multiplying a trigonometric expansion through by a sine or cosine and integrating term by term, but this
work was not published until 1798. And in 1799 Parseval published a formula for the sum of the squares of the coefficients of a trigonometric series in terms of integrals; his formula is reasonably close to what is now called Parseval's formula.

Then came Fourier, who was interested in the diffusion of heat. Fourier derived the heat equation, made a systematic study of cases that could be investigated with separation of variables, offered his own insights into the vibrating-string problem, introduced what we now know as Fourier series, and addressed the representability of certain discontinuous functions by such series, all in a single paper submitted in 1807. The paper ran into objections, particularly from Lagrange and Poisson, and was blocked from publication. At base the objections were that Fourier's results were inconsistent with the prevailing intuition about functions. Functions were supposed to be of an algebraic character. If a trigonometric series
\[
\frac{1}{2} \sin x - \frac{1}{2} \sin 2x + \frac{1}{3} \sin 3x - \cdots
\]
were to sum to a function like \( \frac{1}{2} x \) on an interval \((-\pi, \pi)\), the algebraic character of the limit should force the limit to be \( \frac{1}{2} x \) everywhere, and then the limit would not be periodic, contradiction. Fourier submitted a revision, including the 1807 material and also the inversion formula for the Fourier transform, in 1811 and won a prize. But publication of the revision too was blocked. Fourier's work finally appeared in 1822 in his celebrated book *Théorie analytique de la chaleur*.

The solution to the vibrating-string problem involves Fourier sine series. No group of symmetries is involved, and this work does not foreshadow harmonic analysis with group representations. Instead, this example is motivation for Sturm-Liouville theory, which began in 1836. Similarly Fourier's work with the heat equation does not automatically carry a group along with it. A group occurs only in examples having some symmetry, one such example being the case of an annulus, which has circular symmetry. In the case of the annulus, Fourier was led to series involving both cosines and sines, which nowadays are customarily written with complex exponentials:

\[
f(x) \sim \sum_{n=-\infty}^{\infty} c_n e^{inx},
\]

where

\[
c_n = \frac{1}{2\pi} \int_{-\pi}^{\pi} f(x) e^{-inx} \, dx.
\]

The group lying behind these formulas is the circle group \( \mathbb{R}/2\pi\mathbb{Z} \). The functions \( e^{inx} \) are exactly the (continuous) multiplicative characters for this group, and (10) suggests that \( f(x) \) is to be expanded in terms of these functions. Fourier was troubled by the issue we nowadays refer to as \( L^2 \) completeness of the orthogonal set \( \{e^{inx}\} \), and for this reason he preferred a more complicated method than (11) for obtaining the coefficients \( c_n \). Fourier obtained the Parseval formula,

\[
\frac{1}{2\pi} \int_{-\pi}^{\pi} |f(x)|^2 \, dx = \sum_{n=-\infty}^{\infty} |c_n|^2,
\]

by a manipulation of series, evidently without connecting the validity of his argument with the same completeness question.

**Wiener's View of Harmonic Analysis**

The expansion (10) enters after the variables have been separated in the partial differential equation. A linear ordinary differential operator \( D \) is to be applied to \( f(x) \), with the result 0. This operator commutes with translations \( \tau_x(y) = x + y \) by the circle group. If \( \omega \) is a multiplicative character, then \( (\tau_x \omega)(y) = \omega(x + y) = \omega(x) \omega(y) \), and we compute that

\[
D\omega(x + y) = (\tau_x D\omega)(y) = (D\tau_x \omega)(y) = (D\omega(x) \omega)(y) = (D\omega)(y) \omega(x).
\]
Putting $y = 0$ shows that $D \omega$ is a multiple of $\omega$. In other words, the differential operator $D$ sends each multiplicative character into a multiple of itself, and the effect on $f(x)$ is that its Fourier coefficients are multiplied by various constants. The result is to be $0$ term-by-term, and we obtain necessary and sufficient conditions on $f(x)$.

The work of Fourier provides a second illustration of the principle that although harmonic analysis may be at the core of the solution of a problem, several layers of ingenious ideas may lie between the statement of the problem and the use of harmonic analysis.

To Wiener [5] in the twentieth century, the above method for treating constant-coefficient differential operators is the stuff of harmonic analysis. We have a linear operator $T$ carrying periodic functions to periodic functions and commuting with translations. The operator $T$ must carry $e^{inx}$ to a multiple $b_{n}e^{inx}$, and linearity yields the formula

$$T \left( \sum c_{n}e^{inx} \right) = \sum b_{n}c_{n}e^{inx}$$

(13)

on trigonometric polynomials. Under a suitable condition of boundedness or closed graph for $T$, (13) extends to all functions in the domain of $T$. Thus Fourier series provide a tool for understanding linear operators that commute with translations, i.e., that respect the group of translations as symmetries.

### Further Use of Multiplicative Characters

The remainder of the nineteenth century saw a few other developments with harmonic analysis related to multiplicative characters. Cauchy, in the course of his investigations of water waves, began to work with integral solutions of partial differential equations and published in 1817 the reciprocal formulas

$$f(x) = \sqrt{\frac{2}{\pi}} \int_{0}^{\infty} g(q) \cos qx \, dq$$

and

$$g(q) = \sqrt{\frac{2}{\pi}} \int_{0}^{\infty} f(x) \cos qx \, dx.$$  

It is not known whether Cauchy saw Fourier's 1811 manuscript containing a version of the Fourier inversion formula for the Fourier transform. In today's notation the Fourier transform and inversion formula are often written

$$\hat{f}(y) = \int_{-\infty}^{\infty} f(x)e^{-2\pi ixy} \, dx$$

and

$$f(x) = \int_{-\infty}^{\infty} \hat{f}(y)e^{2\pi ixy} \, dy.$$  

Further work with the Fourier transform in the nineteenth century included the Poisson Summation Formula, which on a formal level relates the two functions of (14) by

$$\sum_{n=-\infty}^{\infty} \hat{f}(n) = \sum_{n=-\infty}^{\infty} f(n),$$

and the development of the Mellin transform, which is a version of the Fourier transform or Fourier-Laplace transform written with the multiplicative positive reals in place of the additive reals. In an important application Riemann used the Poisson Summation Formula in one of his proofs of the functional equation for the $\zeta$ function. (The functional equation itself is due to Euler.) But more serious theoretical work with the Fourier transform itself had to wait for Lebesgue integration, which is a twentieth-century invention.

In 1840 Dirichlet published his theorem that an arithmetic progression $an + b$ with $a$ and $b$ relatively prime contains infinitely many primes as $n$ runs through the positive integers. The proof is a generalization of Euler's argument for $4n + 1$ and $4n + 3$, replacing multiplicative characters on the multiplicative group prime to
4 by multiplicative characters $\omega$ on the multiplicative group $G$ prime to $a$. To each $\omega$ corresponds a Dirichlet character $\chi$ modulo $a$, defined as the lift to the integers of $\omega$, with 0 used as the value on integers that are not prime to $a$. In place of the two functions (6) and (7) are the Dirichlet $L$ functions

$$L(s, \chi) = \sum_{n=1}^{\infty} \frac{\chi(n)}{n^s} = \prod_{p \text{ prime}} \frac{1}{1 - \chi(p)p^{-s}},$$

one for each Dirichlet character $\chi$ modulo $a$. Harmonic analysis is contained most visibly in an inversion formula for multiplicative characters of this kind: If $f$ is a complex-valued function on $G$, then

$$f(x) = \frac{1}{|G|} \sum_{\omega} \left[ \sum_{y \in G} f(y) \overline{\omega(y)} \right] \omega(x). \quad (15)$$

There is another key ingredient in the proof, and harmonic analysis is present there also, albeit less visibly. Euler’s proof for $a = 4$ used that $L(1) \neq 0$, and Dirichlet had to prove that all $L(s, \chi)$ are nonvanishing at $s = 1$. One proof of this assertion works with the product of all the $L$ functions for fixed $a$ and relates it to the $\zeta$ function of the field generated by the rationals and $e^{2\pi i/a}$; harmonic analysis is involved in this identification. The nonvanishing of the $L(s, \chi)$ at $s = 1$ then follows by showing that the $\zeta$ function of this field has a pole at $s = 1$.

Later Dedekind worked with multiplicative characters of the (finite abelian) ideal class group of the ring of algebraic integers of a number field (finite extension of the rationals), and in 1882 Weber introduced multiplicative characters for an arbitrary finite abelian group $G$. The multiplicative characters of $G$ form a group $\hat{G}$ under pointwise multiplication of their values. Distinct multiplicative characters are orthogonal in the sense that $\sum_{x \in G} \omega(x) \overline{\omega'(x)} = 0$, and the inversion formula (15) is valid.

Multiplicative characters are less helpful in exploiting a nonabelian group of symmetries. A multiplicative character must send every commutator $xyx^{-1}y^{-1}$ into 1. For a group that is generated by its commutators, as for example a nonabelian simple group, it follows that 1 is the only multiplicative character. To be able to do harmonic analysis with nonabelian groups, one introduces a multidimensional generalization of multiplicative character, the group representation. In Part II we shall examine group representations and their role in harmonic analysis.

**References**


Penrose tilings (Fig. 1) are beautiful. They also suggest significant new mathematics, so it is about time someone wrote a book about them which is readable (in fact, eminently readable) by mathematicians.

The book, *Quasicrystals and geometry*, by Marjorie Senechal, has an even broader goal: to present certain developments in crystallography from the past decade. The developments were generated in the wake of two profound discoveries. The first was the mathematics discovery [1] in 1966 of aperiodic tilings, the origin of Penrose's 1977 examples. The more recent one was the physics discovery [8] in 1984 of quasicrystals. These two discoveries have led to a large volume of interdisciplinary research—among the fields of crystallography, physics, and mathematics, and also between subfields of mathematics, especially discrete geometry and ergodic theory. The interaction of the viewpoints of the different fields has been enormously beneficial to the mathematics which is emerging. We begin with an overview of the terrain, strongly emphasizing those aspects of relevance to mathematics.

Quasicrystals are solids with unexpected properties. The characteristics referred to in this review are all related to properties of the "diffraction patterns" obtained by illuminating quasicrystals by parallel beams of electrons or X-rays. There is no need for us to delve into the details of diffraction, but it will be useful to note the following. When producing diffraction patterns from solid matter assumed fixed in space, three obvious variables of the experiment (Fig. 2) are: the direction $S_0$ of the incoming beam, the wavelength $\lambda$ of those waves, and the direction $S$ in which one senses the diffraction. ($S_0$ and $S$ are unit vectors in $\mathbb{R}^3$.) It turns out that these variables are not independent as far as the results are concerned: the diffraction intensity $I$ that one measures is only a "function" of the composite quantity $s = (S - S_0)/\lambda$. The intensity $I(s)$ is traditionally treated as a function of $s \in \mathbb{R}^3$ in the crystallography and physics literature, although it is usual to assume, on occasion, singular behavior of $I(s)$ which, like the
well-known "delta functions", are more naturally modeled by distributions or measures. In particular, we will sometimes need to refer to examples for which \( I(s) \) is supported on some countable set of points in \( \mathbb{R}^3 \); using the notation of real analysis, we will then say that \( I(s) \) is "purely discrete". In signal analysis \( I(s) \) would be called the (power) spectrum of the configuration, and we will use that term for later convenience.

The interest in quasicrystals all stems from two facts about the spectra \( I(s) \) of the first quasicrystals that were identified: \( I(s) \) was purely discrete; and there were axes through \( s = 0 \) about which \( I(s) \) was invariant under 10-fold rotation, which is not possible for any "crystal". For us the chief characteristic of a crystal is the fact that the atomic nuclei in it are arranged "periodically"; that is, their configuration consists of unit cells which are repeated, as in Fig. 3. It is this feature which is incompatible with a 10-fold symmetry of \( I(s) \). In fact, it was this incompatibility which showed that these materials were not crystals. We have yet to determine what the atomic-level configurations are for these materials; we just know, from the incompatibility, that they are not periodic in the manner of crystals.

The discovery of quasicrystals produced two surprises. On the one hand it had been widely thought that there are very general physical reasons why all (equilibrium) solids had to be crystals, so these non-crystalline substances should not have existed. Independently, it had been widely thought that only the periodic atomic configurations of crystals could have purely discrete spectra, so even if there were solids which were not crystalline, their spectra would have been expected to be nondiscrete.

Crystallography is devoted to the "inverse problem" of determining the structure of an atomic configuration from its spectrum. This process is greatly simplified by qualitative assumptions on the nature of the internal structure of the solid: in particular, assuming it is periodic is very useful and very widely used. The discovery of quasicrystals caused a profound stir in crystallography, since it affected some of its basic assumptions. This naturally led to a belated desire to understand what kind of atomic configurations could possibly produce the purely discrete spectra with which they are often confronted. In particular, crystallographers wanted to know what symmetries such atomic configurations could have, since symmetries of configurations become symmetries of their spectra and are heavily involved in the methods of crystallography. The book under review is chiefly motivated by this problem. (Crystallographers have been so affected by the discovery of quasicrystals that they have literally altered their definition of "crystal"!)

In condensed-matter physics (the subfield of physics devoted to understanding solids and fluids) the impact of the discovery of quasicrystals was large but not as profound as it was in crystallography, since quasicrystals do not seem to have particularly useful properties. The widespread attention paid to their discovery was simply due to unexpectedness. (Although it was a shock for physicists to realize they did not really understand the fundamental nature of so
We now come to the other basic discovery relevant to Senechal’s book—"aperiodic tilings". First we need some notation. A collection of polygons is a tiling of the plane if the polygons cover the plane without gaps and do not overlap. (Much of what we say about tilings of the plane by polygons goes over to tilings of space by polyhedra.) There is an intuitive connection between tilings and configurations of points. The connection can be made more concrete by associating with a tiling the configuration of its vertices or by the Voronoi construction which associates a tiling to a configuration. However, such specific connections are not important here; it is enough to think of tilings and configurations as similar structures.

The discovery of aperiodic tilings was precipitated by a question of the philosopher Hao Wang in the early 1960s [9]: Is it possible to have a finite number of polygons such that congruent copies of them can tile the plane but only nonperiodically? (A tiling is "periodic" if it consists of repetitions of a unit cell, as in Fig. 4. We have generalized Wang’s question slightly, using hindsight.)

The unexpected answer of yes by Wang’s student Robert Berger [1] led, over the last thirty years, to the new subject of aperiodic tiling. Treating nonperiodicity as a form of "unexpected complication", the subject evolved to analyze what other forms of complication could be forced by a finite set of polygons; that is, what other aspects, not true of periodic tilings, could be true of all tilings built by copies of a given finite set of polygons. (The generalization to tilings of space by polyhedra is clear.)

Wang was a philosopher, and his motivation in asking the question was connected with the algorithmic nature of tilings. The first step in such an analysis is to enumerate the polygons in tilings and thus think of tilings as functions on the integers. One of the first generalizations of Wang’s idea was the example by Dale Myers [5] of a finite set of polygons, congruent copies of which could tile the plane but only "nonrecursively". A tiling is recursive if it can be the output or result of an algorithm. Now, although it was the motivation for the birth of aperiodic tiling, this line of analysis, concerned with the complexity of the tilings forced by a finite set of polygons, has not yet proved very fertile. Most work has been concerned with two other forms of complication: tilings, forced by a finite set of polygons, which are not ordered as are periodic ones, and tilings which have symmetries not possible of periodic ones.

We discuss next these aspects of order and symmetry in tilings, beginning with order. The most mathematically developed measure of orderliness comes from probability theory (from which it was imported by ergodic theory and physics). We begin with an intuitive introduction, in the context of tilings.

Imagine we can see near us the finite portion of some tiling, and assume that although we know everything about the tiling, we do not know where we are in absolute terms within the tiling. We measure the degree of order of the tiling by the extent to which we can infer, from the features near us, features of the tiling far away from us. We use a probabilistic approach to justify such inferences, as follows.

There are two extremes of order. The usual model of extreme disorder is a sequence of independent coin flips. One can easily use this to give various definitions of a "random tiling", any of which would have the property that knowing some finite portion of the tiling would be of no value in predicting the details of the tiling further away. A reasonable model for extreme order...
would be any periodic tiling (consisting of repetitions of a unit cell), in that once one knows the location of a unit cell, one has complete knowledge of the rest of the tiling.

Between these two extremes we need a way to analyze the order of tilings. With the two extremes in mind, we think of the fact that some particular polygons occupy particular positions in a certain tiling of interest as an “event”. For such an event $R$ we use for its “frequency” $\text{Freq}(R)$:

$$\text{Freq}(R) = \lim_{N \to \infty} \frac{\text{number of occurrences of } R \text{ in a box of volume } N}{N}$$

(not worrying here about existence of limits, etc.) Now assume we know some finite number of polygons near us (event $P$) and we want to know if some other finite set of polygons is at a location with relative position given by the vector $t$ (event $Q_t$). We say our tiling is disordered if, for any $P$ and $Q$,

$$\lim_{t \to \infty} \text{Freq}(P \cap Q_t) - \text{Freq}(P) \text{Freq}(Q) = 0.$$

In ergodic theory this is closely associated with the concept of mixing, and various refinements are known. In fact, ergodic theory as a subject was created to analyze such frequencies. The basic theorem of the subject is the pointwise ergodic theorem of G. D. Birkhoff, which in this setting is simply a way to compute such frequencies by averaging over tilings instead of over the occurrences of patterns in a tiling.

Examples have been found of finite sets $S$ of polygons which force tilings with various degrees of order. For instance, an $S$ is known for which in all tilings and for all $P$ and $Q$:

$$\frac{1}{T^2} \int_{|t| \leq T} |\text{Freq}(P \cap Q_t) - \text{Freq}(P) \text{Freq}(Q)| \, dt \to 0,$$

which comes close to the above definition of disorder. But it is still an important unsolved problem to produce a set $S$ which only allows disordered tilings.

Crystallographers like to use a different criterion of order, associated with diffraction. They are particularly interested in configurations for which the spectrum is purely discrete. To understand why this is an order property, it is again useful to turn to ergodic theory. In the ergodic theory of configurations or tilings (in which the “dynamical” group is that of translations in $\mathbb{R}^d$) there is also a notion of spectrum. Since we have made a point of using the same term spectrum for both diffraction and ergodic theory, it should come as no surprise that the two notions are the same (though the details only appeared in the literature recently [2]). We will, of course, use the same symbol for it, $I(s)$. It turns out that in ergodic theory the spectrum is one of the main tools used to analyze order, and in particular it is easy to show that discrete spectrum implies order in the sense discussed above. Crystallographers are interested in the interrelations between this order property and symmetry, which we address next.

Most of the effort in aperiodic tilings is connected in some way or other with symmetry and has a curious history. After Berger published his example, which used over 20,000 different (noncongruent) polygons, a number of people became interested in simplifying the result, in particular by reducing the number of different polygons. In the original examples it was natural (for their algorithmic interpretation) to use only polygons which would appear in the tilings in a single orientation, never rotated. But driven by the criterion of reducing the number of different polygons allowed, researchers (for instance, Raphael Robinson [7]) found it advantageous to have polygons appear in several orientations in the tilings. These were followed by the “kite and dart” tilings (Fig. 1) of Roger Penrose [3]. The Penrose tilings consist of copies of only two polygons (Fig. 5), which appear in ten different orientations. They have an interesting feature which

Figure 4. Periodic tiling, with unit cell in dark lines.
configuration is not the complete information about the positions of all the particles, but only certain statistical facts about the configuration. In particular, in order for the spectrum of a configuration (discrete or not) to exhibit n-fold rotational symmetry about some axis it is sufficient but not necessary for the configuration to have the associated approximate n-fold symmetry. What is both necessary and sufficient is that the configuration have the associated "statistical n-fold symmetry", in the sense that every finite subconfiguration appear in the full configuration, in a given orientation, with the same frequency as it would if the configuration were rotated by $2\pi/n$ about the axis [6]. (The frequency of appearance of a finite subconfiguration is defined in the same way as was the frequency of a finite collection of polygons in a tiling: by counting how many times it occurs in a big box, dividing by the volume of the box, and taking the limit of the fraction as the box gets arbitrarily large.) This has led to a study of tilings with statistical rotational symmetries, with some unexpected developments. For instance, it turns out to be possible for a tiling, using congruent copies of finitely many different polygons, to be statistically symmetric under rotation by all angles. This idea can also be mixed with aperiodicity to produce a finite set of polygons such that all the tilings using such polygons have some n-fold statistical rotational symmetry—even that of "infinite n" which was just mentioned. Statistical symmetry has also led, through the search for new effects in three-dimensional tilings, to new results on subgroups of $SO(3)$.

As might be guessed from the appearance of frequencies in its definition, statistical symmetry is closely connected to ergodic theory. Thus we see that ergodic theory is useful in analyzing both the order and symmetry properties of structures like configurations or tilings. It seems to be the natural mathematical framework for the various aspects of aperiodic tiling. Though it is a subjective judgement, we go further and claim that those results from aperiodic tilings which are already of significance in other parts of mathematics have used ergodic theory at least as inspiration. As a prime example we note results of Shahar Mozes [4] which have used tilings to discover a very surprising connection between two traditional parts of symbolic dynamics, "subshifts of finite type" and "substitution subshifts".

We have given an overview of a very broad area of research and mentioned at a few points how the material is treated in the book under review.
view. But it is now appropriate to concentrate on the book to get a feel for it as a whole.

The book divides naturally into two parts. The first half discusses configurations of points, and the second half discusses tilings. The first half contains the presentation of the main theme, the order and symmetry properties of these structures. The second half is a wonderful catalog of examples of interesting tilings.

In the first half the study of configurations of points is expressly motivated as part of a model for diffraction from an atomic configuration. There is a strong emphasis on configurations which can be obtained from a projection technique from some higher-dimensional lattice, \( \mathbb{Z}^n \). The reason for this preference is that such configurations can easily produce configurations with unusual approximate n-fold rotational symmetries, of interest in crystallography. There is a good treatment of some of the algebraic aspects of symmetry groups, to the algebraic aspects of symmetry groups, to the algebraic aspects of symmetry groups, to the algebraic aspects of symmetry groups, to the algebraic aspects of symmetry groups.

The desired spectrum \( I(s) \) of the full configuration \( C \) is then the limit of \( I_N(s) \). The limit is a spectrum of the configuration of points. The approximate spectrum \( I_N(s) \) is:

\[
I_N(s) = \frac{1}{N} \sum_{j=1}^{N} e^{i s \cdot x_j}^2 = \frac{1}{N} \sum_{j=1}^{N} \sum_{k=1}^{N} e^{i s \cdot (x_j - x_k)}.
\]

The spectrum itself is introduced as it would be in a physics or crystallography text. The spectrum of an infinite configuration \( C = \{x_j : 1 \leq j < \infty \} \) is approximated by that of a finite part \( C_N \) of \( C \). The approximate spectrum \( I_N(s) \) is:

\[
I_N(s) = \frac{1}{N} \sum_{j=1}^{N} e^{i s \cdot x_j}^2 = \frac{1}{N} \sum_{j=1}^{N} \sum_{k=1}^{N} e^{i s \cdot (x_j - x_k)}.
\]

The desired spectrum \( I(s) \) is:

\[
I(s) = \lim_{N \to \infty} I_N(s).
\]

In summary, Quasicrystals and geometry is concerned with a variety of phenomena which are expressed equivalently in terms of configurations or tilings. The main characteristics of these structures which are studied are order properties and symmetry properties, both separately and as they affect one another. The book is aimed at a very broad scientific audience, and the level of mathematics is kept low accordingly. There is, however, significant mathematics coming out of this area. Those wanting to pursue this would need to hunt a bit in more specialized literature. However, there is a large number of appealing examples—well described, illustrated, and referenced—which should fire the imagination and entice new blood into related research.

References

This note is to examine the present popular practice of providing numerical ratings of the relative standing of the various Ph.D.-granting departments in American universities. In order to be specific, I will consider the ratings of departments of mathematics, as presented in the NRC comprehensive 1995 ratings of graduate programs in mathematics, as described in an article in the *Notices of the American Mathematical Society* (vol. 42, no. 12, for December 1995, 1535-1542). The reputational ratings presented there, in math as in other fields, are averages of reports from many mathematicians, each of whom gives ratings of 50 departments (other than the rater's own), using faculty lists for those departments. The result is a listing of departments in linear order, with occasional ties.

There have been several such ratings in the past (e.g., Cartter, "An Assessment of Quality in Graduate Education", American Council of Education, 1966). Even earlier, everyone in 1900 knew that Chicago had the best math department and in 1912 that Harvard was best. In those days the American mathematical community was much smaller; as a result, active mathematicians then had a more varied acquaintance with different fields (for example, before 1940 I customarily sent reprints of my published papers to many mathematicians not active in my own field of research). Today, specialization is pervasive and necessary; many mathematicians's firsthand knowledge is limited to others working in their own field. Thus the published ratings now conflate the opinions of many individuals, variously well or poorly informed.

The National Research Council (NRC) is the working arm of the National Academy of Sciences. In 1980 the Conference Board of Associated Research Councils decided to sponsor new doctoral ratings. The NRC undertook to prepare these ratings—those subsequently published in 1982; I was a member of the committee responsible for that report. As vice-president of the NAS at that time, I did hope that the NRC could develop and use some new and really "objective" ratings. The AMS had been accustomed to selecting the invited hour speakers at its meetings from careful analysis of annual "Lists of Published Papers". I then thought that some index of such invitations, or otherwise based on the recognition of department members by professional societies, would be practical and objective. But it did not work out that way in fields other than mathematics, and even in mathematics any such objective index would have been quite erratic for smaller or lower-ranked departments. So the 1982 NRC report used the accustomed reputational index then called "Measure 08" as well as some other new indices, hopefully more objective. Page 24 of the 1982 volume on mathematics and physical science says:

Measure 08...[is] subject to many of the same criticisms that have been directed at previous reputational surveys. Although care has been taken to improve the sampling design...the survey results merely reflect a consensus of faculty opinions. ... These opinions may well be based on out-of-date information or be influenced by a variety of factors unrelated to the quality of the program.

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As might be expected, the smaller and less prestigious programs were not as well known, and for this reason one might have less confidence in the average ratings of these programs.

The current report states (p. 23): “Reputational ratings are influenced by a number of other factors that limit their usefulness in judging quality.” It then lists, complete with those fashionable “bullets”, several such factors.

The current NRC report has indeed tried out and presented several different alternative ratings, such as the number of citations per faculty member. Such an index is of uncertain worth, since it reflects such nonquality items as the length of papers. Just for example, the number of future citations to Andrew Wiles just now doubled when his justly famous proof of Fermat’s Last Theorem was published in two separate papers rather than one.

Each NRC rater assesses the “scholarly quality of program faculty” under one of six labels, from “distinguished” to “not sufficient”. These words are turned into numbers and then averaged. This average is the reputational “rating” of the program; it is the measure 08 of the 1982 report. But since the numbers come in order, they produce a ranking: a complete linear order of Ph.D. granting departments of mathematics: the first, the second,... eightieth... and beyond, with occasional ties. The current NRC report, unlike the previous one, emphasizes this linear order by tabulating all the alternative indices (in table P) for universities listed in the first (reputational) order. Thus that linear order is the principal apparent product and the one most often cited in the secondary literature (e.g., in the Notices, in “The Chronicle of Higher Education”, and in the U.S. News & World Report. (Yes, the secondary literature comes in order of quality.)

In 1982 the NRC report, as a matter of principle, did not give the ranked list; this was produced (with occasional error) only in the secondary literature.

Appendix Q of the current report gives “confidence intervals” for the reputational ratings. These help little; they refer only to confidence which might be engendered by getting infinitely many raters; they do not relate to confidence which might come about from the use of other means of judgment.

I submit that this linear order is meaningless. There is no such order in the real world. What there is is something much less—a partial order. Given two departments, A and B, sometimes A is better than B, sometimes B is better; but often there is no objective comparison between A and B. This partial order is not even a lattice, and the ambiguous comparisons are especially noticeable in the bottom part of the present list.

Adventures of a Survey Reviewer

“In our capacity as co-chairs of the Committee [for the Study of Research-Doctorate Programs in the United States], we invite you to serve as a reviewer of up to 50 programs in mathematics,” read the May 4, 1993, letter. How could I refuse, even though the reviews were due no later than May 18, 1993, and I was in the midst of grading final exams. In addition to my general willingness to support important assessments like this one, I also had been one of the 348 mathematicians invited to participate in the study’s 1982 predecessor—and one of the 223 who turned in their surveys. Actually, at that time I was slightly embarrassed with my responses. Since I always answer these things honestly, I was often forced to check the “little or no familiarity” box on the “Familiarity with Work of Program Faculty” and the “Don’t Know Well Enough to Evaluate” box for the “Scholarly Quality of Program Faculty” for programs I knew would end up in Group I (even top 10), a reflection on my own mathematical parochialism. In the dozen intervening years (the survey for the 1982 study was done in spring 1981), nearly half of which I had spent as an associate secretary of the Society, I had hoped to have expanded my mathematical range sufficiently to be able to render informed judgment on many more programs.

Alas, mathematics and the community of mathematicians had also expanded. Once again, I found myself having to select the unable-to-evaluate box for many programs, including ones which would end up at the very top. But now a new dilemma surfaced: some programs which I knew well and admired highly didn’t even appear in the survey. It seems that the 1993 survey, like the 1982 one, had a grandfather clause: to be eligible for the current one, the program needed at least a certain score on the last one, or to have produced a certain number of Ph.D.s in the years 1987–92. The enforcement of the criteria was not clear to me: one of the programs I was asked to rate was not rated at all in the 1982 study and had produced only two doctorates in 1987–92; perhaps it was included from some great-grandfather clause based on the 1970 study.

I wasn’t bothered by the inclusion. But troubled by the exclusions, I wrote the study co-chairs in the fall of 1993 and shared my concerns. And even though I had met their 2-week deadline in returning their survey, in the nearly two years since I have received no reply.

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tops, although they might change the order a bit or add one or two departments.

Is there a single best department? The report says that Berkeley and Princeton are tied for the top. Both are indeed very good. Berkeley, since about 1941, has had the best mathematical logic, while Princeton has had the best algebraic topology ever since there was such a subject (cf. Veblen, J. W. Alexander, and S. Lefschetz). But, hold on, it may not be that simple; there are now powerful topologists at Berkeley, and Princeton had outstanding logic (Alonzo Church, Kleene, Rosser, and Turing) at a time when there was precious little math at Berkeley. At Princeton, graduate students are turned out promptly; Berkeley has had many more such students, but some are intellectual orphans (in a long career, I have adopted five such Berkeley orphans). This treatment of graduate students is reflected in another index in the current report. But, again, Berkeley is the only American department of mathematics from which two women have been elected to membership in the National Academy of Sciences.

The upshot of all this is that there are all sorts of divergent comparisons. Berkeley and Princeton are not "tied"; they are, in postmodern lingo, "differently abled".

Anyhow, I meant to argue that Harvard math is better than either Princeton or Berkeley. Harvard has long been tops in algebraic geometry, a subject now of more central interest than topology or logic.

I hope you did not notice that my ratings really reflected how it was fifty years ago; I'm sure no other rater would do any such thing. I suggest an easy exercise for the reader: List the 50 departments which you know best (not those which the NRC may have handed you), and put these departments in your linear order of quality.

These details are exhibited to demonstrate the inevitable conclusion. There are indeed top departments, but there is no objective choice which is best. For less eminent departments, the real order, if any, may be much more uncertain.

Clearly, similar ambiguities in rank order occur in other academic fields. The present reputational rank order is an elaborate fashionable picture which has minimal correspondence with any real facts. These rank orders are concocted from outdated habits of thought and arranged in elaborate tabulations to please the human hunger for "information" and to nourish the prejudice that every aspect of life has its superbowl.

Therefore, such ratings are not fit for any serious use whatever. Let presidents, provosts, and deans beware. All real judgments must come from experts who are demonstrably qualified.
I have not forgotten my first day at MIT. In 1950 Moore instructors had to teach summer school. On a sunny afternoon early in July, I crossed the bridge in search of Building 2. Math headquarters was on the second floor; it still is. I introduced myself to Ruth Goodwin, who handled all secretarial services, and I asked to see the chairman. When I gave Ruth my name, a chap sitting across from her, head buried in the Boston Globe, lowered his paper and said: “Singer, I’m Am­ brose. There is a seminar in Lie groups in five minutes. You can see Martin later. Come.”

I did, and met John Moore, Barrett O’Neill, and George Whitehead, who became lifelong friends. After getting my teaching assignment from Ted Martin, Ambrose told me the seminar met at midnight in the Hayes-Bickford coffee shop. He would pick me up at 11:45. Kay Whitehead joined us for these evening sessions; the coffee was deadly, the conversation lively. Ambrose gave me a tour of Boston that first night and by the time he dropped me off, we were close friends.

One day Ambrose said, “Singer, you listened to Chern’s lectures. What did he say?” At Chicago, I had passively taken notes of S. S. Chern’s course, while writing a dissertation in another subject. What with interpreting my notes, reading Chern’s papers, pouring over Elie Cartan, and Ambrose insisting on absolute clarity in every detail, we learned differential geometry together.

Ambrose designed the Geometry of Manifolds course, and we taught it in alternate years. It is pretty much the same today as it was then: standard manifold theory the first term and instructor’s choice of topics the second. Our students wrote some well-known graduate texts based on this course: Bishop-Crittenden, Hicks, and Warner.

With customary zeal, Ambrose changed the undergraduate program in pure mathematics. Whereas in 1948 Andre Weil explained differential forms to the faculty at the University of Chicago, less than a decade later we were using them in undergraduate differential geometry. Ambrose taught the Lebesgue integral in the analysis course for juniors and seniors “because it’s simpler than the Riemann integral.” For almost twenty years Ambrose was the guiding spirit of pure mathematics at MIT. His efforts were key in making it a great department.

Ambrose and I regularly drove around Boston late at night talking about mathematics and life. We knew every street; and to this day, with the inevitable traffic jam, I’ll remember an alternate route and, often enough, a special moment: yes, here is where we finally understood holonomy.

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A Tribute to Warren Ambrose

I. M. Singer and H. Wu
Ambrose taught me jazz. I had been an enthusiast of Dixieland and swing. But by 1950 bop was dominant. Charlie Parker was king, and everyone else his student. We heard all the great jazz musicians at all the jazz joints. There was a casualness and directness then that makes it difficult for me to hear jazz live today. It's too rigid and formal now.

Imagine watching Bird take on a long line of young sax players, listening to each intently and then playing their variation as it should be played. Teaching at its best, I felt. Imagine having coffee between sets with Billie and thanking her for her early records that meant so much to many of us. Dick Kadison explained jazz to me and talked about it in the fifties the way Wynton Marsalis does now.

Though mathematics was wonderful, I was heavily burdened. My oldest son was blinded at birth and, as I learned later, brain damaged. I couldn't have survived as a mathematician without Ambrose's steady support and the steady support of my very good friend, Dick Kadison. Those who knew Ambrose know that expressing gratitude was forbidden. He walked rapidly away the one time I tried. Occasionally, I can provide special help to a young mathematician. I think of Ambrose and feel that by the time I have helped a hundred, I'll have begun to pay my debt to him.

I loved Ambrose for his absolute honesty, his generosity, his wit, his energy, and above all for his tenderness, which he tried so hard to hide. I am sad that so few mathematicians knew what a great man he was. But I was happy for him when he found his wife, Jeannette, with whom he could be himself for twenty years.

I. M. Singer

Warren Ambrose, a pioneer in differential geometry, passed away on December 4, 1995, in Paris. He was eight-one.

Differential geometry has not always been the popular subject that it is today. In the 1950s Ambrose (together with I. M. Singer) made MIT into the only center in geometry in the United States outside of the University of Chicago.

Ambrose was born on October 25, 1914. He obtained his Ph.D. in probability with J. L. Doob at the University of Illinois at Urbana (now Urbana-Champaign) in 1939, but his interest soon switched to functional analysis. His most notable work in the latter area is probably his structure theory of what he called the $H*$-algebras, a generalization of the $L^2$ group algebra of a compact group (Trans. Amer. Math. Soc. 57 (1945), 364-386). By the early 1950s his interest had changed yet again, this time to differential geometry. In his later years, he was to explain this change by saying that he wanted to be in a field where "the theorems come less easily".

Ambrose entered geometry at a time when the dawn of a new era was just around the corner. The works of J. L. Synge, H. Hopf, and S. Cohn-Vossen in the decade after 1925 and those of S. B. Myers and S. S. Chern in the forties made the shift of focus in geometry from the local to the global all but inevitable. Then in 1950 C. Ehresmann published a paper that cleaned up the foundations; availing himself of the latest works in Lie theory and topology, he gave the first rigorous definition of a connection on a fiber bundle. The stage was thus set for a nontrivial theorem that would embrace this new spirit and new machinery. It can be argued that the Ambrose-Singer holonomy theorem (Trans. Amer. Math. Soc. 75 (1953), 428-443) was exactly that theorem. This theorem concerns a principal $G$-bundle $P$ with connection $C$ over a connected manifold $M$, where $G$ is a Lie group. The connection $C$ associates to each curve $y$ on $M$ joining two points $x$ and $y$ an isomorphism $y_*|_x$ from the fiber $P_x$ over $x$ to the fiber $P_y$ called the parallel translation from $x$ to $y$. (If $P$ is the bundle of bases in the tangent spaces of $M$ so that $G$ is the general linear group $GL(n, R)$, then $y_*|_x$ is the parallel translation in the classical sense, i.e., it maps the bases in $M_x$ (tangent space at $x$) to those in $M_y$.) Now fix an $x$ in $M$ and consider all the loops that begin and end at $x$. $y_*$ then becomes an automorphism of $P_x$ which turns out to coincide with the action of an element $\tilde{y}$ of $G$ on $P_x$. The set of all such $\tilde{y}$ as $y$ runs through all the loops at $x$ is easily seen to be a subgroup.
of $G$. The identity component of this subgroup, to be denoted by $H$, is a Lie group. Up to conjugation in $G$, $H$ is independent of the choice of $x$. $H$ is the (restricted) holonomy group of the connection $C$. The Ambrose-Singer holonomy theorem asserts that the Lie algebra $\mathcal{H}$ of $H$ is exactly the linear span of the values of the curvature form $\Omega$ of $C$. (Technical aside: $\Omega$ should be restricted to the holonomy subbundle of $P$.) This is therefore a vast generalization of the fact that if the Levi-Civita connection of a Riemannian metric is flat (zero curvature), then its parallel translation is trivial (no holonomy).

A similar (but slightly weaker) result was obtained independently by A. Nijenhuis around the same time, but it was the proof of Ambrose and Singer that captured the imagination of the geometers. Although the geometric idea of the proof is clearly in the forefront, the whole argument is carried out with total precision and in an entirely abstract setting. There was never anything vaguely resembling this in the classical literature. This proof is still the one that is reproduced essentially verbatim in the standard texts of today.

The Ambrose-Singer paper has been rightfully recognized as one of the most influential in the recent history of the subject, but the full realization of its import came only in the last ten years. In greater detail, suppose $M$ is a Riemannian manifold with metric $g$, $P$ is the bundle of orthonormal bases in $M$ with respect to $g$, $G$ is the orthogonal group $O(m)$, and $C$ is the Levi-Civita connection of $g$. Then the holonomy algebra $\mathcal{H}$ is now the linear span of a set of skew-symmetric matrices (Lie algebra of $O(n)$) which are the values of the curvature form $\Omega$ of $g$, and $\Omega$ must further satisfy a collection of identities, the Bianchi identities. It is then clear that $\mathcal{H}$ is far from arbitrary. This was the idea that motivated Marcel Berger in 1955 to use the holonomy theorem to prove that the number of Lie subgroups of $O(n)$ that can be holonomy groups of a Riemannian manifold is drastically small. In particular, if $H$ acts irreducibly on a tangent space $M_x$ but is not transitive on the unit sphere of $M_x$, then $M$ must be locally isometric to a symmetric space of rank $\geq 2$. (In 1962 Jim Simons gave a direct proof of this fact.) This startling fact lay dormant for almost twenty years before geometers realized that it provides a powerful tool for singling out the symmetric space of rank $\geq 2$ among Riemannian manifolds. Among its striking applications, one can cite the characterization up to isometry of compact Hermitian symmetric spaces among compact Kähler manifolds in terms of bisectional curvature (N. Mok, 1988) and the characterization up to isometry of symmetric spaces of noncompact type of rank $\geq 2$ among complete Riemannian manifolds of nonpositive sectional curvature in terms of geometric rank (P. Eberlein, W. Ballman, M. Gromov, and others, 1990). These results would be impossible without the work of Berger, and ultimately of Ambrose-Singer.

In 1955 Ambrose published the isometry theorem that now bears his name (Ann. Math. 64 (1956), 337–363). Equally influential was his work in the foundations of Riemannian geometry, which, after much delay, eventually made it to print in J. Indian Math. Soc. 24 (1960), 23–76. The fact that the basic theorems of Riemannian geometry should be developed using only properties of the Levi-Civita connection without the intervention of the calculus of variations is now taken for granted, but it was not so until Ambrose persuasively argued his case.

After 1960 Ambrose’s interest turned to partial differential equations, and his publications soon reflected this shift. He had ambitious plans but did not live to see their fruition.

Those who knew Ambrose in the fifties remember his superb leadership and organizing ability that did so much to make the MIT department an exciting one. As a teacher Ambrose was noted for the clarity of his presentations. Since clarity in geometric writing was one quality that was in short supply back then, it comes as no surprise that Ambrose’s lectures in geometry soon acquired an international audience through the writing of his friends and students.

Ambrose was a man of absolute integrity. His was not the temperament that would gladly suffer pretentiousness or dishonesty. Yet those close to him were also privileged to experience his self-deprecating humor and great kindness.

Ambrose’s whole career was essentially spent at MIT. He retired in 1985 and moved to Paris in 1990. He is survived by his wife, Jeannette, and his children, Ellen and Adam, from a previous marriage.

With customary zeal, Ambrose changed the undergraduate program in pure mathematics.

H. Wu
Memories of Roland Dobrushin

Robert Minlos, Senya Shlosman, and Nikita Vvedenskaya

Roland Dobrushin died in Moscow on November 12, 1995, at the age of sixty-six. His friends and colleagues are preparing a systematic description of his life and career. The present short account is not of this nature; instead it is a personal reflection on the mathematician and the conditions under which he worked.

Dobrushin's work is known to many mathematicians in probability, information theory, and mathematical physics. His interest in probability began in the late forties when he was an undergraduate at Moscow University. His first area of research was Markov chains. In the mid-fifties he became fascinated by the then new subject of information theory, and he made substantial contributions also in that field. In 1962 he turned to statistical physics. Here his legacy is considerable. He was one of the pioneers in the rigorous study of the Ising model and in the elaboration of the more general concept of Gibbs random field. The importance of the Ising model is that it provides a vehicle for studying the question of how the local dependence between sites determines the global nature of the random field. This is a fundamental question not only in statistical mechanics, but also in quantum field theory. Dobrushin's outlook was that the Gibbs state describing the statistical equilibrium of a classical mechanical system should be viewed as a probability measure on the space of all possible configurations of the system at infinite volume. The equations determining this probability measure were formulated by Dobrushin and independently at about the same time by Lanford and Ruelle, and they are now known generally as the DLR equations.

In the seventies Dobrushin was able to combine his experience with Gibbs random fields and Markov processes in the study of Markov processes with local interactions. The stochastic version of the Ising model, first introduced by Glauber, is an example. At each site (point with integer coordinates) there is a spin value ±1. This configuration evolves by having the spin at each site occasionally flip, that is, change sign. The rate of random flips of the spin at a site increases with the number of disagreements with the spins at neighboring sites. Does this process lead to a unique equilibrium probability measure? Or can differing initial conditions produce distinct equilibria, for example, ones where the spins prefer to have a particular sign? Again, this is a question of how local interaction leads to global order. Dobrushin studied such processes in considerable generality. He had many other scientific interests, ranging from kinetics to complex queuing networks to linguistics. A characteristic of his scientific work was an optimism that the viewpoint of statistical physics—looking at a large system as a collection of interacting components—would be fruitful in many other areas.

Robert Minlos, Senya Shlosman, and Nikita Vvedenskaya are members of the Institute for Problems of Information Transmission, Moscow. The authors thank William Faris (University of Arizona) for the translation from Russian to English.
Dobrushin had a habit of continually changing the text of his written work in the course of making improvements. For this reason he never considered writing a book, on the grounds that the process might continue forever and never converge. His only book (written jointly with R. Kotecky and S. Shlosman) came about by chance—the text turned out to be too long for a paper. The book is *The Wulff Construction: A Global Shape from Local Interaction*, and the main content is the proof of one theorem: If in the usual equilibrium Ising model at low temperature one fixes the fraction of minus spins, then the sites with minus spins condense into a drop having an asymptotically nonrandom form given by an explicit construction.

Roland Lvovich Dobrushin was born on July 20, 1929, in Leningrad (now St. Petersburg). At the age of six he lost his father, after which his family moved to Moscow. He was a teenager when his mother died, and he fell under the care of his uncle and aunt. When he was a student in the university, his uncle, a writer who published in Yiddish, was arrested. (In 1948–1949 many people active in Jewish culture were arrested.)

While still a student in school, he became attracted to mathematics and participated in school mathematical Olympiads. He liked to tell the following story. In the work for the Olympiad, he wrote that he could not prove the seemingly obvious fact that a line intersecting one side of a triangle must also intersect one of the other two sides. In his paper he added that, to his shame, he does not know what a line is. Obviously, this confession made a strong impression on the organizers of the Olympiad.

In 1947 Dobrushin entered the mechanical-mathematical faculty at Moscow State University. (In Russia a “faculty” is the analog of a department.) The years of his student life were the years of the postwar glories of this faculty. At that time he was tall, thin, and a very lively youth. He looked on the world with unusual joy, and everything was of interest to him. It seems that he could not imagine that there was something that he could not achieve or not find time to do. He was one of the brightest students in the faculty. Of course, he actively participated in the community life of the faculty. He conducted a mathematical circle for school children. This was also the time when he began to actively work in mathematics. He was a member of the famous student seminar of E. B. Dynkin. It was in this seminar that he did his first work on Markov chains. Then he did his diploma work with A. N. Kolmogorov, and after finishing the university he became a graduate student of Kolmogorov. (It was difficult for Dobrushin to be accepted as a graduate student in 1952, in the midst of the Stalinist anti-Semitic campaign of the time, but Kolmogorov insisted on his admission and succeeded in obtaining it.)

In 1956 Dobrushin was awarded the prize of the Moscow Mathematical Society for young mathematicians. In 1955 he defended his candidate degree dissertation at Moscow State University for the work on Markov processes. He obtained the higher degree of doctorate in 1962 at the Institute of Applied Mathematics (now the Keldysh Institute) for the research on information theory.

Dobrushin became interested early in social questions; while he was still a boy he began to read the newspapers attentively. This remained his passion for the rest of his life. He read eight to ten newspapers every day. His position as a citizen was nonconformist and active. Precisely that (more specifically, a speech in a well-attended meeting of the faculty, a speech that we would now call democratic) cost him his university career. Dobrushin left the university in 1965 and began to work in the Institute for Problems of Information Transmission, where he founded the Laboratory of Multi-Component Random Systems. He turned out to be a good organizer. This, together with his scientific authority, led to his laboratory becoming one of the mathematical centers of Moscow. It has now been renamed the Dobrushin Mathematical Laboratory.

In the company of his friends he was one of the first to think and speak of the fate of his country and of how the seeds of various internal inconsistencies and conflicts were beginning to lead to its dissolution. At the beginning of "perestroika," during the years of general euphoria, he said that the change in the country will require long and difficult years. In spite of
this, he always remained an optimist and was confident of a positive result.

This optimism was a characteristic personal­ity trait. Everyone who knew Dobrushin knew of his energy and civic spirit and scientific enthusiasm. However, those who knew him only in recent years could hardly guess that in his youth, as was typical of boys of the ’40s and ’50s in Moscow, he liked to descend from hills on cross-country skis—later he even learned to ski on downhill skis. In fact, he was not that good a skier. At the beginning he fearlessly hurled himself down the slope, crashing through whatever was in his way. He eventually learned how to “snowplow”. So, as on so many other occasions, the optimism was justified.

Dobrushin also liked to go on hiking trips—sometimes shorter ones of two or three days in the vicinity of Moscow or longer ones lasting two or three weeks in the summer. (In these hikes the participants carried all their food in rucksacks, slept in tents, and cooked on fires.) There were trips to the mountains or the taiga. (It has often been described how mathematicians in Russia used to go on such hikes.) Dobrushin also traveled extensively in the Soviet Union to go to con­ferences or to give lectures. He went everywhere, from the Baltic states to the Far East, from Karelia to Central Asia. In the last years he was able to travel extensively throughout the world, from China to America, and once again he was fasci­nated by all he saw. But the most interesting place was Russia, to which he always returned with joy.

Dobrushin was married several times, and he had five daughters. The oldest is an artist, and the next two work as linguists. The youngest are still young girls, aged six and ten. He loved his daughters and was a good friend to them. He was in no way ready for death; in fact, he had many plans for the future and worked almost to the last days of his life.
Since she started her career as a reporter for *Science* magazine in the 1970s, Gina Kolata has become one of the nation's premier science journalists covering mathematics. Presently working at the *New York Times* primarily covering medicine, biology, and health, she still writes a fair number of stories on mathematics. She is widely respected in the mathematical community for her reporting on mathematics, and her work at the *Times* has resulted in three Pulitzer nominations.

At the Joint Mathematics Meetings in Orlando in January, Kolata received the Communications Award of the Joint Policy Board for Mathematics. "Gina Kolata has consistently given outstanding coverage to many of the most exciting breakthroughs in mathematics and computer science over the past twenty years," says Ronald L. Graham of AT&T Bell Laboratories. "She has a special gift for conveying the essence of a complicated concept in an engaging and understandable way and for portraying the human side of mathematics as well."

Established in 1987, the JPBM Communications Award recognizes individuals who bring accurate mathematical information to nonmathematical audiences on a sustained basis. As the sixth recipient of the award, Kolata joins an outstanding group of communicators about mathematics: James Gleick, author of *Chaos: Making a New Science*; playwright Hugh Whittemore, author of *Breaking the Code*, a play about Alan Turing; Ivars Peterson, editor at *Science News* and author of several books on mathematics; Joel Schneider, content director for *Square One TV* of the Children's Television Workshop; and Martin Gardner, the prolific mathematics writer known for his "Mathematical Games" column in *Scientific American*.

Kolata did her undergraduate degree in molecular biology. After a stint in a Ph.D. program in that subject ("I hated the lab"), she switched to mathematics. She received a master's degree from the University of Maryland, writing a thesis under James Yorke, whom she calls a "great guy, very encouraging". By that time she had set her sights on becoming a writer. Having little writing experience, she decided to try getting a foot in the door by taking a position selecting reviewers for manuscripts for *Science*. Once there she wrote a few stories for the news section of *Science*, which the editors liked and published. Some of these early stories were on biology, and some were on mathematics. She reasoned that covering mathematics would set her apart from other writers—and it worked. "That's how I got started writing math stories, because nobody else was interested and I was," she recalls. "It gave me something different." One of her first contacts was Graham, whom she says, "was almost like a mentor in the beginning."

One of her first stories was about the P and NP problems, which have long fascinated her. This story was "a perfect one for a *Science* mag-
magazine audience, because it's relatively simple to state, and it's a great problem," she notes. "The idea of it is really intriguing philosophically, that there are some problems in computer science that are just computationally impossible. Or are there? Maybe there aren't." Her favorite mathematical stories for *Science* include the proof of the Bieberbach conjecture by Louis de Branges and the computer-aided proof of the 4-color theorem by Wolfgang Haken and Kenneth Appel. At the *Times* she wrote four articles on the proof of Fermat's Last Theorem, and three of them made the front page. She calls the proof "one of the greatest achievements of our lifetime."

Although it is often assumed that mathematics stories have to be tied to applications in order to appeal to a general audience, Kolata believes this can make the stories "uninteresting." "Math stories don't have to tell you how to build a better airplane," she says. "It's not a news-you-can-use type of thing. But there has to be a reason why somebody would want to read it." Often with mathematics the reason is that the story is just intellectually fascinating. As a result, mathematics stories have to "leap a higher hurdle" than stories about other fields of science. "We write stories all the time about minor advances in molecular biology that may someday, if everything works out and we're really lucky, lead to something that might lead to a drug against cancer," she points out. "If that was a math story, an advance that may someday, if we're really lucky, lead to a partial solution of a [longstanding problem], we wouldn't do it."

"Somehow the story has to link up to something in the reader's world. It doesn't even have to be a fear-inspiring topic like cancer; distant galaxies or quarks will do just fine. "But in mathematics, it's harder to tie it to something that people think they understand," she notes.

In addition, mathematics stories often face a problem with immediacy. Newspapers publish news, and a story that's old is apt to go unreported. Yet mathematical developments usually don't happen on a short time scale. "People in other fields are willing to say, 'This is really exciting, it needs more research, we have to check some stuff, but it's a great idea," Kolata says. "Mathematicians would rather say, 'Let's wait until it's circulated in the community and people have checked the proof and we can say it's right.' Maybe two years later they will say, 'Oh, yeah, it's a great idea.'" But by then the story has lost its steam. Even if a particular development didn't occur yesterday, there are ways to convey the idea that something has happened. "You have to have news," Kolata states.

In communicating with reporters, Kolata suggests, mathematicians need to convey why the ideas they work on are intellectually exciting to them. "You have to not trivialize your work, but you've got to ask yourself, What is the core of the idea here that's so incredibly exciting to me?" she says. And steer clear of technicalities. "It doesn't help to get more technical and start writing equations on the board, which is sort of a fallback for mathematicians often," she says. "You've got to speak English, and you've got to sometimes oversimplify, use analogies. ... You've got to try to use analogies that don't use numbers or equations, because [the reporters] are not going to use numbers or equations."

One of Kolata's pet peeves is stories about mathematics that make mathematicians look like hopeless eccentrics. She hates the "little jokey articles" that trivialize mathematics. "Some people think that any publicity is better than no publicity," she says. "I don't know if I agree with that. I think that if you have enough insulting publicity, the image that's created is that mathematicians cannot be spoken to, you might as well not bother interviewing them, they're eccentrics in a world of their own, and you would never want to talk to them." She urges people to write letters to the editor when they see such articles. "I would like to see mathematics treated with the respect it should have."

Kolata calls the JPBM award "an incredible honor. "There is no greater honor to me than getting an award from people who I write about that is unsolicited," she says. "I didn't apply for this, they just chose to honor me like this. So I was really thrilled, it meant a lot." Another person who is undoubtedly thrilled is Kolata's mother, Ruth Bari, a professor emerita of mathematics at George Washington University. Bari, who got her Ph.D. the year Kolata started college as a freshman, had a "second life" as a mathematician. Bari loves mathematics, says Kolata. "She loved teaching. ... She loved research; she loves the company of mathematicians." Bari influenced her daughter in mathematics by her own love of the subject. "It's hard to know somebody who so flourishes in the mathematics community and not be affected by it," Kolata says. "It shows the joy that mathematicians get from their work."

—Allyn Jackson
In 1990 the Executive Committee of the Association for Women in Mathematics (AWM) established the annual Louise Hay Award for Contributions to Mathematics Education. The purpose of this award is to recognize outstanding achievements in any area of mathematics education, to be interpreted in the broadest possible sense. While Louise Hay was widely recognized for her contributions to mathematical logic and for her strong leadership as head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, her devotion to students and her lifelong commitment to nurturing the talent of young women and men secured her reputation as a consummate educator. The annual presentation of this award is intended to highlight the importance of mathematics education and to evoke the memory of all that Hay exemplified as a teacher, scholar, administrator, and human being.

AWM is pleased to present the Sixth Annual Louise Hay Award to two outstanding women mathematicians: GLENDA T. LAPPAN, Michigan State University, and JUDITH ROITMAN, University of Kansas.

Glenda T. Lappan
Citation
Glenda Lappan's long-standing and varied contributions have touched the individual and collective lives of mathematicians, mathematics teacher educators, undergraduates, graduate students, practicing teachers, and children. She embodies a rare combination of "mathematics educator" and "mathematics education educator" whose professional life is grounded in a deep understanding of and love for mathematics and the teaching and learning process. She is highly respected as a teacher, researcher, consultant, and national leader.

The foundation of Lappan's international research reputation was established with her writings on the theoretical and practical problems of teaching and learning mathematics during the important transition years of the "middle grades". In 1986 Professor Lappan was selected to direct the grades 5–8 portion of the National Council of Teachers of Mathematics (NCTM) Curriculum and Evaluation Standards for School Mathematics.
Mathematics. She chaired the project, which resulted in the publication in 1991 of the Professional Standards for the Teaching of Mathematics. Currently, Professor Lappan is codirector of the Connected Mathematics Project at Michigan State, a five-year project to implement the visionary recommendations put forth in the NCTM documents through the design of a complete mathematics curriculum for students in grades 6 through 8.

Professor Lappan has been committed to the professional development of mathematics teachers for over two decades, playing a prominent role in the initiation and oversight of the many workshops and summer programs conducted by the Michigan State University Mathematics Education Group. She has taken her philosophical ideas on curriculum and standards right into the classroom and has, through her innovative workshops, coached hundreds of precollege mathematics teachers and school administrators to rediscover their own and their students' mathematical abilities.

In addition to her commitment to mathematics education, Professor Lappan is herself a consummate educator. Interweaving research with methods in her teaching and learning activities, Professor Lappan has served well the educational needs of undergraduates, graduate students, and workshop attendees. She has acted as undergraduate advisor and mentor in the Department of Mathematics at Michigan State and has directed the dissertations of Ph.D. students. In all of these efforts, Professor Lappan's integrity, concern for others, and depth of understanding of mathematical content and the teaching and learning process have been abundantly evident.

Professor Lappan has lectured and delivered invited presentations extensively, including plenary lectures at the International Congress of Mathematics Education in Québec City (1992) and the Regional Conference on Mathematics Education in Shanghai (1994).

Professor Lappan is a highly visible spokesperson for policies of standards and reform. Her extraordinary energy, political acumen, compassionate communication skills, and vision for the future of mathematics education have made her an obvious choice for appointment to the profession's more influential governing positions and boards. Lappan serves on the Mathematical Sciences Education Board (MSEB) for the National Research Council and, in that capacity, has been prominent in negotiations with the National Academy of Sciences concerning the future of mathematics education reform. She has also served as a member of the MSEB Executive Committee and as Chair of the MSEB Committee on Systemic Change. Professor Lappan has served as a program director in the Teacher Preparation Program in the Education and Human Resources Directorate at the National Science Foundation.

Professor Lappan has been elected by its membership to serve on the NCTM Board of Directors. She has been Board Liaison to the Research Advisory Committee and is currently a member of NCTM Standards Coordinating Committee. She serves on numerous other advisory boards of projects and consults with educational task forces across the nation. U.S. Secretary of Education Richard Riley recently named Professor Lappan to the National Education Research Policy and Priorities Board, making her the only scientist in higher education selected. Lappan's mission during the term of her appointment is to develop a long-term education research agenda and to set priorities for the Education Department's Office of Educational Research and Improvement. As one of five appointees nominated by the National Academy of Sciences, the honor gives recognition to Professor Lappan's distinguished career as an internationally known researcher, educator, and leader in the field of mathematics education.

Response

It is a very great honor to receive the Louise Hay Award for Contributions to Mathematics Education from the Association for Women in Mathematics. To borrow a phrase from my wonderful parents, I am humbly proud—and proud of all the students young and old that I have had the privilege and pleasure of teaching. It is to them and their stimulation and challenges that I owe so very much.

When I was a student in high school in Douglas, Georgia, I had Mrs. Sarah Betty Durham for mathematics for my last two years. I was a kid off the farm who thought she had died and gone to heaven when she had access to this incredible stuff called mathematics. It was Mrs. Durham's challenge and her belief in me that made all the difference in dreaming that college was possible. She died a few years ago, but to the end she kept up with what I was doing and, in her own way, kept up the pressure for excellence. I owe her a great deal.

Many other teachers of mathematics have made a difference in my life. I never ceased to be amazed that Dr. Ball, Dr. Brahana, Dr. Cantrell, Dr. Jewett, and others at the University of Georgia never ran out of mathematics questions to throw at me even as we passed in the halls while I was in graduate school. They never stopped working to try to teach me something about mathematics, and they never let me stop working for myself. I hope that some of what they did
for me I have been able to do for students who have come through my hands.

I would like to thank my department chair, Jonathan Hall, and my colleague and friend, Patricia Lamm, for nominating me for this award. While it is very nice to have a pat-on-the-back from the field, it is even more gratifying to have your own colleagues appreciate what you have tried to do in your professional life. Thank you to AWM for the honor of receiving this award given in the name of a woman mathematician that gave so much to her profession—Louise Hay.

Judith Roitman
Citation
Judith Roitman has a long and distinguished career as a mathematics researcher, advocate for women in mathematics, and mathematics educator. Her research activity in set-theoretic topology and Boolean algebra spans several decades, and she has encouraged other research mathematicians to be actively interested in education and educational reform. She has helped influence and shape policy and practice in education through her service on committees such as the MSEB Panel on College and University Programs, the AMS Committee on Education, and the MER Advisory Board and has assumed critical leadership roles over the last two decades. She was AWM president from January 1979 until January 1981.

She has encouraged and mentored young persons in mathematics and freely and expertly shares her knowledge and experience about research, teaching, and mathematical history and folklore.

Elementary teachers have benefited from the workshops that Professor Roitman has directed. The standards of excellence and high expectations of Professor Roitman and her staff have inspired and motivated these teachers to share their new knowledge of both mathematical content and educational practice district wide. In addition to the local impact of these projects, Professor Roitman has been active on the state level and currently serves as a board member of the Kansas Mathematics and Science Education Coalition.

Professor Roitman believes that postsecondary institutions need to acknowledge their responsibilities to K-12 and has disseminated her thoughts broadly through invited talks, publications, and electronic networks, as well as informal conversations and interactions.

Professor Roitman is truly a model of a research mathematician who maintains substantive involvement in mathematics education.

Response
Receiving the Louise Hay Award is a great honor, and it is an even greater honor to share it with Glenda Lappan.

I don't know if the Hay Award committee planned it this way, but sharing the award with Glenda is a most welcome symbol of the cooperation needed among mathematicians, researchers in mathematics education, and teachers. It has been a privilege to be part of the emerging dialogue among and within these communities and to be part of the emerging community of research mathematicians involved with K-12 education. It is as a member of this community that I accept this award.

Our work is hampered, however, by not being part of the ordinary life of a research department. Even in a department like mine, where 20 percent of the faculty has been seriously involved in K-12 activities in the last few years, access to resources—both money and time—is neither routine nor reliable. It is important that research mathematicians be involved in K-12 education and our community recognizes this, but this has not yet been reflected in the way our universities and departments are organized. Receiving this award gives me a very public opportunity both to point out the problem and to hope for its solution.

AWM has been an important part of my life since early graduate school days, and I am most grateful to it. Of all the teachers and students I have learned from over the years, I would especially like to acknowledge the elementary and middle school teachers I have worked with in the last few years and two teachers of my own, whose care for and trust in students I can only hope to approximate: from graduate school, Mary Ellen Rudin, and from undergraduate school, Ed Cogan. Thank you.

-AWM
At the Joint Mathematics Meetings in Orlando in January, the Mathematical Association of America (MAA) presented a number of awards. Presented below are the citations for the awards.

Haimo Awards for Distinguished College or University Teaching
In 1991 the MAA instituted Awards for Distinguished College or University Teaching of Mathematics to honor college or university teachers who have been widely recognized as extraordinarily successful and whose teaching effectiveness has been shown to have had influence beyond their own institutions. In 1993 the MAA Board of Governors renamed the award to honor Deborah and Franklin Tepper Haimo. Deborah Tepper Haimo was president of the MAA (1991–1992).

Citation: Thomas F. Banchoff
Letters from former students stretching over a period of 30 years express their appreciation for Professor Banchoff’s engaging and challenging teaching techniques in the most glowing terms. Typical examples include:

"I have never been a student in a more delightful or effective class in my life, and from my own teaching at Harvard and Stanford I know just what a gift it is to be able to do what Banchoff did."

"What a teacher! He certainly had a major impact on my life and was one of the reasons I finally decided to become a mathematician. It would be hard to find a candidate more deserving than Tom." (The writer is now professor of mathematics at Yale University.)

Professor Banchoff is always ready to discuss educational issues with his colleagues and graduate and undergraduate student teaching assistants. He is an author of a widely used MAA volume on the training of teachers. He has been involved in many of the innovations in mathematics teaching at Brown, from the Summer Transitional Program for Minority Students in the late 1960s to his course in the Fourth Dimension, begun under the rubric of the Modes of Thought program in the New Curriculum and now a permanently established course. He is best known for his work in computer graphics, in collaboration with computer science colleagues and student assistants, beginning with the award-winning film "The Hypercube: Projections and Slicing" and extending to his current projects in interactive computer laboratories for multi-variable calculus and differential geometry.

Although Professor Banchoff has spent the greatest part of his efforts with undergraduate students, he also has had six Ph.D. students who have gone on to college and university teaching. It is no surprise that three of them have won teaching awards at their own institutions and a fourth is working in a post-doctoral position at the Geometry Center at the University of Minnesota.

When two years ago President Vartan Gregorian of Brown University announced the creation of awards for teaching excellence at Brown University, Professor Banchoff became the first recipient of the Philip Bray Award for Teaching in Natural Sciences. His nomination for that award ended as follows: "If the term 'great' is reserved for the departed, as it should be, then the
term that best describes Thomas Banchoff is 'Master Teacher.' This accolade, together with the long list of successes achieved by Professor Banchoff in his superb teaching, makes him an exceptionally strong candidate for the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics. It is a great pleasure to be able to pay tribute to his extraordinary teaching success in this way.

Citation: Edward M. Landesman
Professor Landesman's effectiveness as a teacher encompasses the full mathematics curriculum, from calculus and linear algebra to real and complex analysis, as well as all types of classroom situations—large classes held in lectures to small advanced seminars. Whenever he teaches in the core courses required or encouraged of majors, enrollments surge. Students often put off taking a course until he teaches it. His teaching evaluations provide incontrovertible proof of the esteem students have for his teaching; ninety-five percent invariably rate him excellent.

His classes are incredibly well prepared. He is constantly finding new and better ways of presenting the material, and during his office hours his office is swarming with students, indicating a very welcoming attitude toward them. Many of his undergraduate students have gone on to earn Ph.D.s in mathematics, and he has supervised as many Ph.D. students as anyone else in his department. With these students he creates a close personal relationship, and they continue to turn to him for advice and tell of their successes.

His contributions to mathematics education extend far beyond the classroom in a variety of ways and media, all of which have gained significant notice through professional articles or newspaper features: He has, since its inception, been co-director of the Monterey Bay Area Mathematics Project, through which he has helped over 200 pre-college teachers to upgrade their mathematics and instructional skills; he has written a linear algebra textbook; and, as a pioneer in the use of media in technology for teaching mathematics, [he has] produced many high-quality videotapes for precalculus and interactive videodisk modules for learning mathematics. Recently he has started an honors mathematics high school in Santa Cruz County.

As one of his students, now a college teacher of mathematics, put it: "I can't emphasize enough the significant role Ed has played in shaping both my mathematics and teaching careers. Ed's successes as a teacher of mathematics are reflected in his popularity among undergraduate and graduate students and serve as a model and inspiration to me in my own teaching. It is with the utmost respect and admiration that I reflect upon Ed's teaching and acknowledge how fortunate I was to be instructed by the greatest teacher I have ever known."

By both his example and his advocacy of the need to improve instruction, Professor Landesman sets the standard for teaching to which the rest of his department aspires. He has mentored junior faculty. He has more to offer than nuts and bolts advice: he is also acquainted with recent research on everything from epistemology to cognitive science, whatever will be useful in helping students to grasp the beauty and power of mathematics. For this, he has won numerous awards, including the 1994 UCSC Alumni Association's Distinguished Teacher of the Year Award and was one of three awardees (from over 100 nominations, the only one in mathematics) of a 1987 Excellence in Teaching Award from the Northern California Phi Beta Kappa Honor Society. It is, therefore, only fitting that the MAA joins the many organizations that have previously recognized Professor Landesman's outstanding accomplishments by awarding him the Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics. It is a great pleasure to be able to do so.

Citation: Herbert S. Wilf
Professor Wilf has been considered one of his department's master teachers ever since he started at the University of Pennsylvania in the 1960s. In the course evaluations' standard questions "rate the teacher on a scale from 0-4" his rating has never been below 3.5, and scores of 3.9 and even higher are plentiful. Students' comments are always glowing. The following are typical ones from his calculus courses:

"Wilf is God. He is a great teacher, he is very accessible and helpful, and he makes a nasty course seem straightforward...." "Professor Wilf is great. He is generally concerned that we learn what's going on; I did not miss one class! I learned a lot from him. ..." "Dr. Wilf gives understanding and insight into the seemingly inexplicable."

A typical comment from his combinatorics class: "Before I took his class, combinatorics was just one branch of mathematics; now thanks to Dr. Wilf, I see combinatorics as something that is theoretically sound, intellectually challenging and interesting at the same time. I am very glad that I took this class; not only have I learned a lot, but also I enjoyed every single lecture and gained a new perspective on the subject."

Similar comments from other students illustrate the effectiveness of his teaching style, his concern that students understand clearly everything that is going on in class, his dedication to the students as evidenced by his outside-of-class availability, and the innovative nature of
the curricula he presents—students often refer to the fact that they are excited to be using current mathematics literature and working on projects that involve unsolved problems.

Twenty people have the distinction of having had Professor Wilf as their Ph.D. thesis advisor. He has been unusually successful in attracting students to the field of combinatorics, and his students have been unusually successful completing their Ph.D.s. As one of his Ph.D. students wrote: "Many academics feel grateful and even devoted to their Ph.D. supervisor. I hope to convey reasons why my praise goes beyond such emotions because of Professor Wilf's distinction and excellence as a teacher, scholar, and person."

"Professor Wilf has done more than lecture clearly and enthusiastically and contribute substantially to research in the field of combinatorics. He really shaped it by exploring algorithmic aspects of this discrete subject and so forged an important connection with theoretical computer science as that field was also developing. But for his graduate students and many undergraduates, Professor Wilf did even more. He listened and advised about suitable research problems, but then he left us to find our own way in this first research endeavor ..."

Professor Wilf has written extensively for students of mathematics and for teachers of mathematics. His (at least) seven books on subjects ranging from calculus to algorithms to generating functions to FORTRAN are models of clear and effective writing. As one of his former graduate students put it, "Professor Wilf writes as well as he speaks."

This certainly does not exhaust the list of activities in which Professor Wilf has been a champion of good mathematics and of the effective communication of good mathematics. In over 120 publications ranging from books to essays to research articles, he has inspired several generations of mathematical scholars and students in other disciplines as well. His unusual success as an effective communicator of good mathematics clearly qualifies him superbly for a Deborah and Franklin Tepper Haimo Award for Distinguished College or University Teaching of Mathematics. It is a great pleasure to be able to honor him by conferring this award upon him.

Educom Medal

The Educom Medal was established in 1994 to assist in improving "the quality of the undergraduate learning experience and to promote the effective use of information technology in higher education." Educom works with professional societies, this year with the MAA, identifying people who have "addressed a significant pedagogical problem fundamental to the discipline, provided an innovative solution offering clear advantages over other techniques, and demonstrated substantial impact on improved student learning." The recipient this year was chosen by the MAA's Committee on External Awards (Kenneth M. Hoffman, Donald L. Kreider (chair), and David A. Sanchez).

Citation: David A. Smith

David A. Smith has dedicated his professional life to his students, to mathematics, and to a vision of dramatically improving mathematics education through the use of computers and emerging technologies. For him it has been more than a vision. He has prodigious energy, and his sustained effort in academic computing has influenced many of his colleagues and associates across the country to follow his lead.

David was an early pioneer in the field of academic computing. He was mathematics editor for CONDUIT during the 1980s. He has served as associate editor for Mathematics Magazine and The College Mathematics Journal and as software reviews editor for UME Trends. He provided strong leadership as chair of the MAA's Committee on Computers in Mathematics Education and has served on the advisory committee of the Interactive Mathematics Text Project, which was strongly influenced by his work.

David is, perhaps, best known for Project CALC, a program developed by him and L. C. Moore at Duke University. Project CALC, which covers three semesters of calculus, was an early example that demonstrated to the mathematical community what calculus reform can be. Through numerous workshops and lectures on Project CALC, David encouraged faculty across the country to use the Project CALC materials and its philosophy. The primary innovation of Project CALC, David says, is seen in its title—Calculus As a Laboratory Course, not calculus with a lab. He was an early proponent of students discovering mathematics for themselves and becoming involved in doing mathematics through guidance and stimulation of well-structured labs. Writing became such an integral part of his students' work that Project CALC classes at Duke became part of the University's "Writing across the Curriculum" program. Few educational reform efforts have been so carefully evaluated as has Project CALC. From the beginning, the project has been evaluated in many ways by Jack Bookman, a Duke faculty member with Ph.D. in mathematics education and a specialist in evaluation. This careful and thorough evaluation has become a model for other calculus reform efforts.

David has received many grants and awards for his work and has directed several NSF grants devoted to computing in the curriculum. In 1991 he received, with L. C. Moore, Educom's Award.
for Best Curriculum Innovation in Mathematics. It is no surprise to anyone involved in recent mathematics reform efforts that David has been selected as recipient of Educom’s newest and most prestigious award, the Educom Medal. Recipients of this award must have addressed a significant pedagogical problem fundamental to the discipline, must have provided an innovative solution offering clear advantages over other techniques, and must have demonstrated substantial impact on improved student learning.

David was an ideal candidate for the nomination committee that recommended him to Educom. His lifelong work in mathematics and academic computing, the stimulation that he has provided to his peers, and his supreme dedication to his students and to excellence have sharpened the meaning of the Educom Medal’s stated requirements. Educom and the Mathematical Association of America are proud to be able to honor David Smith through the award of the Educom Medal.

Beckenbach Book Prize
The Beckenbach Book Prize, established in 1986, is the successor to the MAA Book Prize. It is named for the late Edwin Beckenbach, a long-time leader in the MAA publications program and a well-known professor of mathematics at the University of California at Los Angeles. The prize is awarded for distinguished, innovative books published by the MAA.

Citation: Constance Reid
Most mathematicians are acquainted with the work of Eric Temple Bell. A number theorist and president of the Mathematical Association of America, he was also the author of popular expositions of mathematics and of entertaining, if sometimes fanciful, accounts of its history. Constance Reid’s *The Search for E. T. Bell* introduces us to the man behind these accomplishments. Part biography and part detective story, Reid’s book unravels the mystery of Bell’s early years and leads us through his prodigious nonmathematical works, including epic poetry and science fiction published under the pseudonym John Taine. Reid summarizes Bell’s research in number theory with the clarity that typifies her approach to mathematical biography, and her description of the influences on his mathematical development contributes valuable details to our understanding of the history of American mathematics.

*The Search for E. T. Bell* is a fascinating, informative, and readable account of an enigmatic mathematical personality. With her investigation of the human side of E. T. Bell, Constance Reid has once again performed a great service for the mathematical community. This outstanding book fully deserves its place among recipients of the Beckenbach Book Prize.

Chauvenet Prize
The Chauvenet Prize for expository writing, first awarded in 1925 to Gilbert Bliss of the University of Chicago, is given for an outstanding expository article on a mathematical topic by an MAA member. The prize is named for William Chauvenet, a professor of mathematics at the United States Naval Academy. It was established through a gift in 1925 from J. L. Coolidge, then MAA president.

Citation: Joan S. Birman
The 1995 Chauvenet Prize is awarded to Joan Birman for her article “New points of view in knot theory”, which appeared in the *Bulletin of the AMS, 28* (April 1993), pages 253-287. This marvelous article does everything one might want an expository account of a subject to do.

It is all of these, at the same time:

- It is an article that one can give to a student who is just about to take a first course in knot theory. Birman sets down vividly, precisely, and agreeably the basic definitions, aims, intuitions, examples in the theory. Her article even provides at one point a sketch, readable by any student, of a proof of an important foundational matter which cannot be found elsewhere.
- Birman’s article conveys the marvelously Protean nature of the subject matter and of its history—including a sympathetic recollection of important ideas occurring in the early papers of Alexander, a discussion of the efforts of classification of knots in the nineteenth century by the physicist P. G. Tait and others, as well as the more recent startling connection to von Neumann algebras which are factors of type II stemming from the work of Vaughan Jones.
- As announced by its title, her article describes the “new points of view”. Someone who had no inkling of these new developments, e.g., of the HOMFLY polynomial, the Kauffman polynomial, the quantum group invariants—alias “generalized Jones invariants”, the ideas of Arnold and Vassiliev on the “moduli space” of all knots—including degenerate ones—and the “Vassiliev invariants” that one can deduce from the study of this “moduli space”, and the connections between these collections of new invariants can get a clean explanation of parts of this exciting work, including a sense of the swarm of open problems that remain, from Birman’s article.

The instructions for the Selection Committee say that “preference should be given to papers
that come within the range of profitable reading for members of the Association." Birman's article is particularly appropriate in this regard. It provides something for everyone and does so with clarity and spirit.

**Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics**

The Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics is the most prestigious award made by the MAA. This award, first given in 1990, is the successor to the Award for Distinguished Service to Mathematics, awarded since 1962, and has been made possible by the late Dr. Hu and his wife, Yueh-Gin Gung. It is worth noting that Dr. Hu was not a mathematician. He was a retired professor of geology at the University of Maryland. He had such strong feelings about the basic nature of mathematics and its importance in all human endeavors that he felt impelled to contribute generously to our discipline.

**Citation: Andrew Gleason**

Andrew Gleason was born in Fresno, California, in 1921, received most of his schooling in Yonkers, New York, and went to Yale, where he was in the top five in the Putnam Competition for three years in a row. After four years of active and fortunately mathematical duty in the Navy, he became a Junior Fellow at Harvard in 1946. With some time out for further active duty during the Korean War, he has been at Harvard ever since, becoming a full professor in 1957. His wife, Jean Berko Gleason, is professor of psycholinguistics at Boston University; they have three daughters, Katherine, Pamela, and Cynthia.

In thinking about, and admiring, Andy Gleason's career, your natural reference is the total profession of a mathematician: designing and teaching courses, advising on education at all levels, doing research, consulting for the users of mathematics, acting as a leader of the profession, cultivating mathematical talent, and serving one's institution. Andy Gleason is that rare individual who has done all of these superbly.

His influence on mathematics education has covered over 40 years, and has been outstanding. He has been heavily involved in the thinking about mathematics education ever since the 1950s. A few examples: He was chairman of the Advisory Board to the School Mathematics Study Group; he organized the Cambridge Conference on School Mathematics; and he was on the Advisory Board to USMESA, the Unified Science and Mathematics program in the Elementary Schools. All of these, while controversial, were influential and thoughtful projects. He taught some elementary school math himself and pioneered re-

porting what didn't work as well as what did. He was the chief mathematical advisor to Houghton Mifflin and the Dolciani Series for many years and undertook many key tasks nationally, participating, for example, in the thinking that led to the establishment of the Mathematical Sciences Education Board. In recent years, Andy's "guiding hand", as Anneli and Peter Lax have described it, can be seen throughout Harvard Project Calculus. He has continued to be active in education since his 1992 retirement, working with the Massachusetts State Board of Education on curricular reform and with the Interactive Mathematics Project as a member of its Advisory Board.

The students at Harvard University, where Gleason was the Hollis Professor of Mathematics and Natural Philosophy, have been the beneficiary of many other curricular innovations besides Project Calculus. For example, he designed a second-year calculus experience truly integrated with linear algebra (the students took naturally to a rather abstract development) and developed Natural Sciences 1a (Euclid, Archimedes, and Newton, inter alia) as part of the Core Program at Harvard. Both of these show his strong sense of history in the teaching of mathematics and science.

His success in mathematical research has been outstanding. He was one of the major contributors to finishing the solution of Hilbert's 5th problem, and his research has had major influence in areas as apparently disparate as quantum mechanics and combinatorics. He has been known to explain that his strength is a thorough knowledge of the fundamentals, and he rarely, if ever, turns down a good problem. Gleason is a member of the National Academy of Sciences, a past president of the American Mathematical Society, and was both chairman of the organizing committee and president for the International Congress of Mathematicians at Berkeley in 1986. His mathematical tastes are very broad. Although he is classified as an abstract analyst, and this field encompasses the majority of his research papers, he has worked, and supervised dissertations, in many fields of both pure and applied mathematics. The one I remember best is the thesis in algebraic coding theory of Jessie MacWilliams, whom he helped to develop into one of the outstanding women mathematicians of our time. Many of his students agree that his quickness in thought and understanding make him a tough supervisor. He once characterized his main function in working with future Ph.D.s as giving them the opportunity to find out how good they are!

Gleason organized a group on coding theory, which met monthly for about ten years, and which included Ed Assmus, H. F. Mattson, Jr.,
John N. Pierce, Vera Pless, and Gene Prange among its “regulars”. Gleason’s interest in coding theory and cryptography extends beyond his own research, and that of a number of his students, to his consulting both for industry and for the nation’s intelligence and security programs for over 50 years. He worked with both NSA and IDA and consulted at many levels. In summary, as David Lieberman has put it, “It has been inspiring to review and comprehend the role which he has played in shaping the science, the teaching, and the application of mathematics, both through his own contributions and through the many lives and careers he has so strongly influenced.”

Certificates of Meritorious Service
The Certificates of Meritorious Service are presented for service to the MAA at the national level or for service to a section of the Association. The first such awards were made in 1984. At each January meeting of the Association, honorees from roughly six sections are recognized.

This year’s honorees are: Marvin L. Brubaker, Eastern Pennsylvania and Delaware Section; Robert Buncrot, Metropolitan New York Section; Sylvan Burgstahler, North Central Section; Donald W. Bushaw, Pacific Northwest Section; and Donald V. Meyer, Iowa Section.

—MAA
The AMS Committee on the Profession (CoProf) is charged—as are the other AMS policy committees—with periodically reviewing AMS activities within its purview. This is a summary report, written by the Subcommittee on Employment Issues and adopted by CoProf, on activities in the area of Ph.D. employment.

Background
The harsh employment environment over the past five years is a major problem facing the profession. Is this just a cyclical demand-vs.-supply trough, deepened by general economic retrenchment and the singular influx of mathematicians from China and Eastern Europe? Or does it reflect the inevitable end of exponential growth in basic science as a whole, accompanied by fundamental changes in public attitudes toward academia? Thoughtful analyses can be accessed from CoProf’s e-MATH page [2] or from News/Commentaries on SIAM’s gopher [3] or from Geoff Davis’s policy page [4].

What should the profession and, in particular, the Society do?

The 1991 Task Force
In 1991 the Society formed a Task Force on Employment, whose report is available on e-MATH [5]. The task force postulated that continued robustness of the profession requires broader training of mathematics Ph.D.s to prepare them better to meet the full range of society’s mathematical needs. To this end the AMS should foster wider recognition of the possibilities and challenges of nonacademic employment, and it should encourage doctoral programs to place more emphasis on development of teaching and communication skills.

The task force recommended further that the Society advocate for a larger pool of postdoctoral positions with imaginative teaching and/or industrial components to strengthen professional development of mathematicians. In addition, the task force called for promotion of industrial internship programs as a means of developing awareness of each other’s potential value among both employers and mathematicians. (In 1993 CBMS submitted a proposal to the NSF for establishing postdoctoral fellowships with major emphasis on research, educational, interdisciplinary, or industrial experience. The NSF subsequently funded fifteen industrial fellowships. Another proposal to study the feasibility of a national industrial internship program was not funded.)

The task force also discussed expansion of academic employment opportunities, recognizing that universities are generally cutting back, so that very cogent arguments will be needed by mathematics departments to back up requests...
for additional resources. Areas which could be explored are:

1. The need for small classes to improve the quality of mathematics instruction.
2. The designing of courses that can entice students preparing for other careers where mathematics can be useful.

A related recommendation is the expansion of professional master's programs. (The AMS has commissioned a Task Force on Excellence in Mathematics Scholarship, whose report is expected in 1997. This report should be of considerable value in negotiations with administrators about departmental needs.)

For the shorter term the task force recommended upgrading electronic employment services, designing of a standard cover sheet for academic employment applications, and recruiting more nonacademic employers for the annual Employment Register. They also recommended holding seminars and intensive workshops dealing with specific employment areas such as teaching in two-year or four-year liberal arts colleges and careers in government, commerce, and industry. Their idea of organizing full-scale workshops outside the setting of national meetings has not as yet caught on. (MAA did sponsor a minicourse, by Curtis Bennett and Richard Phillips, on "Today's Job Market for Math Ph.D.s", at the January 1995 San Francisco meeting.) In all other respects these short-term recommendations have been implemented by JCEO (see Ongoing Employment Services below).

CoProf
At its first semiannual meeting (October 1993) CoProf undertook a review of AMS actions taken pursuant to the task force report. The results are discussed below (Task Force Follow-up).

At the same meeting CoProf drafted a statement on "Supportive Hiring Practices", which was adopted in essence by the Council in January 1994 [6]. A similar statement has been adopted by MAA and AWM. It calls on Ph.D.-granting departments to ensure that their students are aware of the realities of the job market and to prepare them for a broad range of careers. It urges departments to make every effort to make multiyear appointments and to eliminate altogether exploitative part-time positions.

The statement was widely publicized in the national press. CoProf discussed proposals that the AMS call for a reduction in the size of graduate programs, especially "weaker" ones. The consensus of the committee is embodied in the following extract from a statement on "Graduate Programs in Mathematics", adopted by the Council in January 1995. (The full statement appeared in the June 1995 Notices, p. 690 [7]. For a more global view, see also the National Academy report, "Reshaping the Graduate Education of Scientists and Engineers", National Academy Press, Washington, DC, 1995 [8].)

It is not the Society's role to attempt to regulate the size of graduate programs in mathematics. However, we urge individual departments to re-examine the content, focus, and size of their programs and consider possible restructuring or reallocation of resources to better serve their needs and the needs of their students and graduates. In some cases this may involve shifting resources from graduate programs to postdoctoral programs or from Ph.D. programs to master's programs. It may also involve broadening the training of graduate students to prepare them for nonacademic as well as academic careers.

Addressing the interlinked questions of graduate education and employment of mathematicians is and will remain a high priority for the American Mathematical Society. The Council pledges to continue to commit Society resources and efforts to help enhance career opportunities for its members.

Task Force Follow-Up
In May 1994 CoProf recommended that the AMS continue to work along lines recommended by the task force, especially through its unique capabilities to gather and disseminate the information people need for making intelligent decisions on matters related to the employment situation.

Here, in brief, are some particular suggestions made and related outcomes.

- Publicize related activities of other professional organizations. Outstanding examples are (a) SIAM's "Mathematics in Industry" (MII) project ([9], final report at [10]), as well as Mathematics That Counts [11], and (b) a multiyear project of the Joint Committee on Preparation for College Teaching [12]. Also, the Young Mathematicians Network has set up an excellent informational resource on its WWW home page [13]. CoProf sponsored a talk by Paul Davis, the director of MII, at the 1995 annual meeting. The AMS-SIAM Sloan-funded project (see below) is building, in part, on material developed by SIAM's project.
• Substantive information on the history and present state of the job market should be made available to all members of the mathematical community, for example, in regularly appearing articles. See "Mathematical Employment in the 1990's", which appeared in the 1994 edition of Assistantships and Graduate Fellowships in the Mathematical Sciences. See also the recently revised JCEO pamphlet "Seeking Employment in the Mathematical Sciences" [14].

• Continue to sponsor talks and panel discussions concerning employment issues at national meetings. Moreover, these talks and discussions should be made available to those who cannot attend. At the 1995 annual meeting CoProf sponsored a talk by Stanley Benkoski of Wagner Associates on "Preparing for a Job outside Academia"; see [15] or the October 1994 Notices, pp. 917-919. At the 1996 Orlando meeting Annalisa Crannell, a member of CoProf's Employment Issues subcommittee, moderated an MAA-sponsored panel discussion on applying for jobs. For the summer 1996 Seattle meeting she is organizing a three-hour CoProf-sponsored program on "Preparing Ourselves and Our Students for Careers in Mathematics".

• Set up e-MATH directories on employment and career matters containing copies of the most relevant articles as well as guides to further reading and make provisions for ongoing publicity and maintenance of these directories. CoProf's e-MATH page [2], [17] now points to a number of such articles. Several other electronic sources have been mentioned above.

• Publish descriptions, from which others could draw inspiration and practical advice, of graduate programs which stand out in preparing students for careers in teaching, in interdisciplinary work, or outside academia. Models for such publication are the SIAM booklet on "How to Start an Industrial Mathematics Program in the University", by Friedman and Lavery, and the MAA publication "You're the Professor, What's Next?" [16]. Another fine example is the article by James Glimm on the Stony Brook program in industrial mathematics, "Mathematics Speaks (and Listens) to Industry", SIAM News, January 1995.

Ongoing Employment Services
Through both bad and good times the AMS has provided a variety of employment information and data-gathering services, sponsoring the AMS-MAA-SIAM Joint Committee on Employment Opportunities (JCEO) and the AMS-IMS-MAA Data Committee.

The most visible activity of JCEO is the Employment Register run at the annual winter meeting. Recent years have seen substantial improvements in the scheduling algorithm and procedures used to bring applicants and employers together and in the arrangement of physical facilities. In addition, JCEO has organized panel discussions and help programs for applicants. For example, at the Cincinnati annual meeting (January 1994) there were panel discussions on "Effective job seeking in today's market" and on "What can be done about employment of mathematicians in the 90s and beyond?"

Registration procedures and information exchanges will be transformed in coming years to an electronic format. This will result in major qualitative changes in the delivery and use of employment information and interview services.

Efforts have been undertaken to increase nonacademic employer participation in the Register. In view of the oversupply of qualified candidates in the present job market, such efforts have met with limited success.

The applicant/employer ratio at the Register has gone from 1.6 in 1988 to 7.6 in 1995, while the number of applicants per position has gone from .8 (for 418 positions) to 7.6 (for 108 positions). (The rise in this ratio was one of the earliest among the belatedly noticed indicators of deteriorating demand for mathematics Ph.D.s in the 1990s. Another widely available one was the experience of new Ph.D.s at one's own institution.)

JCEO oversees the publication of "Employment Information in the Mathematical Sciences" (EIMS), the most complete listing of open positions for mathematicians. Classified and other ads appear in each issue of the Notices as well. EIMS also contains informative articles on employment issues. The EIMS listings can be found on e-MATH [17], as can selected articles from past issues and the full text of the JCEO pamphlet "Seeking Employment in the Mathematical Sciences" [14].

JCEO has sought to help alleviate growing strain on both sides of the academic employment process by distributing a uniform Application Cover Sheet [18], along with recommendations for Professional Standards in Hiring Practices, both of which appear regularly in the Notices (for example, February 1996, pp. 236-237).
Surveys
The Data Committee is a joint committee of the AMS, IMS, and MAA. It is charged with coordinating the data collection, analysis, and reporting activities of the three sponsoring societies.

The principal activity of the committee is the design and analysis of the Annual Survey. The survey reports on employment experiences of new Ph.D.s in mathematics, statistics, biostatistics, applied mathematics, and operations research. It also reports on salary levels of new doctoral recipients and on salaries of mathematical sciences faculty at all levels in four-year colleges and universities. Recent annual reports have also studied recruitment of faculty for academic positions at four-year colleges and universities in the USA. Reports on the Annual Survey are published in the Notices; see [19].

The Data Committee routinely provides support for the information needs of other professional undertakings, such as the AMS Task Force on Employment and the SIAM project on Mathematics in Industry. In response to a recommendation of the employment task force, the Data Committee has recently completed a longitudinal study of employment experiences of 1990–91 doctoral recipients. This Employment Profile Survey was reported in the July 1995 Notices [20].

There is continuing demand from the community for more information about employment. Currently, for example, the Committee is considering suggestions to extend the longitudinal study and to determine characteristics of the full population of job seekers.

The Sloan Project
In 1994 the Sloan Foundation, concerned about employment prospects of young scientists across the board, invited professional societies to submit proposals for actions to alleviate the problem. A response from the AMS and SIAM resulted in a $345,000 grant for a joint project. The following description is excerpted from the announcement on pp. 64–65 of the January 1995 Notices [21].

The project will forge links between the academic mathematical sciences community and business, industry, and government. Its centerpiece will be the creation of a database of profiles of individuals who use mathematics extensively in their work. The profiles will describe the individuals’ jobs, mathematical backgrounds, and additional training they needed for their work. Case studies of individuals will be accessible over the Internet, will appear in the news public-

Under the direction of Dr. Linda C. Thiel of Ursinus College, the project is now well underway. Dr. Thiel presented an update in a CoProf-sponsored session at the 1996 Orlando meeting. A Mathematical Careers Bulletin Board, a Mathematical Applications Index, and additional career planning resources can be found at [22].

The project is intended to be not just a temporary response to a bad job market, but rather the foundation for a permanent community resource.

Conclusion
In addition to providing traditional employment services, the Society has responded actively to the present severe situation. Much remains to be done. CoProf welcomes input from the membership on all matters concerning the profession. Comments and suggestions concerning employment-related policy can be directed to the Subcommittee on Employment Issues, cp-emp@ams.org.

References
The University of Rochester is feeling the heat of the public outcry over the elimination of its graduate program in mathematics. In a tartly worded memorandum, the administration proposed a plan whereby the graduate program would be restored, but only if other departments chipped in to pay for it. The Mathematics Department, emboldened by the strong support it has garnered outside the university, firmly rejected the proposal.

The story began last November, when Rochester unveiled a downsizing plan that called for deep cuts in the Mathematics Department. The Ph.D. program would disappear, the faculty would be reduced from twenty-one to ten, and adjuncts would be hired to teach lower-level courses. The university has received about one hundred letters from mathematicians, scientists, engineers, and industrialists protesting the cuts. The controversy has also sparked coverage in the popular press.\(^1\)

In a memorandum sent in January to selected department chairs, the administration proposed a way to test the contention, set forth in many of the letters of protest, that a mathematics Ph.D. program is essential to successful science and engineering programs at a research university. "If that contention is correct," the memorandum says, "then we believe nonmath departments should be willing to contribute financially to a Ph.D. program outside their department that will prevent their own research from becoming inferior." If science and engineering departments put up the funds, then the administration would agree to a "focused" Ph.D. program run by thirteen mathematics faculty.

The proposal also outlined a mini public relations plan, in case the funds were not forthcoming. First, the Mathematics Department would have to issue a joint press release with the administration conceding that the other departments did not believe that a graduate program in mathematics is essential. In addition, the department would have to agree to "acknowledge this point in any external communications that it makes thereafter critical" of the university's decision. Finally, the proposal includes a draft statement from the "Mathematics Department Leadership" that the department would have to adopt, saying that the administration had "read relevant faculty sentiment more accurately than we have and that its action is consistent with a rationally held belief that, given financial constraints, this action was institutionally sound."

In reply, the Mathematics Department flatly refused to make any such statements and rejected the entire proposal as a "plan designed to fail." They pointed out that the original downsizing plan stated that decisions about which programs to cut had to come from the administration, not from a collective decision of the faculty. "We find it inconsistent that you are now proposing that the faculty make these decisions in such a way that the deck is stacked," the department wrote. In addition, recognizing that other departments suffered cuts in the downsizing, the department declared, "We are sympathetic with their reluctance, and in some cases their inability, to volunteer further cuts." In another memorandum, this time to the entire faculty, the administration said that the department's refusal of their proposal "means that this specific claim of value [of the mathematics Ph.D. program] will not be tested, but the fact that they did not wish us to test it remains valuable information."

By mid-February, the acrimony seemed to have cooled. "We are not near a solution," said Mathematics Department chair Joseph Neisendorfer, "but now it's more civil." At the time of this writing, some headway had been made in the negotiations, though nothing could be made public. But one thing is clear: the off-campus outcry has given the department a powerful bargaining chip.

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\(^{1}\)Two articles in the March 1996 issue of the Notices provide more background, as does the e-MATH web page http://www.ams.org/profession/rochester.html.

—Allyn Jackson
## Backlog of Mathematics Research Journals

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**Backlog.** Information on the backlog of papers for research journals, primarily those published in North America, is reported to the Providence office by those editorial boards which elect to participate. The figures are an estimate of the number of printed pages which have been accepted, but are in excess of the number required to maintain copy editing and printing schedules.

**Observed Waiting Time.** The quartiles give a measure of normal dispersion. They do not include extremes which may be misleading. Waiting times are measured in months from receipt of manuscript in final form to publication of the issue. When a paper is revised, the waiting time between an editor’s receipt of the final revision and its publication may be much shorter than is the case otherwise, so these figures are low to that extent.

The observations are made from the latest issue published, before the deadline for this issue of Notices, from journals that have actually been received by a subscriber in the Providence, Rhode Island area; in some cases this may be two months later than publication abroad. If the waiting time as defined above is not given in the journal, if no new issue has been received since the last survey, or if the latest issue is for some reason obviously not typical, no times are given in this report and such cases are marked NA (not available or not applicable).
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NR means no response received.
NA means not available or not applicable.
* Special issue.
** From date accepted.
*** Date of receipt of manuscript not given in this journal.
AAAS Fellows Elected

Last fall, the American Association for the Advancement of Science (AAAS) announced the names of scientists elected as Fellows of AAAS. The Mathematics Section of AAAS elected four Fellows: M. DOUGLAS McILROY, AT&T Bell Laboratories; JILL P. MESIROV, Boston University; CLIFFORD H. TAUBES, Harvard University; and RUTH J. WILLIAMS, University of California, San Diego.

— AAAS

1996 ACM Fellows Named

Each year the Association for Computing Machinery (ACM) honors a number of ACM members for outstanding achievements in their fields of work and their significant contributions to ACM. This year 53 individuals were so honored and named Fellows of the ACM.

Among the new fellows are three AMS members: MICHAEL J. FISCHER, Yale University; MARIA M. KLAWE, University of British Columbia; and EDWARD M. REINGOLD, University of Illinois at Urbana-Champaign.

— from Communications of the ACM

Ian Stewart Receives Faraday Award

IAN STEWART has received the Michael Faraday Award for 1995 from the Council of the Royal Society. The Faraday Award consists of a medal and a gift of 1,000 pounds. It is presented annually to the scientist or scientists deemed to have done the most to further, in the United Kingdom, the public understanding of science.

Stewart is the director of the Interdisciplinary Mathematical Research Programme at the Mathematics Institute of the University of Warwick and Gresham Professor of Geometry at Gresham College, London. The award is made in recognition of Stewart's work in communicating mathematical ideas to the widest possible range of audiences.

A tireless popularizer of mathematics, Stewart has written 180 articles for newspapers and magazines in the UK and other countries. He has contributed to such publications as New Scientist, Scientific American, and Discover. His popular books are well known and widely read by the general public and by students; his best known, Does God Play Dice?, focuses on the theory of chaos and has been translated into twelve different languages. A sequel, The Collapse of Chaos, has recently appeared in paperback, and his new book, Nature's Numbers, was published in September of last year in the "Science Masters" series. Stewart has also contributed to many television and radio pro-
grams on science and has presented numerous public lectures.

—from Royal Society News Release

Eliasson Receives 1995 Salem Prize

H. ELIASON of the Royal Institute of Technology in Stockholm, Sweden, has been awarded the 1995 Salem Prize. Eliasson was honored for his work in the theory of dynamical systems and small divisors.

The Salem Prize, established in 1968, is given each year to a young mathematician who is judged to have done outstanding work in the area in which Raphaël Salem worked, primarily Fourier series and related topics. The selection committee for the 1995 prize consisted of J. Bourgain, V. Havin, P. Jones, Y. Katznelson, E. M. Stein, and J. C. Yoccoz.

—Salem Prize selection committee

Manuel Blum Receives ACM Turing Award

MANUEL BLUM, Arthur J. Chick Professor of Electrical Engineering and Computing Sciences at the University of California, Berkeley, has received the A. M. Turing Award of the Association for Computing Machinery (ACM). He was honored “in recognition of his contributions to the foundation of computational complexity theory and its applications to cryptography and program checking.”

Born in Caracas, Venezuela, in 1938, Blum received his B.S., M.S., and Ph.D. degrees at the Massachusetts Institute of Technology. He has been at Berkeley since 1968. Blum is renowned for his work on computational complexity, automata theory, inductive inference, cryptography, and program result-checking. During his career, Blum has received numerous awards, published 47 technical papers, and advised 26 Ph.D. students.

The ACM Turing Award is given annually for technical achievements in the field of computing deemed by a jury of leading professionals to be of lasting and significant importance to the computing community. It is accompanied by a prize of $25,000, contributed by AT&T.

—from Communications of the ACM

Deaths

WOODROW W. BLEDSOE, of Carlisle, PA, died on October 4, 1995. Born on November 12, 1921, he was a member of the Society for 44 years.

SAMUEL G. BOURNE, of the University of California at Berkeley, died on August 3, 1995. Born in April of 1916, he was a member of the Society for 55 years.

MELCHER P. FORES, professor emeritus of The College of Wooster, Wooster, OH, died on November 27, 1995. Born on September 18, 1911, he was a member of the Society for at least 25 years.

CARL S. HERZ, Redpath Professor of Pure Mathematics at McGill University, died on May 1, 1995. Professor Herz had also been director of the Institut des Sciences Mathématiques since 1993. Born on April 10, 1930, he was a member of the Society for 45 years.

HAROLD T. JONES, of Berrien Springs, MI, died on May 10, 1995. Born on December 22, 1925, he was a member of the Society for 47 years.

ANTONIE F. MONNA, professor emeritus of Utrecht University, the Netherlands, died on October 7, 1995. Born on March 10, 1909, he was a member of the Society for 32 years.

BETTY M. TANG, of Arizona State University, died on September 13, 1995. Born on July 17, 1956, she was a member of the Society for 14 years.

OLGA TAUSKYY-TODD, of the California Institute of Technology, died on October 7, 1995. Born on August 30, 1906, she was a member of the Society for 60 years.

EDMUND H. UMBERGER, of Carlisle, PA, died on June 30, 1995. Born in May of 1913, he was a member of the Society for 57 years.

ALBERT LEON WHITEMAN, professor emeritus of the University of Southern California, died on December 9, 1995. Born on February 15, 1915, he was a member of the Society for 58 years.

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Mathematics Opportunities

U.S.-Mexico Collaborative Research Opportunities

The National Science Foundation (NSF) of the U.S. and the Consejo Nacional de Ciencia y Tecnología (CONACyT) of Mexico announce the continuation of a five-year pilot activity to support new efforts in international collaborative research and research infrastructure in computer science, information systems, and computer engineering.

The areas of interest include high-performance computing and communications, information infrastructure and technology, digital libraries, basic research in computer and information sciences and engineering, and all areas of engineering. Projects supported under this initiative must include researchers and educators in institutions from both countries. Corresponding proposals are expected from each side for binational awards under this initiative. Generally, NSF will administer and cover costs of U.S. investigators only, while CONACyT will administer and cover costs of Mexican researchers. Exceptions to this rule may include per diem for travel within the host country by visitors.

The total amount of support requested from NSF for a project under this initiative should be in the $5,000 to $100,000 range, with duration from one to three years, but larger or smaller grants may be awarded if appropriately justified. Activities supported by these grants may include research collaboration by individuals or small research teams in each country, workshops, short- and long-term visits by junior and senior research faculty and teaching faculty, undergraduate and graduate student exchanges, and short-duration learning experiences and exchange of technical experts.

For further information, consult the program announcement, NSF publication 96-4. A paper copy may be requested by sending e-mail to pubs@nsf.gov or by calling the NSF Publications Section at 703-306-1130. The program announcement is also available through the NSF's World Wide Web home page, http://www.nsf.org/. There are two deadlines each year in this program, on the second Tuesday in January and the second Tuesday in May. The next deadline is May 14, 1996.

—NSF Program Announcement

Call for Applications to Project NExT

Project NExT (New Experiences in Teaching) is a program for new or recent Ph.D.s in the mathematical sciences who are interested in improving the teaching and learning of undergraduate mathematics. Faculty who are just beginning or just completing their first year of full-time teaching at the college/university level are invited to apply to become Project NExT Fellows. Project NExT is sponsored by the Mathematical Association of America (MAA) with support from the Exxon Education Foundation.

The first event for the 1996-1997 Fellows will be a workshop, August 7-9, 1996, just prior to the Summer Joint Mathematics Meetings (the Mathfest) in Seattle, Washington. At this workshop, Fellows will explore and discuss issues of special relevance to beginning faculty, including:

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Mathematics Opportunities

calculus and pre-calculus reform, alternative methods of teaching and assessment, using technology in the classroom, lessons from pedagogical research, and the faculty member as teacher and scholar. The Fellows will also have an opportunity to meet and interact with the Fellows who began the program in previous years.

Invited speakers include: Gerald Alexanderson, Santa Clara University, MAA president-elect; Joseph Gallian, University of Minnesota-Duluth; Sol Garfunkel, Consortium for Mathematics and its Applications; Pamela Matthews, Mount Hood Community College; and Anita Solow, Grinnell College.

Following the workshop, Project NExT Fellows will attend the MathFest, August 10-12, 1996, participating in all the opportunities of that meeting and choosing among special short courses on issues in teaching and learning collegiate mathematics, including the pedagogical uses of graphing calculators and computers. During the following year, Project NExT Fellows will participate in: a network that links Project NExT Fellows with one another and with distinguished teachers of mathematics; special events at the Joint Mathematics Meetings in San Diego, California, in January 1997; and a workshop in the summer of 1997.

Approximately sixty Project NExT Fellows will be selected for the 1996-1997 year. Funding for room and board at the workshop in Seattle, Washington, and for the short courses at the 1996 MathFest will be provided by a grant from the Exxon Education Foundation. Institutions employing the Project NExT Fellows are expected to provide financial assistance. Limited funds are available to assist those institutions that are unable to afford full or partial support.

To apply, send the application form and chair's letter of support by April 26, 1996, to the address given below. Applications received after that date will be considered until all spaces are filled. Applicants will be notified by June 1, 1996, whether they have been accepted as Project NExT Fellows.

Applications and other inquiries should be sent to: James R. C. Leitzel, Department of Mathematics and Statistics, University of Nebraska-Lincoln, P.O. Box 880323, Lincoln, NE 68588-0323; telephone 402-472-7323; fax 402-472-8466; e-mail jml@unlinfo.unl.edu. Application forms may be obtained by writing to Leitzel; they are also available at the Project NExT World Wide Web site, http://archives.math.utk.edu/projnext/.

—Project NExT Announcement

Interdisciplinary Initiative in Materials Science

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) and the Applied and Computational Mathematics Program (ACMP) at the Advanced Research Projects Agency (ARPA) are developing a joint program to bring mathematical tools to bear on problems in materials science. The program will fund multidisciplinary teams of researchers working on projects having clear connections to industrial needs. Although at the time of this writing final approvals for the program had not been secured, the DMS and ACMP are confident that the program will proceed. The deadline has not been set, but it is anticipated that the time between the call for proposals and the deadline will be fairly short, probably a few months.

"This program is a fantastic opportunity for mathematicians to interact directly with scientific and engineering teams, from experiment to modeling, to theory and to the discovery and invention of new mathematical structures," says Ronald Coifman of Yale University. "Problems in materials science are extraordinarily varied and difficult, and traditional modeling by partial differential equations often fails to provide adequate macroscopic descriptions. It is quite clear that new mathematical paradigms for modeling need to be invented and integrated with computation and simulation."

"This is not, for DMS, a departure from individual investigator grants," explains DMS Director D. J. Lewis. "It is, rather, a new direction that we are exploring and is a broadening of our portfolio of research support mechanisms." The portion of the program's budget contributed by the NSF came from the new Office of Multidisciplinary Activities; none of the funding came from the core DMS budget. NSF would like to encourage mathematical scientists to collaborate with others on interdisciplinary research. For its part, ARPA recognizes that fundamental and applied research in mathematics has the potential to revolutionize much of the technology it seeks to develop. The two agencies created the program based on the rationale that many applications of deep mathematics are inaccessible to potential users in industry and in other scientific and engineering disciplines.

The new program will support research toward developing a design paradigm for new thin film processes in which computer simulations play a major role. Some computer modeling is currently used in this area, but extensive use of physical prototypes is still needed. ACMP director Anna Tsao says the ultimate goal, still decades away, is to eliminate the use of extensive physical prototypes. "We want to be able to create the perfect material for the user the first time, every time," she states.

The problems fall in three main areas: understanding basic thin film properties, understanding and controlling fabrication processes, and devising modeling and simulation techniques that lead to advances in the first two areas. Mathematical opportunities include: modeling, from the atomistic to the continuum; designing sensing, control, and optimization strategies from high-fidelity models; developing better numerical simulation techniques for the models; and developing statistical techniques for understanding the data describing materials properties and the sensing data arising in fabrication processes. It is critical that the mathematical models developed be validated against experimental data.

The program will support teams of researchers from the mathematical, physical, and computational sciences. The DMS and ACMP hope to put in place a process whereby interested mathematical scientists and engineers...
neers in other areas can establish contacts with each other, for the purpose of building teams and preparing joint research plans. The projects funded must have demonstrable connections to industry so as to maintain a focus on realistic long-term goals. The research must relate directly to experimental data and validation, but it is expected that the research groups will leverage existing experimental infrastructure and/or industrial connections.

Out of the total program budget of $4 million, a number of two-year grants will be made. In fact, DMS and ACMP are proceeding on the assumption that they will offer a three-year commitment to grantees, and they anticipate that the program will receive additional funds in fiscal year 1997. The typical grant is anticipated to be at least $1 million for the initial two years, but the size of the teams to be funded is not specified.

"It is possible that many of the tools needed already exist in some form within mathematics, but it is more likely that they will have to be invented, being inspired by existing techniques from core mathematics," Coifman notes. "It is quite obvious that the better the simulation and understanding of these processes, the easier it will be for industry to integrate them in production. The beauty of this program is that by integrating teams, from manufacturing to theory, we have both a reality check and mutual inspiration."

Because of the short window of opportunity for this program, those interested are urged to begin developing their ideas right away. By the time this issue of the Notices reaches its readers, further information about the program should be available on the World Wide Web, on the ARPA home page http://www.arpa.mil/ and the DMS home page, http://www.nsf.gov/mps/dms/. To gather ideas for the program, two workshops were held at the Institute for Mathematics and its Applications in January and February. Reports of the workshops are available from Anna Tsao, atsao@arpa.mil.

--Allyn Jackson

News from The Fields Institute

In 1997 The Fields Institute for Research in Mathematical Sciences will be sponsoring a program in Singularity Theory and Geometry. The organizing committee for the program consists of Edward Bierstone, Askold Khovanskii, Pierre Milman, Alex Nabutovsky, and Mark Spivakovsky (University of Toronto). All activities will take place during the period January 1997 to June 1997 at The Fields Institute in Toronto.

The program will concentrate on topics in the following areas: geometric and topological applications of singularity theory, resolution of singularities and subanalytic geometry, fewnomials and subanalytic sets, and geometry and complexity. The program will include three workshops: Real Algebraic Geometry, January 1997, organized by Selman Akbulut, Gregory Mikhalkin, and Oleg Viro; Geometry and Complexity, May 1997, organized by Askold Khovanskii, and Alex Nabutovsky; and Symplectic Geometry, June 23–27, 1997, organized by Yakov Eliashberg and Boris Khesin.

There will be at least three graduate courses during the period January–April 1997: Differential Topology and Geometry from a Recursion-Theoretic Viewpoint, taught by A. Nabutovsky; Fewnomials, taught by A. Khovanskii; and Resolution of Singularities, taught by E. Bierstone or P. Milman.

The Fields Institute is also planning to host several related activities, such as a workshop on The Model Theory of Analytic Functions (March 17–21, 1997, organized by A. Macintyre and D. Marker, related to subanalytic geometry) and a conference in honour of V.I. Arnold, the Arnoldfest (June 15–21, 1997).

The Fields Institute particularly invites applications from graduate students and young researchers who are interested in taking part in the program. Postdoctoral fellowships, graduate student fellowships, and support for short- and long-term visitors is available. The deadline to apply is June 28, 1996.

For further information, send a message to singular@fields.utoronto.ca or contact: Singularity Theory and Geometry Program, The Fields Institute, 222 College Street, Toronto, Ontario, Canada, M5T 3J1.

--from Fields Institute Announcement

News from the Mathematical Sciences Research Institute

The Mathematical Sciences Research Institute is planning a Mathematics in Finance Workshop for June 26–28, 1996. For information, see MSRI's World Wide Web page (http://www.msri.org/) or e-mail inquiries@msri.org.

--MSRI

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NOTICES OF THE AMS 455
For Your Information

New AWM Executive Director Appointed

The Association for Women in Mathematics (AWM) has appointed Carol A. Tascione as executive director, effective at the start of this year. Tascione taught mathematics at Okaloosa-Walton Community College in Niceville, Florida. For the past several years, Tascione has been a graduate student in mathematics education at American University and received her Ph.D. there last year. In addition to her work at AWM, she teaches part-time at Marymount University.

—from AWM Announcement

Humanistic Mathematics Network Journal

The Humanistic Mathematics Network Journal is a semi-annual publication devoted to the expression of thoughts and ideas about mathematics as a humanistic discipline. The journal carries a wide variety of articles, graphics, poems, puzzles, and other material that reveal the human side of mathematics. It is refereed and circulates worldwide.

The journal publishes articles about what mathematics shares with the humanities—art, music, poetry, etc. Examples of such connections are found in the nontechnical works of such mathematicians as Hardy, Poincaré, Weyl, Wilder, Bronowski, Hadamard, and Whitehead, to name a few. The purpose of the journal is to discuss the processes of creating, learning, and teaching mathematics and the similarities and points of contact it has with other humanities. Intuition, values, teaching and learning, and emotions all play a role in this perspective on mathematics.

Among the offerings in the most recent issue are a piece by J. D. Phillips on "Mathematics as an Aesthetic Discipline", a piece by Reuben Hersh on "A University Mathematician's View of What's Wrong with University Mathematics Education", and some poems about mathematics. Earlier issues have had essays by Philip J. Davis, Gian-Carlo Rota, Paul Ernest, Clarence Stephens, Rosemary Schmalz, Sherman Stein, JoAnne Gowney, and many others.

The Humanistic Mathematics Network is supported by a grant from the Exxon Education Foundation. Subscriptions to the journal are free of charge. To subscribe, send a letter or e-mail indicating your postal address to: Alvin White, Humanistic Mathematics Network Journal, Harvey Mudd College, Claremont, CA 91711; e-mail awhite@hmc.edu.

—Allyn Jackson

Educational Grants from Toyota USA

The Toyota USA Foundation has awarded grants totaling $240,000 to implement innovative educational programs. The University of Montana will receive $100,000 to develop a portable instructional laboratory to train kindergarten-through-grade-12 teachers in the state in the use of...
technology to enhance mathematics and science instruction. A $60,000 grant will provide seed money to expand the Summerbridge program for top students from seventh grade to college in Atlanta and Houston. Each site will select students with strong academic potential who face a variety of obstacles and enroll them in a two-year academic program of six weeks each summer.

Economics America of Louisville will receive an $80,000 grant for Economics at Work in Kentucky. The program will train Kentucky high school teachers in the use of a comprehensive curriculum based on fundamental economic concepts.

The Toyota USA Foundation is a $25.3 million charitable endowment dedicated to supporting unique education programs serving kindergarten through grade 12 in the U.S., with special emphasis on mathematics and science.

—for Toyota USA news release

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Everett Pitcher Lectures

The next series of Everett Pitcher Lectures will be held April 30, May 1, and May 2, 1996, on the campus of Lehigh University in Bethlehem, Pennsylvania. The speaker will be Carl Pomerance of the University of Georgia. The title of his talk will be “Primes: A Computational Perspective”.

The lectures, which are open to the public, are held in honor of Everett Pitcher, who was secretary of the AMS from 1967 until 1988. Pitcher served in the mathematics department at Lehigh from 1938 until 1978, when he retired as Distinguished Professor of Mathematics. Further information can be obtained by writing to Pitcher Lecture Series, Department of Mathematics, Lehigh University, Bethlehem, PA 18015, or by calling 610-758-3753.

—Department of Mathematics, Lehigh University

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President’s Breakfast Held in Orlando

Cathleen S. Morawetz, president of the American Mathematical Society, hosted a President’s Breakfast at the Joint Meetings in Orlando to recognize individuals who have made a special annual gift to the Society. The breakfast, which was held for the first time this year, will be held each year in conjunction with the Joint Annual Meetings.

During 1995 the AMS introduced a bequest and charitable gift annuity program. The program promotes support of the Society’s mission and provides interested individuals wishing to make a sizable charitable gift the opportunity to do so and to receive an annual income through a charitable gift annuity. Individuals interested in making a planned gift to the Society should contact Tim Goggins at 401-455-4110 or t@ams.org.

Joel Schneider and President Cathleen Morawetz. Left to right: William Chinn, Ronald Graham, and Leon Henkin.
Add this Cover Sheet to all of your Academic Job Applications

How to use this form

1. Using the facing page or a photocopy, (or a TeX version which can be downloaded from the e-math "Employment Information" menu), fill in the answers which apply to all of your academic applications. Make photocopies.

2. As you mail each application, fill in the remaining questions neatly on one cover sheet and include it on top of your application materials.

The Joint Committee on Employment Opportunities has adopted the cover sheet on the facing page as an aid to job applicants and prospective employers. The 1995-96 hiring season is the second year in which the cover form is being utilized. The form is now available on e-math in a TeX format which can be downloaded and edited. The purpose of the cover form is to aid department staff in tracking and responding to each application.

Mathematics Departments in Bachelor's, Master's and Doctorate granting institutions have been contacted and are expecting to receive the form from each applicant, along with any other application materials they require. Obviously, not all departments will utilize the cover form information in the same manner. Please direct all general questions and comments about the form to:
dmm@math.ams.org
or call the Professional Programs and Services Department, AMS, at 800-321-4267 extension 4105.

JCEO Recommendations for Professional Standards in Hiring Practices

The JCEO believes that every applicant is entitled to the courtesy of a prompt and accurate response that provides timely information about his/her status. Specifically, the JCEO urges all institutions to do the following after receiving an application:

(1) Acknowledge receipt of the application—immediately; and
(2) Provide information as to the current status of the application, as soon as possible.

The JCEO recommends a triage-based response, informing the applicant that he/she
(a) is not being considered further;
(b) is not among the top candidates; or
(c) is a strong match for the position.
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Current Institutional Affiliation

Highest Degree and Source

Ph.D. Advisor

If the Ph.D. is not presently held, date on which you expect to receive

Indicate the mathematical subject area(s) in which you have done research using the 1991 Mathematics Subject Classification printed on the back of this form. If listing more than one number, list first the one number which best describes your current primary interest.

Primary Interest

Secondary Interests (optional)

Give a brief synopsis of your current research interests (e.g., finite group actions on four-manifolds). Avoid special mathematical symbols and please do not write outside of the boxed area.

Most recent, if any, position held post Ph.D.

University or Company

Position Title

Dates

Indicate the position for which you are applying and position posting code, if applicable

If unsuccessful for this position, would you like to be considered for a temporary position?

- [ ] Yes  - [ ] No

If yes, please check the appropriate boxes.

- [ ] Postdoctoral Position  - [ ] 2+ Year Position  - [ ] 1 Year Position

List the names, affiliations, and e-mail addresses of up to four individuals who will provide letters of recommendation if asked. Mark the box provided for each individual whom you have already asked to send a letter.

- [ ]

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1991
Mathematics Subject Classification

00 General
01 History and biography
03 Logic and foundations
04 Set theory
05 Combinatorics
06 Order, lattices, ordered algebraic structures
08 General mathematical systems
11 Number theory
12 Field theory and polynomials
13 Commutative rings and algebras
14 Algebraic geometry
15 Linear and multilinear algebra, matrix theory
16 Associative rings and algebras
17 Nonassociative rings and algebras
18 Category theory, homological algebra
19 K-theory
20 Group theory and generalizations
22 Topological groups, Lie groups
26 Real functions
28 Measure and integration
30 Functions of a complex variable
31 Potential theory
32 Several complex variables and analytic spaces
33 Special functions
34 Ordinary differential equations
35 Partial differential equations
39 Finite differences and functional equations
40 Sequences, series, summability
41 Approximations and expansions
42 Fourier analysis
43 Abstract harmonic analysis
44 Integral transforms, operational calculus
45 Integral equations
46 Functional analysis
47 Operator theory
49 Calculus of variations, optimal control
51 Geometry

52 Convex and discrete geometry
53 Differential geometry
54 General topology
55 Algebraic topology
57 Manifolds and cell complexes
58 Global analysis, analysis on manifolds
60 Probability theory and stochastic processes
62 Statistics
65 Numerical analysis
68 Computer science
70 Mechanics of particles and systems
73 Mechanics of solids
76 Fluid mechanics
78 Optics, electromagnetic theory
80 Classical thermodynamics, heat transfer
81 Quantum theory
82 Statistical mechanics, structure of matter
83 Relativity and gravitational theory
85 Astronomy and astrophysics
86 Geophysics
90 Economics, operations research, programming, games
92 Biology and other natural sciences, behavioral sciences
93 Systems theory, control
94 Information and communication, circuits
1995 Report—AMS Committee on Science Policy

In 1995 the AMS Committee on Science Policy has been under the leadership of W. James Lewis as chair. There have been two formal meetings of the committee in Washington, DC, in the spring and fall. The CSP has also conducted activities and informal discussions at the AMS’s annual and summer meetings.

The activities of the committee have largely centered around the four elements of its charge:

- Governance and Organizational Issues
- Advocacy and Public Information
- Fostering Awareness and Appreciation of Mathematics as a Science

Under Governance and Organizational Issues, the committee finalized work on its revised charge, which will be forwarded by the AMS secretary to the Council for approval. The CSP National Policy Agenda Subcommittee (NATPOL) has been reappointed, with William H. Jaco as chair and a revised charge “to articulate public policy issues of significance for the mathematical sciences, to inform policymakers and the public about these issues, and to help formulate goals at the national level and set priorities for their accomplishment.” The chair of CSP also appointed a Current Policy Issues Committee, chaired by Jean E. Taylor and charged to “identify for discussion and debate issues facing the mathematics community and where appropriate see that documents are created to act as a community sounding board,” and a Long Term Strategy Committee, chaired by Richard E. Ewing and charged with “interacting with the Washington Office by recommending strategy, advising on the relationship of the profession and the AMS to federal agencies, and identifying groups of mathematicians to work on particular concerns and issues related to the federal agencies and federal policy affecting mathematics.”

As part of the efforts for Advocacy and Public Information, the Committee meets regularly with the leadership of BMS, JPBM, MAA, NAS, NSF, SIAM, distinguished members of the mathematics community, and representatives of the federal agencies. CSP is also involved in sending alerts to the mathematical community and has formed a contact group of mathematicians actively involved in advocacy and public information with members of Congress and federal agencies. The CSP home page is available in e-MATH, allowing the committee to generate and disseminate ideas on a regular and immediate basis.

The CSP continues to work on fostering awareness and appreciation of the role and value of mathematics through activities generated by the AMS Washington Office and JPBM, such as Mathematics Awareness Week; by dissemination of the AMS National Policy Statement; by working with the AAAS Coalition to Improve Public Understanding of Science, Mathematics and Technology; by supporting activities such as the participation of research mathematicians in exhibitions for members of Congress and the public; and by holding lectures and panels on a regular basis as part of the AMS meetings program.

Editor’s Note: This report was received on November 20, 1995, and was inadvertently omitted from the regular February publication of policy committee reports.
Concerning Mathematics as a Science, the Committee continues to investigate and support mathematical research and applications by making recommendations on the structure and breadth of federal support for mathematical research within the context of federal objectives and policies through activities such as the JPBH-generated testimonies before Congress and Senate appropriations committees. On a regular basis the CSP consults with members of the National Science Foundation and other agencies in order to gain knowledge regarding new initiatives, strategic directions, and other information of importance to the mathematics community, such as the Office of Multidisciplinary Activity and the new Group Infrastructure Grants, and to advise and contribute to the direction that will affect the discipline by providing input, lectures, and panel discussions at AMS meetings. The CSP has scheduled Dr. William C. Harris, assistant director for the Mathematical and Physical Sciences at the NSF, to be the plenary speaker at the Annual Meeting in Orlando and has also scheduled several panel discussions that will explore the possibilities of establishing priorities for research in mathematics.

The January 1996 Council

The Council met at 1:00 p.m. on Tuesday, 09 January 1996, in Orlando, Florida. Despite inclement weather on the northeastern seaboard, twenty-five members attended, including President Morawetz, who was, however, slightly delayed. Several chairs of policy committees and several persons who were elected to serve on the Council as of 01 February 1996 were in attendance. The meeting lasted until 10:30 p.m., with a 1 1/2-hour break for dinner. Marc Rieffel presided for most of the afternoon meeting. President Morawetz presided during the evening meeting.

The terms of Ronald Graham as ex-president; Vice-President Anil Nerode; Bulletin Editorial Committee Chair Haynes Miller; Executive Committee member Joan Birman; and Members-at-Large Svetlana Katok, James Lepowsky, Peter Li, and Susan Gayle Williams end on 31 January 1996. This was their last meeting in their current positions. They were thanked for their service to the Society and the mathematical community.

The Minutes of the August 1995 Council, which had been distributed by mail, were approved.

The Council recognized the founding twenty-five years ago of the Association for Women in Mathematics by passing the following resolution:

The Association for Women in Mathematics, founded in 1971, "to encourage women to study and to have active careers in the mathematical sciences" is celebrating the Twenty-Fifth Anniversary of its founding at this meeting in Orlando.

The American Mathematical Society extends to AWM its warmest congratulations on this very happy occasion. The Society looks forward to continued cooperation with the AWM to encourage equal opportunity to all within the mathematical sciences.

The Council approved the reports of the teller. Arthur Jaffe of Harvard University was elected president-elect, a position in which he will serve for one year, after which he will become president for two years. Michael Aschbacher of the California Institute of Technology was elected to a three-year term as vice-president. Michael Crandall of the University of California Santa Barbara was elected to a five-year term as trustee. David M. Bressoud of Macalester College, Gail A. Carpenter of Boston University, John B. Conway of the University of Tennessee, Krystyna Kuperberg of Auburn University, and Andrew Odlyzko of AT&T Bell Laboratories were elected to three-year terms as members-at-large of the Council. Their terms all began on 01 February 1996.

Sylvain Cappell of New York University, Eric M. Friedlander of Northwestern University, and Jane P. Gilman of Rutgers University were elected to three-year terms on the Nominating Committee. Their terms began on 01 January 1996.

Sun-Yung Alice Chang of UCLA and Andrew Granville of the University of Georgia were elected to three-year terms on the Editorial Boards Committee. Their terms began on 01 February 1996.

The amendments to the bylaws that were submitted to the membership for ratification were approved.

The Council approved the appointment of Susan Friedlander to a three-year term, Joan Birman to a two-year term, and Ken Brown to a one-year term on the Colloquium Editorial Committee. Friedlander was appointed chair of the Committee.

The Council approved the appointment of G. W. Stewart and Stanley Osher to three-year terms on the Mathematics of Computation Editorial Committee.

The Council approved the appointment of Clarence Wilkerson for a three-year term as (Electronics) Editor and the reappointment of Wendell Fleming for a three-year term retroactive to 01 February 1995 on the Mathematical Reviews Editorial Committee.

The Council approved the appointment of Clifford Earle as managing editor of the Proceedings effective 01 February 1997.

The Council approved the appointment of Rodrigo Banuelos for a four-year term on the Transactions and Memoirs Editorial Committee.

The Council approved replacing Nolan Wallach by David Eisenbud for the unexpired term of Wallach and appointing Eisenbud to a full term when that term expires on the Bulletin Editorial Committee.

Based on a report of a special task force on electronic journals appointed by the president, the Council authorized the creation of three initial electronic journals:

The Electronic Journal of Representation Theory
The Electronic Journal of Conformal Dynamics
The Electronic Journal of Geometric Methods in Differential Equations
The Council reappointed for two-year terms, beginning on 01 February 1997, Robert Daverman as associate secretary for the Southeastern Section, Lesley Sibner as associate secretary for the Eastern Section, B. A. Taylor as associate treasurer, Franklin Peterson as treasurer, and Robert Fossum as secretary.

It also agreed that the Society should conduct nationwide searches for a secretary and a treasurer to be appointed to take office on 01 February 1999. The searches, which are to begin in 1996, are to be coordinated by the Executive Committee and Board of Trustees. The search committees will be appointed by the president.

The ECFT Nominating Committee was established by the Council in August 1991. It consists of members of the Executive Committee and trustees. The Council agreed that the composition of the committee should consist of the fourth- and second-year members of the EC, the third- and second-year trustees, and the chair of the Nominating Committee.

When the Council established the five policy committees, it also requested that a review of their efficacy take place three years later. This review should thus be undertaken in 1996. At the request of the Council, the president has established five committees consisting of Council members that will each review a committee. The chairs of the five committees will form a committee to review the overall structure and to collect and assimilate the individual reviews.

The Council agreed that chairs of AMS committees, including joint committees, may, on request, receive free copies of the Council agenda and minutes.

Upon recommendation by the Committee on Meetings and Conferences and the Executive Committee and Board of Trustees, the Council agreed that

there be no joint summer meeting in the present Mathfest format in the summers of 1997, 1998, and 1999.

After hearing from members of a special task force that had visited the University of Rochester in order to inquire further into that university’s decision to terminate the mathematics graduate program, the Council passed the following resolution:

The Council of the American Mathematical Society is deeply concerned over the University of Rochester’s announced intention to severely downgrade its strong mathematics program by eliminating Ph.D. studies, shrinking the mathematics faculty “over time” by more than one half, and assigning the teaching of calculus to faculty in other departments and to nontenured adjuncts.

This plan displays a lack of understanding of the nature of mathematics, its role as a core discipline among the sciences, and its place in a well-rounded education.

The entire Rochester academic community is ill-served by such a strategy. Calculus students will be taught by instructors much less likely to have either the wide-ranging overview of mathematics or the involvement with the subject necessary for truly effective teaching. Nor will these instructors be likely to stay abreast of current evolution in the pedagogy and content of calculus.

The hiring of low-paid adjuncts with no long-term commitment to or from the institution will undermine educational quality. It could lead to an egregious violation of principles of nonexploitation enunciated in the January 1994 resolution adopted by the Council in the name of the Society, on “Supportive Practices and Ethics in the Employment of Young Mathematicians”.

Advanced undergraduates in mathematics and graduate students in other scientific disciplines will be deprived of the support that a mathematics graduate program provides to their studies. Faculty in quantitative disciplines will miss opportunities to consult and collaborate with their colleagues in mathematics. In the absence of excellence in mathematics, the attractiveness of Rochester as a first-rate research center in physical science, engineering, and economics will diminish.

On intellectual, educational, and practical grounds, Rochester’s intended treatment of mathematics is incompatible with its aspirations to national distinction as a research university emphasizing quality undergraduate education.

The Council strongly urges the University of Rochester’s administration to reconsider its proposed course of action with regard to mathematics.

The Council approved a change in the eligibility rule for the Fulkerson Prize. It approved a revision to the charge to the University Lecture Series Editorial Committee and it approved a charge for the Committee on Science Policy.

The Council reviewed and filed a preliminary report from the president’s Special Task Force on Participation for Underrepresented Minorities in Mathematics. Since the report recommends creation of a Society committee that will address the issues involved, the Council agreed to withdraw its cosponsorship of the joint Committee on Opportunities in Mathematics for Underrepresented Minorities.

The special Committee on Procedures for the Committee on Professional Ethics presented its final report for approval by the Council. The Executive Committee and Board of Trustees, at its meeting in November 1995, had the opportunity to review a version of this report. Based on this
review, several minor amendments to the procedures were proposed and adopted by the Council, which then adopted the procedures for the Committee on Professional Ethics. The final version of the procedures is printed separately elsewhere in this issue.

The Council of the AMS endorsed the following AWM resolution on affirmative action.

The Association for Women in Mathematics (AWM) regrets the recent action by the regents of the University of California to end its affirmative action programs. Twenty years ago there were many fewer women and underrepresented minorities among students, faculty, and administrators in the University of California system. Affirmative action has played an important role in increasing the representation of these groups and in making the higher-education community at large aware of the discrimination, blatant or subtle, against underrepresented groups. At the same time, bringing people from these groups has strengthened the universities while maintaining the high quality of faculties and student bodies.

In particular the dramatic change in the representation of women in the mathematical sciences in the past decades would have not have been possible without the changes that affirmative action has brought. Less than thirty years ago the highest ranked mathematics graduate program in the U.S. did not even allow applications from potential women students. Many of the leading colleges and universities either accepted only men or kept the ratio of women students intentionally small. Even among public high schools, some of those most successful in scientific and mathematical training were closed to girls. Some men who received their scientific training in the sixties and earlier and who are now holding positions with responsibility and power came to accept the official discrimination against girls and women as the normal status quo.

The Council received and filed many annual reports. Finally, the Council continued its discussion of the issue of its composition, after which it adjourned at about 10:30 p.m.

Officers of the Society 1995 and 1996

Except for the members-at-large of the Council, the month and year of the first term and the end of the present term are given. For members-at-large of the Council, the last year of the present term is listed.
From the AMS

Member of Executive Committee
Members of the Council, as provided for in Article 7, Section 4 (last sentence) of the Bylaws of the Society.
Joan S. Birman 2/93-1/96
John M. Franks 2/91-1/97
Steven George Krantz 2/95-1/99
Marc A. Rieffel 2/92-1/98

Publications Committees
Bulletin Editorial Committee
Haynes R. Miller 2/94-1/97
Murray H. Protter 2/95-1/98
Colloquium Editorial Committee
William Browder 2/93-1/96
Susan J. Friedlander 2/96-1/99
Journal of the AMS Editorial Committee
William Fulton 2/93-1/99
Mathematical Reviews Editorial Committee
Philip J. Hanlon 2/93-3/95
Hugh L. Montgomery 3/95-1/99
Mathematical Surveys and Monographs Editorial Committee
Georgia Benkart 1/94-1/97
Tudor Stefan Ratiu 2/96-1/99
Mathematics of Computation Editorial Committee
Walter Gautschi 1/84-1/96
Lars B. Wahlbin 1/90-1/98
Proceedings Editorial Committee
Irwin Kra 2/91-1/97
Transactions and Memoirs Editorial Committee
Peter B. Shalen 2/92-1/00

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M. Susan Montgomery 1/86-1/96
Cathleen S. Morawetz (ex officio) 2/95-1/97
Franklin P. Peterson (ex officio) 8/73-1/97
B. A. Taylor (ex officio) 2/93-1/97

Pattern Formation: Symmetry Methods and Applications
John Chadam, Fields Institute, Waterloo, ON, Canada, Martin Golubitsky, University of Houston, TX, William Langford, University of Guelph, ON, Canada, and Brian Wetton, University of British Columbia, Vancouver, Editors
This volume contains the proceedings of two related workshops held at The Fields Institute in February and March 1993. The workshops were an integral part of the thematic year in Dynamical Systems and Bifurcation Theory held during the 1992-1993 academic year.
Fields Institute Communications, Volume 5; November 1995; 358 pp.; Hardcover; ISBN 0-8218-0256-9; List $99; Individual member $59; Order code FIC/SNA

American Mathematical Society
Dynamical Systems and Probabilistic Methods in Partial Differential Equations
—Percy Deift, New York University-Courant Institute, NYC, C. David Levermore, University of Arizona, Tucson, and C. Eugene Wayne, Pennsylvania State University, University Park, Editors
This volume contains some of the lectures presented in June 1994 during the AMS-SIAM Summer Seminar at the Mathematical Sciences Research Institute in Berkeley. The book serves as an ideal introduction to the varied and interesting topics covered.
Lectures in Applied Mathematics, Volume 31; November 1995; 296 pp.; Softcover; ISBN 0-8218-0386-0; List $79; AMS members $59; Order code LAM/31NA

All prices subject to change. Charges for delivery are $3.00 per order, or for air delivery outside of the continental U.S., please include $6.50 per item. Prepayment required. Orders from American Mathematical Society, P. O. Box 6248, Providence, RI 02940-6248. For orders outside the U.S. and Canada, please call toll free 800-321-4AMS (4267) in the U.S. and Canada. Residents of Canada, please include 7% GST.

April 1996 Notices of the AMS 465
The Reference section of the Notices is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.

Mathematical Scientists on the Advisory Committee for the Mathematical and Physical Sciences Directorate of the National Science Foundation

Susan Graham
University of California, Berkeley
Richard H. Herman, Dean
University of Maryland
Margaret Wright
AT&T Bell Labs

The mailing address for the Division of Mathematical Sciences at the NSF is:
Division of Mathematical Sciences
National Science Foundation
4201 Wilson Blvd., Room 1025
Arlington, VA 22230
http://www.nsf.gov/mps/dms/

Mathematical Sciences Education Board
(July 1, 1995–June 30, 1996)

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The mailing address for the Board is:
Mathematical Sciences Education Board
National Research Council
2101 Constitution Avenue, NW, HA 476
Washington, DC 20418
telephone: 202-334-3294
e-mail: mseb@nas.edu.

Following is a list of contact names and addresses for some of the major math institutes in North America:

Center for Discrete Mathematics and Theoretical Computer Science (DIMACS)
Fred S. Roberts, Director
Core Building, Busch Campus
The IAS/Park City Mathematics Institute (PCMI) brings together mathematicians from all sectors of the mathematical community for a month-long program. Each volume contains lectures given by leading mathematicians and introduces a broad area of current research, bridging the gap between standard graduate texts and specialized journal articles. Future volumes in this series will involve aspects of high school and undergraduate education.

Geometry and Quantum Field Theory

Daniel S. Freed and Karen K. Uhlenbeck, Editors

Exploring topics from classical and quantum mechanics and field theory, this book is based on lectures presented in the Graduate Summer School at the Regional Geometry Institute in Park City, Utah, in 1991. Presenting material at a level between that of textbooks and research papers, much of the book would provide excellent material for graduate courses. The book provides an entry into a field that promises to remain exciting and important for years to come.

Contents: R. L. Bryant, An Introduction to Lie groups and symplectic geometry; J. M. Rabin, Introduction to quantum field theory for mathematicians; O. Alvarez, Lectures on quantum mechanics and the index theorem; F. Quinn, Lectures on automorphic topological quantum field theory.

ISBN 0-8218-0406-1. All AMS members $35, list price $44. Ordering code PCMI/1NA

Members of the Mathematical Association of America (MAA) and the National Council of Teachers of Mathematics (NCTM) receive a 20% discount from list price.

All prices subject to change. Charges for delivery are $3.00 per order, or for air delivery outside of the continental U.S., please include $5.00 per order. Prepayment required for domestic orders only. Payment must be in U.S. dollars in the form of a personal check, money order, purchase order, or credit card. For credit card orders, call 1-800-331-1622 or fax 1-800-334-3400. For international orders, please include additional postage and handling.

206 Church St., SE
514 Vincent Hall
Minneapolis, MN 55455
Telephone: 612-624-6066
Fax: 612-626-7370
e-mail: guilliver@ima.umn.edu or ima-staff@ima.umn.edu

The Fields Institute

Mary West, Executive Assistant
222 College Street
Toronto, ON, Canada M5T 3J1
Telephone: 416-348-9710
Fax: 416-348-9714
e-mail: mwest@fields.utoronto.ca

Upcoming Deadlines


April 26, 1996: Deadline for applications for Project NExT, R. C. Leitzel, Dept. of Mathematics and Statistics, Univ. of Nebraska-Lincoln, P.O. Box 880323, Lincoln, NE 68588-0323; telephone 402-472-7232; fax 402-472-8466; e-mail jimleitz@unlinfo.unl.edu. Applications are also available at the Project NExT World Wide Web site, http://archives.math.utk.edu/projnext/.

May 14, 1996: Deadline for application for U.S.-Mexico collaborative research support from NSF. For information, telephone 703-306-1130; e-mail pubs@nsf.gov. NSF's World Wide Web home page: http://www.nsf.org/.
April 1996

11-12 Symposium on Types and Ordinal Notation Systems, Uppsala University, Uppsala, Sweden. Program: The aim of the program is to present current research on extensions of intuitionistic type theory and their relation to ordinal notation systems in proof theory as well as connections to transfinite hierarchies of domains with totality. Invited Participants: P. Aczel (Manchester), U. Berger (Munich), W. Buchholz (Munich), P. Martin-Loef (Stockholm), D. Normann (Oslo), W. Pohlers (Muenster), M. Rathjen (Leeds, Muenster), H. Schwichtenberg (Munich), A. Setzer (Munich), S. Wainer (Leeds). Program Committee: E. Griffor (Uppsala), E. Palmgren (Uppsala), and V. Stoltenberg-Hansen (Uppsala). Information: Inquiries should be sent to: Symp. on Types and Ordinal Notation Systems, Department of Mathematics, Uppsala University, Box 480, 751 06 Uppsala, Sweden, or by e-mail to types@math.uu.se. Information concerning the symposium is also available on the WWW at the URL: http://www.mat.uu.se/logik/types/.

21-24 SUPER! 96 - A Conference for HPC on IBM Systems, Iowa State University, Ames, Iowa. Focus: SUPER!, a group of users and technical support staff involved in high-performance parallel and clustered computing on IBM systems, announces the 1996 conference. The presentation of the SP2 computer into a variety of roles — academic and commercial; scientific, technical, and data management — provides a focus for this year’s conference.

Scope: Researchers, computing center manager, and technical support staff from all SP sites are invited to attend, as well as those anticipating the arrival of an SP. Conference activities include the following: Plenary talks by distinguished speakers in the field; technical sessions on systems management, emerging uses, computational applications and new products; panel discussion by SP sites on SP system administration; open forum with IBM product executives — open mike Q&A for the audience; tutorial on SP Network Tuning; an SP User Group BOF; an SP User Gallery of SP sites; variety of informal discussion opportunities, including a special dinner excursion.

Information: Registration forms and updated information are available from the SUPER! home page: http://ike.engr.washington.edu/superp96/ and by e-mail to: super96@ike.engr.washington.edu.

27 44th Algebra Day, Carleton University, Dept. of Mathematics and Statistics, Ottawa, Canada. Program: 10:30—J. McCool (Toronto) presenting $G_2(Z[x,x^{-1}])$ [with an application to Aut (Free$_2$)]; 13:30—Y. Billig (New Brunswick) presenting Cartan subalgebras in infinite-dimensional Lie algebras; 15:00—D. Djokovic (Waterloo) presenting Some infinite-dimensional simple Lie algebras of characteristic 0 (generalized Witt algebras). Information: For further information contact V. Dlab at 613-788-3531, e-mail: vdlab@math.carleton.ca, or fax 613-788-3536.

May 1996

13-17 The Fifth International Conference on Simulation of Devices and Technologies ICSDT'96, Obninsk, Russia. General Topics: Simulation of semiconductor devices; simulation of processes in thin insulator films in strong electric fields; simulation of technologies (including simulation of crystal growth in microgravity, simulation of nuclear technologies and nuclear power plants); numerical methods for simulation devices and technologies. Information: All correspondence should be sent to: Dr. V. Ginklin, Bondarenko Sq. 1, Obninsk, Kaluga Region, 249020, Russia; tel: 412509 URAN SU; fax: 095-8833112;
**Mathematics Calendar**

*20-21* Crystallographic Groups and Their Generalizations, K. U. Leuven Campus, Kortrijk, at Kortrijk, Belgium.

**Aim:** The aim of the meeting is to report on and to discuss recent developments and problems in the field.

**Invited Speakers:** Invited talks will be given by H. Abels (Univ. of Bielefeld), W. Goldmann (Univ. of Maryland, College Park), F. Gruenewald (Univ. of Dusseldorf), K. B. Lee (Univ. of Oklahoma), F. Raymond (Univ. of Michigan), D. Segal (Oxford Univ.).

**Scientific Committee:** Main speakers above plus P. Igodt (K. U. Leuven).

**Abstracts:** Short communications can be proposed by sending an abstract to the scientific committee (e-mail to Paul. Igodt@kulak.ac.be). Deadline is April 10.

**Registration:** To workshop@kulak.ac.be.

**Information:** More information is available at the Web site: http://www.kulak.ac.be/workshop/workshop.html.


**Program:** This is an annual conference focusing on operator algebras and operator theory. There will be eight main speakers and many contributed talks.

**Main Speakers:** B. Arveson, B. Blackadar, R. Curto, J. Kaminker, T. Loring, V. Paulsen, I. Putnam, and I. Raeburn.

**Organizers:** J. Quigg and J. Spielberg.

**Information:** e-mail: geps@math.asu.edu or (if e-mail is not possible) contact J. Spielberg, Dept. Math., ASU, Tempe, AZ 85287-1804; tel: 602-965-3286.

**June 1996**

*10-15* NSF Undergraduate Faculty Enhancement Workshop, Teaching Undergraduate Geometry, Cornell University, Ithaca, New York.

**Aim:** This workshop is intended for college and university faculty who teach (or soon will teach) an undergraduate geometry course—such as the courses typically attended by future or inservice teachers.

**Sessions:** Morning sessions—the participants will experience a learning and teaching environment that is innovative both in terms of content and in terms of teaching methods. The content will be the integration of geometries on plane, sphere, and other surfaces—presented through problems which emphasize experiencing the meanings in the geometry. Student explorations, small group learning, and writing assignments will be explored.

**Afternoon sessions:** There will be seminars and presentations on topics related to the workshop theme, including: How to Write Good Expository Problems, Using Writing in Mathematics, Curriculum Developments in School Geometry, Using Computer Technology in Geometry, Formal versus Intuitive Knowing in Geometry. What is in the 8 Undergraduate Courses at Cornell. Non-test-based Assessments, including all students by encouraging diverse ideas. In addition, there will be ample free time for informal discussions and enjoyment of the geometry of nature in and around Ithaca.

**Support:** Most of the housing and food expenses will be covered by the NSF for all participants. There are also expected to be NSF funds available to support travel costs for participating faculty from institutions with limited resources. The NSF will also support follow-up activities by the participants after the workshop including local workshops, exchange of related classroom materials, and communication of experiences and ideas.

**Information:** For more information and application procedures contact: WWW http://math.cornell.edu/~dhb or (if you have no WWW access): e-mail: dhb@math.cornell.edu or write to: Geometry Workshop, Department of Mathematics, Cornell University, Ithaca, NY 14853-7901.


**Invited Speaker:** M. Freedman (U. San Diego).

**Organizers:** R. Angel, C. Guilbault (U. Wisconsin—Milwaukee), D. Garity (Oregon St. Univ.), F. Tinsley (Colorado College)*, D. Wright (Brigham Young Univ.) (*host).

**Funding:** Limited funding is available to help pay travel and living expenses of those without other means of support (NSF sponsored).

**Information:** Contact C. Mills (workshop secretary), Dept. of Math., Colorado College, Colorado Springs, CO 80903; e-mail: cmills@cc.colorado.edu.

*17-21* Geometry of Multivariable Calculus Workshop on Computational Geometry, Spokane, WA.

**Sponsor:** NSF grant DUE-9455061.

**Information:** Y. Niwergelt, Dept. of Mathematics, MS-32, Eastern Washington Univ., 526-5th Street, Cheney, WA 99004-2431; e-mail: yniwergelt@ewu.edu.


**Purpose:** The Calculus Consortium, based at Harvard University, in conjunction with the National Science Foundation (NSF) and John Wiley and Sons, Inc., will host The Fifth Conference on the Teaching of Mathematics. This year’s conference will continue its broadened focus to include undergraduate courses that precede and follow calculus. Two and four year college, university, and secondary school faculty are welcome. The Calculus Consortium will conduct at least two all-day workshops dedicated to single and multivariable calculus on the day before the Fifth Conference on the Teaching of Mathematics.

**Call for Papers:** Contributed papers of 15 minutes are invited in the following categories: changing pedagogy, using technology, assessing students’ knowledge, special topics, topics in transition: before calculus, calculus, and beyond calculus. To submit a paper, send the title of the paper, the category from the above list, and a 25-word abstract to K. or J. Thrash, Mathematics, Univ. of Southern Mississippi, 730 East Beach Boulevard, Long Beach, MS 39560 or e-mail your submission to calculus@bull.cs.wwu.edu. Please include your U.S. mailing address. Deadline for submission is April 10, 1996.

**Information:** For more information or to register, please contact: J. Kirsch, John Wiley and Sons Publishers, 605 Third Avenue, New York, NY 10158; fax: 212-850-6118; e-mail: math@wiley.com. For further information on the workshops and registration contact: H. Sudholz, Calculus Consortium, Science Center # 325, One Oxford Street, Cambridge, MA 02138; tel: 617-496-5421; e-mail: calculus@math.harvard.edu.

*25-28* Sixth Annual International Conference of the Society for Chaos Theory in Psychology & Life Sciences, Berkeley, California.

**Scope:** The purpose of the conference is to provide a forum for the presentation and discussion of recent work in the application of nonlinear dynamics and related methods to problems in the fields of psychology, psychiatry, neuroscience, biology, physiology, medicine, economics, sociology, anthropology, political science, organizations and their management, as well as philosophy and the humanities.

**Invited Speakers:** J. Crutchfield (UCBerkeley), R. Abraham (USanta Cruz).

**Call for Papers:** Original papers related to the scope of the conference are solicited. Authors should submit an abstract (less than 500 words) before February 28 to the address below. Late submissions will be considered until April 30.

**Information:** For information regarding the conference, contact W. Sulis, 255 Townline Rd., E. R. 5, Cayuga, Ontario, Canada NOA 1E0; e-mail: sulis@camster.ca; tel: 905-772-7218; fax: 905-521-7948.


**Purpose:** The symposium is planned to celebrate the 65th birthday of Professor Sir Roger Penrose and his outstanding contributions to many different areas of mathematics and physics and the twenty-three years so far during which he has been enlivening and shaping Oxford mathematics. The conference will be broadly based and will draw together the fields to which Roger has contributed.

**Location and Accommodation:** The symposium will be held at St. John’s College, Oxford, in the conference facilities in their...
new Garden Quad buildings.

Board and lodging can be obtained in St. John's. The prices in UK pounds (including VAT) are as follows:

One night's accommodation: 26.50
Breakfast: 4
Lunch: 6
Dinner: 16
Banquet: 30

Attendance and Registration: The number of participants that we can accommodate is limited.

There will be a registration fee of 50 pounds if submitted by May 1, which will increase to 75 pounds after that date. The registration will be half price for research students and the financially challenged.

Financial Support: There may be some limited support for participants who would otherwise not be able to attend. Let organizers know what is needed.

Workshop Submissions: There will be a limited number of slots for speakers in the parallel sessions. If you wish to speak, please submit an abstract by February 29.

Local Organizing Committee: S. Huggett, L. Mason, P. Tod, T. S. Tsun, N. Woodhouse.


Invited Speakers: (The * denotes those speakers who have not fully confirmed their intention to come.) M. Atiyah (Trinity Cambridge), N. J. Hitchin (Univ. of Cambridge), S. K. Donaldson (Univ. of Oxford), A. Connes (College de France), A. Ashtekar (Pennsylvania State Univ.), G. Veneziano* (CERN), H. Friedrich (Max Planck Institute, Potsdam), R. S. Ward (Univ. of Durham), C. R. LeBrun (SUNY at Stonybrook), A. Ebert (The Clarendon Laboratory, Oxford), S. Hameroff (Tucson, Arizona), A. Shimony (Boston Univ.), F. P. Stienhardt (Univ. of Pennsylvania), D. W. Sciama (S.I.S.S.A, Trieste), S. W. Hawking (Univ. of Cambridge), V. I. Arnold* (The Steklov Institute, Moscow).

Information: Geometric Issues '96, The Mathematical Institute, 24-29 St. Giles, Oxford, OX1 3LB, England; fax: +44-1865-273583; e-mail: geom96@maths.ox.ac.uk. Please address all correspondence by post, fax, or e-mail to the address above. Up-to-date information will be posted on the Web site: http://www.maths.ox.ac.uk/geom96/geom96.html, where copies of all forms may be obtained. Completed application forms should be sent to the above address as soon as possible. An official invitation will be sent to you by airmail or fax.

*30-July 6 Different Approaches to Population Dynamics, Anogia Academic Village, Anogia, Crete, Greece.

Purpose: The Department of Mathematics of the University of Crete announces the 1996 conferences of the series Euroconferences in Mathematics on Crete, sponsored by the Human Capital and Mobility Programme of the Commission of the European Union.

Organizer: P. Jagers (Gothenburg, Sweden).

Main Speakers: O. Dieckmann (Amsterdam, Holland), M. Gyllenberg (Turku, Finland), P. Jagers (Gothenburg, Sweden), Z. Taib (Gothenburg, Sweden), S. Tavare (Zurich, Switzerland/Los Angeles, USA).

Scientific Committee: The topics of the conferences which will follow in the next years will be decided by the international scientific committee consisting of: H. Abels (Bielefeld, Germany), H. Bauer (Erlangen, Germany), C. Dafermos (Brown Univ., USA), O. Kegel (Freiburg,Germany), S. Papadopoulou(Crete, Greece), V. Thomee (Goteborg, Sweden), A. Wilkie (Oxford, UK).

Financial Support: The Human Capital and Mobility Programme financially supports young researchers from the countries of the European Economic Area to enable them to attend the conferences. It is expected that financial support can be extended to young researchers from some countries of Central and Eastern Europe.

Information: For additional information please contact the local coordinator: S. Papadopoulou, Dept. of Mathematics, University of Crete, Heraklion, Crete, Greece; fax: 81-234516; e-mail: souzana@talos.cc.uch.gr; or for the conferences of 1996: P. Jagers, Dept. of Mathematics, Chalmers University of Technology and Gothenburg University, S-41296 Goteborg, Sweden; e-mail: jagers@math.chalmers.se; D. B. A. Epstein, Mathematics Institute, University of Warwick, Coventry CV4 7AL, United Kingdom; e-mail: dba@maths.warwick.ac.uk.

July 1996

*1-2 16th Conference in Operator Theory, University of Timisoara, Timisoara, Romania.

Topics: The conference is devoted to operator theory, operator algebras and their applications. There will be 45 minute lectures and 20 minute communications.

Organizers: The 16th Conference in Operator Theory is organized jointly in Timisoara by the Institute of Mathematics of the Romanian Academy and the Faculty of Mathematics of the University of Timisoara.


Organizing Committee: D. Gaspar, A. Gheondea, R. N. Gologan, N. Suciu, A. Trescenco and D. Timotin.

Proceedings: The publishing of the proceedings will be continued by the Institute of Mathematics in an international series distributed especially among the subscribers of the Journal of Operator Theory.

Information: Information and registration can be obtained from: OT16, Institute of Mathematics, P.O. Box 1-764, 70700 Bucuresti, Romania; fax: 40-1-222-9826; e-mail: ot16mar.ro or ot16stoliol.imar.ro.

*11-17 International Workshop on Accurate Eigensolving and Applications, Split, Croatia.

Theme: The main theme is the accuracy in the EVD or SVD computation or even in solving linear systems. There will be invited lectures (one or two) in the morning, while the afternoon will be reserved for contributed lectures, including those from junior people, as well as for less formal discussions and working groups.

Possible general themes for discussion are: (i) how to turn recent results on accurate algorithms systematically into good software, (ii) how to present them in a monograph, (iii) how to let them influence the teaching of numerical linear algebra, (iv) real world engineering problems.

Organizers: J. Barlow (The Pennsylvania State Univ.), J. Slapnicar (Univ. of Split (local manager)), K. Veselic (Fernuniversitaet Hagen).

Tentative Speakers: J. Barlow (The Pennsylvania State Univ.), J. Demmel (Univ. of California at Berkeley), Z. Drmac (Univ. of Colorado at Boulder), I. Ipsen (North Carolina State Univ.), B. Parlett (Univ. of California at Berkeley), J. Slapnicar (Univ. of Split), K. Veselic (Fernuniversitaet Hagen), H. Zha (The Pennsylvania State Univ.).

Information: For further information please contact K. Veselic, Fernuniversitaet Hagen, LG Mathematische Physik, P. O. Box 940, D-58084 Hagen, Germany; e-mail: kvaselic@fernuni-hagen.de. WWW sites: Workshop: http://adria.fesb.hr/~slap/workshop/; Split and the University: http://www.fesb.hr/; Croatia: http://tjov.tel.fer.hr/.

*13-20 Algebraic and Geometrical Approach to Nonlinear Partial Differential Equations and Secondary Quantized Calculus, Diffiety Institute, Moscow, Russia.

Topics: Geometry of nonlinear partial differential equations; secondary (quantized) calculus; in the category of differential equations; homology structures on infinitely prolonged differential equations and diffeologies; local and nonlocal symmetries and conservation laws; Lagrangian and Hamiltonian formalism for nonlinear PDE; local cohomology in field theory and secondary calculus; differential invariants; super differential equations; applications to specific equations.


*15-19 Seventh Meeting on Real Analysis and Measure Theory, Hotel Continental Terme, Ischia, Italy.

Purpose: The meeting is biennially organized by Progetto di Ricerca di Interesse Nazionale "Analisi Reale".

Program: There will be 50-minute invited lectures (program to be defined)
and shorter communications (25 minutes, approximately).

Information: C. A. R. Te. Mi., O/Dip. Matematica e Applicazioni, Università Federico II, Complesso Monte S.Angelo, via Cintia 80126 Napoli, Italy; fax: 81-7662106; e-mail: delucia@matna2.dma.unina.it.

*15-20 International Colloquium on Combinatorics and Graph Theory, a Satellite Conference of ECM2, Balatonelle, Hungary.
Organizers: L. Lovasz (chair), Z. Furedi, E. Gyori (co-chairs), A. Sali (secretary).
Information: Contact: comb96@math-inst.hu. WWW: http://www.math-inst.hu/ecm2/satellites.html.

*21-26 Seventh International Congress on Computational and Applied Mathematics, Katholieke Universiteit, Leuven, Belgium.
Purpose: The Congress will concentrate on the analysis for computational techniques for solving real scientific problems. There will be sessions on: parallel algorithms, numerical conformal mapping, constructive numerical quadrature and integral equations, numerical software, experimental mathematics, mathematical techniques for operations research, and mathematical techniques for financial and actuarial sciences.

Invited Speakers: H. Brunner (Canada), M.E.H. Ismail (USA), F. Marcellan (Spain), M. Nakao (Japan), J. Nedoma (Czech Republic), W. Sweldens (Belgium), P. Toint (Belgium).
Short Communications: Short communications (20 minutes duration) will be accepted for presentation. Participants who would like to present a paper should submit a title and a short abstract (at most 1 page) not later than March 1, 1996, to: M. J. Goovaerts, K. U. Leuven, huis Eggen Heerd, CRIR, Minderbroederstraat 5B, 3000 Leuven, Belgium; tel/fax: 32-16-29-53-46; e-mail: fbdaa356cc1.kuleuven.ac.be. This address should also be used if more information is required.

August 1996

*17-22 Fifth Conference of the Canadian Number Theory Association, Carleton University, Ottawa, Ontario, Canada.
Program: The subject of the conference is number theory in general, with special emphasis in the areas of: algebraic and computational number theory, analytic number theory, arithmetic algebraic geometry and elliptic curves, and diophantine problems.
Information: Contact: comb96@math-inst.hu. WWW: http://www.math-inst.hu/cnta96/index.html.

*17-27 Aegean Conference on Operator Algebras and Applications, Samos, Greece.
Themes: The main themes of the conference include: non-self-adjoint operator algebras; multivariable operator theory and representations of function algebras; Hilbert and operator modules; operator spaces and applications to Banach space theory and harmonic analysis; C*-algebraic quantum groups; operator algebras and wavelets.

In addition, shorter talks will be given by participants.

Financial Aid: Partial financial assistance will be provided for participants who have no other source of funding, particularly graduate students and postdocs.
Organizing Committee: M. Anoussis (Aegean), J. Erdos (King's, London), N. Hadjivalidavas (Aegean), A. Katavolos (Athens), P. Muhly (Iowa).
Information: Anyone wishing to participate is invited to send an email message to opalg@math.aegean.gr.
Further information can be obtained from the Conference, The Fields Institute, 222 College Street, Toronto, Ontario, Canada M5T 3J1; e-mail: math.aims.utoronto.ca.

*19-30 NATO Advanced Study Institute (ASI) on Algebraic Model Theory, The Fields Institute, Toronto, Ontario, Canada.
Aim: The aim of this conference is to expose current researchers in model theory to recent major advances including connections between model theory and diophantine and real analytic geometry, permutation groups and finite algebras. The conference is intended for researchers at the postdoctoral level and beyond, and will be accessible to good research students.
Organizers: E. Bouscaren (Université Paris 7), A. Lachlan (Simon Fraser University, Di­rector, D. Marker (University of Illinois, Chicago), A. Pillay (University of Notre Dame), and M. Valeriote (McMaster University).
Support: Financial support for suitable participants will be obtained from NATO countries and NATO Cooperation Partner countries is available. (Apply by April 15, 1996, to the address below.)
Information: Further information may be obtained from: NATO Conference, The Fields Institute, 222 College Street, Toronto, Ontario, Canada. NATO:

*23 First Annual Computational Finance Conference, Stanford University, Palo Alto, California.
Aim: This one-day meeting will emphasize practical, state-of-the-art applications of computational technology to solve financial problems.
Call for Papers: Papers are invited in the following areas: stochastic differential equations in finance, financial applications of partial differential equations and numerical methods, simulation technology in finance, parallelism and distributed computing in financial applications, other areas of interest in computational finance. Please submit a two-page abstract by March 1, 1996. Authors will be notified of review decisions by March 31, 1996. Authors must submit complete papers by June 30, 1996.
Conference Co-chairs: D. Duffie (Stanford Univ.), D. Tavella (Integral Development Corp.).
Information: Send abstracts to: D. Duffie, Graduate School of Business, Stanford Univ., Stanford, CA 94305-5015. For registration materials and more information, please contact: D. Tavella, Integral Development Corporation; tel: 415-462-2145; fax: 415-462-2131; e-mail: tavella@integral.com.

Main Speakers: M. Bestvina (Utah, USA), E. Rips (Jerusalem, Israel), Z. Sela (Jerusalem, Israel), K. Vogtmann (Cornell, USA).
Local Coordinator: S. Papadopoulou (Univ. of Crete) e-mail: souzana@salos. cc. uch.gr.
Information and Application: From C. Kourouniotos, Univ. of Crete, Dept. of Mathematics, 714 09 Iraklio, Crete, Greece; fax: +30 81 234516; e-mail: chrisk@salos. cc. uch.gr. More information will be available after November 1, 1995, from http://
Mathematics Calendar

April 1996

NOTICES OF THE AMS 473

/ww.uch.gr Financial support available to young researchers from European Economic Area and possibly from some Central and Eastern European countries.

* 26-30 Geometry of Multivariable Calculus Workshop on Computational Geometry, Spokane, WA.
Sponsor: NSF grant DUE-9455061.
Information: Y. Nievergelt, Dept. of Mathematics, MS-32, Eastern Washington Univ., 525-5th Street, Cheney, WA 99004-2431; e-mail: ynievergelt@ewu.edu.

September 1996

* 4-6 Symposium on Operations Research 1996, Technical University, Braunschweig, Germany.
Purpose: Annual conference of the DGOR and GMOOR with the participation of WG 7.4 of the IFIP.
Topics: Linear programming; nonlinear programming; combinatorial and discrete optimization; graph algorithms and complexity; stochastic models and optimization; scheduling; production; transportation; macroeconomics; economic theory; games; statistics and econometrics; marketing and data analysis; information and decision support systems; banking, finance, insurance; energy, environment, health; neural networks and fuzzy systems, control theory; simulation; practical or application reports. Conference languages: English and German.
Deadlines: Preliminary registration: February 1, 1996; Submission of abstracts by mail: April 1, 1996; Submission of abstracts by e-mail: April 15, 1996; Regular registration: May 15, 1996.
Information: Distribution and gathering of information for SOL '96 will to a large extent be based on e-mail and electronic networks. So, whenever possible, use e-mail and the Web for communication. In particular, we ask you to fetch a pre-registration form by e-mail using the following mailheader: To: sol96@tu-bs.de Subject: help preregister or preregister via the Web. Start at URL http://www.math.tu-bs.de/sol96/ and follow the respective links (WWW-forms). Mailing address: Dr. U. Zimmermann, Abt. Mathem. Optimier., TU Braunschweig, D-38106 Braunschweig, Germany; tel: +49-5-30-391-7550.

* 9-14 Drinfeld Modules, Modular Schemes and Applications, Alden Biesen, Bilzen-Rijkevew, Belgium.
Aim: An instructional meeting with the aim of bringing together research students and specialists for lectures and discussions on the different parts and aspects of the theory of Drinfeld modules.
Preliminary Scheme for Program: 1. Drinfeld modular schemes; Construction, Algebraization, Compactification; 2. Applications: Modular forms, Arithmetic of global function fields and of division algebras over global function fields, Elliptic curves over function fields.
Organizers: E. Gekeler, M. Reversat, M. van der Put, J. Van Geel.
Information: J. Van Geel, University of Gent, Dept. of Pure Mathematics and Computer Algebra, Galglaan 2, B-9000 Gent, Belgium; tel: 32-9-264-40-98; fax: 32-9-264-49-93; e-mail: jvg@cage.rug.ac.be. Announcements concerning the meeting can also be found on the Internet: http://cage.rug.ac.be/~jvg/workshop.html.

* 16-21 Second Conference on Stochastic Analysis, Random Fields and Applications, Centro Stefano Franscini, Ascona, Switzerland.
Program: Main topics of the conference are stochastic partial differential equations, applied stochastic analysis in engineering, and a minisymposium on stochastic methods in financial models (September 20-21).
Organizers: R. Dalang (EPFL, Switzerland), M. Dozzi (Nancy, France), and F. Russo (Paris).
Principal Invited Speakers: S. Albeverio (Bochum), G. Ben-Arous (ENS, Paris), R. Durrett (Cornell), D. Geman (Massachusetts), F. Hirsch (Evry, France), J.-F. Le Gall (Paris 6), G. Pages (Paris 12), R. Sowers (Northwestern), F. Delbaen (ETH, Zurich), N. El Karoui (ENS, Paris), C. Rogers (Queen Mary), W. Schachermayer (Vienna).
Information: E. Gindraux, Ascona 96, Mathematics, Swiss Federal Institute of Technology Lausanne, CH-1015 Lausanne, Switzerland; e-mail: gindraux@math.epfl.ch; fax: +41-21-6094303.

* 25-27 VECPAR '96 - Second International Conference on Vector and Parallel Processing (Systems and Applications), Faculdade de Engenharia da Universidade do Porto, Porto, Portugal.
Purpose: The meeting is interdisciplinary in nature, bringing together people from science, engineering, and industry to explore some of the many challenges and promises of vector and parallel processing. The event is intended to disseminate current present knowledge on the topic and to provide a forum for presentation and discussion of basic research and applications in this area. The focus of the scientific section of the meeting will be key invited lectures to describe the concepts behind vector/parallel processing and to highlight some of the major trends in the field. After these main talks, contributed papers of approximately 20 minutes' duration will be presented.
Topics of Interest: Papers may address a broad range of research fields of current interest. A list of possible topics includes (but is not limited to) the following: architectures, operating systems, environments, software tools and languages; numerical and symbolic algorithms; applications in science and engineering (e.g., computational fluid dynamics, reservoir modelling, etc.); industrial and commercial systems and applications (e.g., database-based systems, traffic flow modelling, optimisation); signal processing and both image processing and synthesis. Papers on systems and applications to science and engineering will be encouraged.
Dates to Remember: Extended abstracts due: March 15, 1996.
Notification of acceptance: May 10, 1996.
Final papers due: August 30, 1996.
Information: If you are interested in receiving information on this conference, please register on the mailing list by sending your name and address to: VECPAR '96 Attention of Dr. J. L. Palma Faculdade de Engenharia, DEMEGI-Seccao de Fluides e Calor Rua dos Bragas 4099 Porto Codex, Portugal Tel: International +2+4001746; fax: International +2+312476; e-mail: vecep96@garfield.fe.up.pt; WWW address: http://garfield.fe.up.pt:8001/vecep96/

* 25-28 Advanced Mathematical Tools in Metrology, Magnushaus, Berlin, Germany.
Topics: Stochastic data analysis, robustness problems, experimental design in metrology; numerical analysis and algorithms, inverse problems in metrology; mathematical problems in CMM data processing, geometric measurements; mathematical problems in modelling and data analysis of medical measurements; software quality assurance problems in metrology.
Important Dates for Authors: Abstracts due: April 15, 1996.
Notification of acceptance: June 1, 1996.
Final paper due: September 25, 1996.
Information: Contact H. Moeck, Physikalisch-Technische Bundesanstalt, Euro-Conference 96, Abbestrasse 2-12, D-10587 Berlin; tel: +49-30-3481-483/494; fax: +49-30-3481-406; e-mail: hmoekc@berlin.ptb.de.

October 1996

* 5-6 Eastern Section, Rider University, Lawrenceville, NJ.
Information: Deadlines, address for abstract submission, topics of meetings, pre-registration information, please contact e-mail: g3636179@rnahidol.ac.th.

Purpose: The purpose of the Society is to foster and promote the interchange of ideas and information among the various fields of engineering science and the fields of theoretical and applied physics, chemistry and mathematics, and to provide forums and meetings for the presentation of such ideas and information, and to make available such information and ideas to its members and other interested persons.
Program: Symposia are planned in the areas of acoustics, atmospheric sciences, au-
# Mathematics Calendar

**November 1996**

8-9 St. Norbert College Pi Mu Epsilon Regional Undergraduate Math Conference, St. Norbert College, De Pere, WI.

**Program:**
Friday evening: 7:00-9:00—Student Presentations.

9:00-10:00—Invited Speaker: Don Saari (Northwestern U), "How Do We Decide? It Involves Some Surprising Mathematics". Saturday morning: 9:00-11:00—Student Presentations.

11:00-12:00—Don Saari, "A Mathematical View of Newton’s Universe".

**Information:** Free and open to the public. For registration material (available in late September), contact by e-mail Rick Poss, possri@snccc.snc.edu.

**14-16 International Conference on Applied Mathematics and Engineering Sciences, École Nationale Supérieure d’Électricité et de Mécanique, Casablanca, Morocco.**

**Presentation:** The International Conference on Applied Mathematics and Engineering Sciences aims at bringing together mathematicians and engineers concerned with the areas of numerical analysis and optimization, statistics and data analysis, stochastic processes and operational research, and mathematical modelling applied to engineering sciences.

**Important Dates:**
- Deadline to receive the abstracts: March 15, 1996
- Notification of acceptance: May 15, 1996
- Final version: September 1, 1996

**Information:** For more information, contact A. Zaki (head of the Department of General Education), ENSEM, P.O. Box 8118, Oasis Route de Jadida, Casablanca, Morocco. Tel: 212-02-23-13-22; fax: 212-02-23-12-99; e-mail: zaki@math.chalmers.se.
American Mathematical Society Translations—Series 2

Mathematics in St. Petersburg
A. A. Bolibruch, A. S. Merkur'ev, and N. Yu. Netsvetaev, Editors
Volume 174

This volume is dedicated to the 30th anniversary of the founding of the Academic Gymnasium of St. Petersburg University. From the day it was founded until recent times, the school was officially called the "Specialized Physico-Mathematical Boarding School #45 of Leningrad University" but was generally known as the "45th Boarding School". Almost all of the authors of this volume graduated at different times from the 45th Boarding School and then studied at Leningrad University. The initial impetus for publishing this volume was a three-day conference held at St. Petersburg University in October 1993. The papers of the volume were mostly collected during the winter and spring of 1994.

Feature:
• Some Memories of Boarding School #45 — A. A. Bolibruch

Contents

March 1996, approximately 288 pages (hardcover), ISBN 0-8218-0559-2, LC 91-640741, ISSN 0065-9290
1991 Mathematics Subject Classification: 00B15; 12G05, 14D20, 14L05, 14P25, 19-XX, 34A30, 52A37, 57Mxx, 58F07, 68Q99, 81T70
Individual member $59, List $99, Institutional member $79
To order, please specify TRANS2/174N

CBMS Regional Conference Series in Mathematics

Introduction to Intersection Theory in Algebraic Geometry
William Fulton
Number 54

This book presents expository lectures from the CBMS regional conference held at George Mason University during the summer of 1983. This volume has been reprinted by the AMS with updates and corrections. In the work, Fulton gives references to many further developments in the field.

Contents
Intersections of hypersurfaces; Multiplicity and normal cones; Divisors and rational equivalence; Chern classes and Segre classes; Gysin maps and intersection rings; Degeneracy Loci; Refinements; Positivity; Riemann-Roch; Miscellany; References; Notes (1983-1995).

1991 Mathematics Subject Classification: 14C17, 14C15, 14C40, 14M15, 14N10, 13H15
All individuals $14, List $24
To order, please specify CBMS/54N
Collected Works

Selected Papers of Freeman Dyson with Commentary
Freeman Dyson with Foreword by Elliott Lieb
Volume 5

"The writings of Freeman Dyson are among the jewels that crown the subject [of theoretical physics] and today even the earliest among them can be read with profit and much pleasure by beginners and experts."

This book offers a unique compilation of papers in mathematics and physics from Freeman Dyson's 50 years of activity and research. These are the papers that Dyson considers most worthy of preserving, and many of them are classics. The papers are accompanied by commentary, explaining the context from which they originated and the subsequent history of the problems that either were solved or left unsolved. This collection offers a connected narrative of the developments in mathematics and physics in which the author was involved beginning with his professional life as a student of G. H. Hardy.

This book is jointly published by the AMS and the International Press.

Contents
Elliott Lieb, Foreword; Preface and Commentary; Some guesses in the theory of partitions; A theorem on the densities of sets of rationals; The approximation to algebraic numbers by rationals; On the product of four non-homogeneous linear forms; A new symmetry of partitions; mappings and symmetries of partitions; Fourier transforms of distribution functions; The rate of growth of functions defined by Dirichlet series; Quaternions determinants; On spheres; Missed opportunities; A walk through Ramanujan's garden; The radiation theories of Tomonaga, Schwinger, and Feynman; The S matrix in quantum electrodynamics; Renormalization method in quantum electromagnetic; Divergence of perturbation theory in quantum electrodynamics; Connection between local commutativity and regularity of Wightman functions; Integral representations of causal commutators; The dynamics of a disordered linear chain; Electron spin resonance absorption in metals. II. Theory of electron diffusion and the skin effect; General theory of spin-wave interactions; Thermodynamic behavior of an ideal ferromagnet; Ground-state energy of a hard-sphere gas; Existence of a phase-transition in a one-dimensional Ising ferromagnet; Nonexistence of spontaneous magnetization in a one-dimensional Ising ferromagnet; An Ising ferromagnet with discontinuous long-range order; Statistical theory of the energy levels of complex systems. I; Statistical theory of the energy levels of complex systems. II; Statistical theory of the energy levels of complex systems. III; A Brownian-motion model for the eigenvalues of a random matrix; The threefold way. Algebraic structure of symmetry groups and ensembles in quantum mechanics; Correlations between eigenvalues of a random matrix; A class of matrix ensembles; Stability of matter. I; Ground-state energy of a finite system of charged particles; Stability of matter. II; Seismic response of the earth to a gravitational wave in the 1-Hz band; Time variation of the charge of the proton; Variation of constants; Scattering of mesons by a fixed scatterer; Fredholm determinants and inverse scattering problems; Time without end: Physics and biology in an open universe; Feynman's proof of the Maxwell equations; Photon noise and atmospheric noise in active optical systems; Search for artificial stellar sources of infrared radiation; The search for extraterrestrial technology; Can we control the carbon dioxide in the atmosphere?; A model for the origin of life; Chronological list of papers; Acknowledgements.

May 1996, approximately 606 pages (hardcover), ISBN 0-8218-0561-4
1991 Mathematics Subject Classification: 01A75
All AMS members $47, List $59
To order, please specify CWORKS/5N

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science

Clique, Coloring, and Satisfiability
David S. Johnson and Michael A. Trick, Editors
Volume 26

The purpose of a DIMACS Challenge is to encourage and coordinate research in the experimental analysis of algorithms. The First DIMACS Challenge encouraged experimental work in the area of network flow and matchings. This Second DIMACS Challenge, on which this volume is based, took place in conjunction with the DIMACS Special Year on Combinatorial Optimization. Addressed here are three difficult combinatorial optimization problems: finding cliques in a graph, coloring the vertices of a graph, and solving instances of the satisfiability problem. These problems were chosen both for their practical interest and because of their theoretical tractability.

Contents
Graduate Studies in Mathematics

Enveloping Algebras
Jacques Dixmier
Volume 11

This classic text is being made available by the AMS to a wide readership. The new printing of the 1977 English edition of the original French volume, *Algebres Enveloppantes*, returns to circulation a book that is still valuable to those interested in Lie algebras and their representations. This volume includes a new section with updates from the author.

**Features:**
- A short section, “State of the problems,” is added, where progress is reported in solving problems listed as “unsolved” in the previous edition.
- An additional bibliography is included which lists major works related to the theme of the book, and also works related to the above-mentioned section.
- A few minor additions and corrections have been made.

**Contents**
- Lie algebras: Enveloping algebras; Two-sided ideals in enveloping algebras; Centres; Induced representations; Primitive ideals (the solvable case); Verma modules; The enveloping algebra of a semisimple Lie algebra; Harish-Chandra modules; Primitive ideals (the general case); Appendix; Problems; Bibliography; Added in 1996; Index.

May 1996, 379 pages (hardcover), ISBN 0-8218-0560-6, ISSN 1065-7339
1991 *Mathematics Subject Classification: 17Bxx*
All AMS members $47, List $59
To order, please specify GSM/11N

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Fields Institute Monographs

**Multiplicative Galois Module Structure**

A. Weiss
Volume 5

This book is the result of a short course on the Galois module structure of $S$-units that was given at The Fields Institute in the fall of 1993. Offering a new angle on an old problem, the main theme is that this structure should be determined by class field theory, in its cohomological form, and by the behavior of Artin $L$-functions at $s = 0$. A proof of this—or even a precise formulation—is still far away, but the available evidence all points in this direction. The work brings together the current evidence that the Galois structure of $S$-units can be described.

**Contents**
- Overview; From class field theory; Extension classes; Locally free class groups; Tate sequences; Recognizing $G$-modules; Local analogue; $\Omega_m$ and the $G$-module structure of $E$; Artin $L$-functions at $s = 0$; $q$-indices; Parallel properties of $A_p$ and $q_0$; Q-valued characters; Representing the Chinburg class; Small $S$; A cyclotomic example; Notes; Bibliography; Subject index.

May 1996, 93 pages (hardcover), ISBN 0-8218-0265-8, ISSN 1069-5273
1991 *Mathematics Subject Classification: 11R33; 11R37, 11R23, 11R34, 11R37, 11R42, 11S25, 11S31, 16H05, 19A31, 20C10, 20J06*
Individual member $23, List $39, Institutional member $31
To order, please specify FIM/5N

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Proceedings of Symposia in Pure Mathematics

**Quantization, Nonlinear Partial Differential Equations, and Operator Algebra**

William Arveson, Thomas Branson, and Irving Segal, Editors
Volume 59

Recent inroads in higher-dimensional nonlinear quantum field theory and in the global theory of relevant nonlinear wave equations have been accompanied by very interesting cognate developments. These developments include symplectic quantization theory on manifolds and in group representations, the operator algebraic implementation of quantum dynamics, and differential geometric, general relativistic, and purely algebraic aspects. *Quantization and Nonlinear Wave Equations* thus was highly appropriate as the theme.
The author has faithfully translated the Japanese edition with the exception of appendix 6—on the collapsing of Riemannian manifolds and Grothendieck’s convergence theorem—which has been considerably revised and expanded, including the addition of a few comments on further developments, and corrections of small errors.

Contents

Preliminaries from manifolds; Fundamental concepts in Riemannian geometry; Global concepts in Riemannian geometry; Comparison theorems and applications; Curvature and topology of Riemannian manifolds; Isoperimetric inequality and spectral geometry; Appendices: Hints and solutions to problems and exercises; Bibliography; Index.

May 1996, approximately 356 pages (hardcover), ISBN 0-8218-0284-4, LC 96-6475, ISSN 0065-9282
1991 Mathematics Subject Classification: 53-01, 53C20, 53C21, 53C22, 53C23, 53C35, 58G25, 35P15
Individual member $71, List $119, Institutional member $95
To order, please specify MMONO/149N

Lectures on Entire Functions

B. Ya. Levin

Volume 150

As a brilliant university lecturer, B. Ya. Levin attracted a large audience of working mathematicians and of students from various levels and backgrounds. For approximately 40 years, his Kharkov University seminar was a school for mathematicians working in analysis and a center for active research. This monograph aims to expose the main facts of the theory of entire functions and to give their applications in real and functional analysis. The general theory starts with the fundamental results on the growth of entire functions of finite order, their factorization according to the Hadamard theorem, properties of indicator and theorems of Phragmén-Lindelöf type.

Contents (Preliminary)

Part I. Entire Functions of Finite Order: Growth of entire functions; Main integral formulas for functions analytic in a disk; Some applications of the Jensen formula; Factorization of entire functions of finite order; The connection between the growth of an entire function and the distribution of its zeros; Theorems of Phragmén and Lindelöf; Subharmonic functions; The indicator function; The Pólya Theorem; Applications of the Pólya Theorem; Lower bounds for analytic and subharmonic functions; Entire functions with zeros on a ray; Entire functions with zeros on a ray (continuation); Part II. Entire Functions of Exponential Type: Integral representation of functions analytic in the half-plane; The Hayman Theorem; Functions of class C and their applications; Zeros of functions of class C; Completeness and minimality of system of exponential functions in $L^2(0, a)$; Interpolation by entire functions of exponential type; Interpolation by entire functions of the spaces $L_\nu$ and $B_\nu$; Sin-type functions; Riesz bases formed by exponential functions in $L^2(-\pi, \pi)$; Completeness of the eigenfunction system of a quadratic operator pencil; Part III. Some Additional Problems of the Theory of Entire Functions: Carleson’s and R. Nevanlinna’s formulas and their applications; Uniqueness problems for Fourier transforms and for infinitely-differentiable functions; The Matsuura Theorem on the growth of entire functions admitting a lower bound; Entire functions of the class $P$; S. N. Bernstein’s inequality for entire

Translations of Mathematical Monographs

Riemannian Geometry

Takashi Sakai

Volume 149

This volume is an English translation of Sakai’s textbook on Riemannian geometry which was originally written in Japanese and published in 1992. The book describes the outstanding recent progress in this important and challenging field and presents general background for the scientific context and specifics regarding key difficulties. Quantization is developed in the context of rigorous nonlinear quantum field theory in four dimensions and in connection with symplectic manifold theory and random Schrödinger operators. Nonlinear wave equations are exposed in relation to recent important progress in general relativity, in purely mathematical terms of microlocal analysis, and as represented by progress on the relativistic Boltzmann equation.

Most of the developments in this volume appear in book form for the first time. The resulting work is a concise and informative way to explore the field and the spectrum of methods available for its investigation.

Contents


Mathematics Subject Classification:

58Cxx, 35Lxx, 35Qxx, 47Bxx, 47Nxx

To order, please specify PSPUM/59N

May 1996, 224 pages (hardcover), ISBN 0-8218-0381-6, LC 96-5187, ISSN 0082-0717
1991 Mathematics Subject Classification: 81Txx, 81Rxx, 81Vxx, 35Lxx, 35Qxx, 47Bxx, 47Nxx, 58Cxx, 58Exx, 46Gxx, 46Lxx
Individual member $32, List $54, Institutional member $43
To order, please specify MMONO/149N
functions of exponential type and its generalizations; Bibliography; Author index; Subject index.

May 1996, approximately 265 pages (hardcover), ISBN 0-8218-0282-8, LC 96-318, ISSN 0065-0282
1991 Mathematics Subject Classification: 30Dxx, 30D20

Individual member $50, List $99, Institutional member $79
To order, please specify MMONO/150N

Other Publications Available Through the AMS

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EME  Education/Mathematics Education

00  General

01  History and biography

03  Mathematical logic and foundations

04  Set theory

05  Combinatorics

06  Order, lattices, ordered algebraic structures

08  General algebraic systems

11  Number theory

12  Field theory and polynomials

13  Commutative rings and algebras

14  Algebraic geometry

15  Linear and multilinear algebra; matrix theory

16  Associative rings and algebras

17  Nonassociative rings and algebras

18  Category theory; homological algebra

19  K-theory

20  Group theory and generalizations

22  Topological groups, Lie groups

26  Real functions

28  Measure and integration

30  Functions of a complex variable

31  Potential theory

32  Several complex variables and analytic spaces

33  Special functions

34  Ordinary differential equations

35  Partial differential equations

39  Finite differences and functional equations

40  Sequences, series, summability

41  Approximations and expansions

42  Fourier analysis

43  Abstract harmonic analysis

44  Integral transforms, operational calculus

45  Integral equations

46  Functional analysis

47  Operator theory

49  Calculus of variations and optimal control; optimization

51  Geometry

52  Convex and discrete geometry

53  Differential geometry

54  General topology

55  Algebraic topology

57  Manifolds and cell complexes

58  Global analysis, analysis on manifolds

60  Probability theory and stochastic processes

62  Statistics

65  Numerical analysis

66  Computer science

70  Mechanics of particles and systems

73  Mechanics of solids

76  Fluid mechanics

78  Optics, electromagnetic theory

80  Classical thermodynamics, heat transfer

81  Quantum theory

82  Statistical mechanics, structure of matter

83  Relativity and gravitational theory

85  Astronomy and astrophysics

86  Geophysics

90  Economics, operations research, programming, games

92  Biology and other natural sciences, behavioral sciences

93  Systems theory; control

94  Information and communication, circuits
**Membership Categories**

Please read the following to determine what membership category you are eligible for, and then indicate below the category for which you are applying.

For ordinary members whose annual professional income is below $45,000, the dues are $90; for those whose annual professional income is $45,000 or more, the dues are $120.

The CMS cooperative rate applies to ordinary members of the AMS who are also members of the Canadian Mathematical Society and reside outside of the U.S. For members whose annual professional income is $45,000 or less, the dues are $77; for those whose annual professional income is above $45,000, the dues are $102.

For a joint family membership, one member pays ordinary dues, based on his or her income; the other pays ordinary dues based on his or her income, less $20. (Only the member paying full dues will receive the Notices and the Bulletin as a privilege of membership, but both members will be accorded all other privileges of membership.)

Minimum dues for contributing members are $180.

For either students or unemployed individuals, dues are $30, and annual verification is required.

The annual dues for reciprocity members who reside outside the U.S. and Canada are $60. To be eligible for this classification, members must belong to one of those foreign societies with which the AMS has established a reciprocity agreement, and annual verification is required. Reciprocity members who reside in the U.S. or Canada must pay ordinary member dues ($90 or $120).

The annual dues for category-S members, those who reside in developing countries, are $16. Members can choose only one privilege journal. Please indicate your choice below.

Members can purchase a multi-year membership by prepaying their current dues rate for either two, three, four or five years. This option is not available to category-S, unemployed, or student members.

**1996 Dues Schedule (January through December)**

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CMS Cooperative rate ..................................... □ $77 □ $102

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Reciprocity member (please verify) ³ ............... □ $60 □ $90 □ $120

Category-S member ⁴ ..................................... □ $16

Multi-year membership ................................. $ for years

¹ Student Verification (sign below)

I am a full-time student at ................................................... current working toward a degree.

² Unemployed Verification (sign below) I am currently unemployed and actively seeking employment. My unemployment status is not a result of voluntary resignation or of retirement from my last position.

³ Reciprocity Membership Verification (sign below) I am currently a member of the society indicated on the right and am therefore eligible for reciprocity membership.

Signature

⁴ □ send NOTICES □ send BULLETIN

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- Edinburgh Mathematical Society
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- Irish Mathematical Society
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- Saudi Association for Mathematical Sciences
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Journal mailing lists must be printed four to six weeks before the issue date. Therefore, in order to avoid disruption of service, members are requested to provide the required notice well in advance.

Besides mailing addresses for members, the Society's records contain information about members' positions and their employers (for publication in the Combined Membership List). In addition, the AMS maintains records of members' honors, awards, and information on Society service.

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Has Fermat's Theorem really been proved?
Is your PC always right when it computes something—even when you've input everything correctly?
How well is turbulence understood, including the type that makes you uncomfortable on an airplane?
Does modern mathematics have anything to teach the wizards of Wall Street?

What is happening to one of the most renowned and complicated mathematical proofs in history, i.e., the classification of finite simple (!) groups?

Answers to these questions and other fascinating articles can be found in this book.

These articles describe many cutting-edge areas of modern pure and applied mathematical research, yet they are written at a level that can be understood and appreciated by anyone with a high-school mathematical background. The author, Barry Cipra, is a well-known scientific journalist and mathematical expositor who is a contributing correspondent for *Science* magazine and writes for *SIAM News* and *American Mathematical Monthly*. In reading these articles, you will also get a feeling for the beauty and the universality of mathematics.
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Meetings & Conferences of the AMS

The following pages give information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee. For some meetings the list may be incomplete. Up-to-date meeting information is available on the World Wide Web via the Internet at URL http://www.ams.org/.

Meetings:

1996

April 13-14 New York, New York p. 498
April 19-21 Baton Rouge, Louisiana p. 499
May 22-24 Antwerp, Belgium p. 500
August 10-12 Seattle, Washington p. 500

Mathfest

October 5-6 Lawrenceville, New Jersey p. 502
October 11-12 Chattanooga, Tennessee p. 502
November 1-3 Columbia, Missouri p. 503
November 16-17 Pasadena, California p. 504

1997

January 8-11 San Diego, California p. 504

Annual Meeting

March 21-22 Memphis, Tennessee p. 504
April 12-13 College Park, Maryland p. 504
May 2-4 Detroit, Michigan p. 505
September 26-28 Montreal, Canada p. 505
October 10-12 Atlanta, Georgia p. 505
October 24-26 Milwaukee, Wisconsin p. 513

1998

January 7-10 Baltimore, Maryland p. 505

Annual Meeting

March 27-28 Manhattan, Kansas p. 505

Conferences:

1996


Important Information Regarding AMS Meetings

Potential organizers and speakers should refer to the January issue of the Notices for guidelines on participation and abstract submission. Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

NEW! Beginning with the fall 1996 meetings, an enhanced system for submitting your abstract will be in place. See details on the opposite page.

Completed electronic abstracts should be submitted to abs-submit@ams.org with 'submission' as the subject line; paper abstracts should be sent to the Abstracts Coordinator, AMS Meetings and Conferences Department, P. O. Box 6887, Providence, RI 02940; telephone: 401-455-4182. Any other inquiries about AMS meetings may be sent to meet@ams.org.

Should your university be interested in hosting an AMS meeting, see the January issue for details.
Meetings and Conferences

**Refunds for Orlando Meeting**

Individuals who registered in advance for the January 1996 Joint Mathematics Meetings in Orlando, Florida, but who were prevented from attending the meeting because of severe weather along the eastern seaboard which closed airports over several days, may request a refund of 50 percent of the meeting advance registration fee by writing to the Mathematics Meetings Housing Bureau, P.O. Box 6887, Providence, RI 02940, or by sending e-mail to pop@ams.org. The Joint Meetings Committee is granting this exception to the usual refund policy because of the unusual weather circumstances, but this will in no way prejudice the application of the usual policy for future meetings. (For information, the usual policy is that a 50 percent refund can be made if notice of cancellation is received before the start of the meeting. After the start of the meeting, no refunds can be made.)

**MAA Minicourse Refunds**

If you preregistered for an MAA Minicourse at the Orlando meeting and were unable to attend due to the storm, you are eligible for a 50 percent refund. Please send a written request to: MAA Minicourse Coordinator, 1529 18th Street, NW, Washington, DC 20036 or e-mail to jheckler@maa.org.

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**New York, New York**

*New York University, Courant Institute*

April 13–14, 1996

**Meeting #910**

Eastern Section

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: February 1996

Program issue of *Notices*: April 1996, p. 506

Issue of *Abstracts*: Volume 17, Issue 2

**Registration**

Saturday, 8:00 a.m. to 4:00 p.m., and Sunday, 8:00 a.m. to noon, in the lobby of Warren Weaver Hall, 251 Mercer Street.

**Invited Addresses**

Claude R. LeBrun, State University of New York, Stony Brook, On 4-dimensional Einstein manifolds.

Zee'ev Rudnick, Tel Aviv University, Israel, The Riemann zeta function and random matrix theory.

Jose Scheinkman, University of Chicago, Assessing the empirical performance of continuous time methods in finance.

Michael F. Singer, North Carolina State University, The inverse problem in differential Galois theory.

**Special Sessions**

Differential Algebra, Phyllis J. Cassidy, Smith College, William F. Keigher, Rutgers University, Newark, and Michael F. Singer, North Carolina State University.

Gauge Field Theory, Janet C. Talvacchia, Swarthmore College, and Yisong Yang, Polytechnic University.

Global Riemannian Geometry, Tobias H. Colding, Courant Institute of Mathematical Sciences, New York University, Claude R. LeBrun, State University of New York, Stony Brook, and Santiago R. Simanca, Polytechnic University.

Hyperbolic Geometry and Discrete Groups, Jane P. Gilman, Rutgers University, Newark.

Number Theory, William D. Duke, Rutgers University, New Brunswick, and Zee'ev Rudnick, Tel Aviv University, Israel.

Partial Differential Equations, Patricia E. Bauman, Purdue University, West Lafayette, Fanghua Lin, Courant Institute of Mathematical Sciences, New York University, and Peter J. Sternberg, Indiana University, Bloomington.

Stochastic Models in Mathematical Finance, Thaleia Zariphopoulou, University of Wisconsin, Madison.

Topological Methods, Edward Beckenstein, Lawrence Nirenberg, and Charles R. Traina, Saint John's University.

**Program Updates**

Joachim Heinze, Springer Verlag, should have been included in the list of panelists in the March issue for Saturday's forum on Perspectives on doing mathematics in the electronic age.

AMS Council Meeting: Saturday, 7:00 p.m., at the Marriott Marquis, 1535 Broadway.
Baton Rouge, Louisiana
Louisiana State University
April 19-21, 1996

Meeting #911
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: February 1996
Program issue of Notices: April 1996, p. 515
Issue of Abstracts: Volume 17, Issue 2

Registration
Friday, noon to 5:00 p.m.; Saturday, 8:00 a.m. to 5:00 p.m.;
and Sunday, 8:00 a.m. to noon, in the atrium of the How­
Russell Geoscience Complex.

Invited Addresses
Ronald A. Fintushel, Michigan State University, Geography
of smooth 4-manifolds.
Fritz Gesztesy, University of Missouri, Columbia, Variations
on a theme of Picard.
Edward L. Green, Virginia Polytechnic Institute and State
University, Computational algebra and finite dimensional
modules.
William A. Massey, AT&T Research, Murray Hill, New Jer­
sy, Limit theorems for time-varying queues.

Special Sessions
Asymptotic Behavior of Difference Equations With Appli­
cations, Saber N. Elaydi, Trinity University, San Antonio,
and Vlajko Lj Kocic, Xavier University of Louisiana.
Control Theory, Guillermo Segundo Ferreyra and Peter R.
Wolenski, Louisiana State University.
Fixed Point Theory and Dynamical Systems, Michael R.
Kelly, Loyola University.
Fluid Dynamics, Jerome A. Goldstein and Michael Mudi
Tom, Louisiana State University.
Geometric Group Theory, Stephen G. Brick, University of
South Alabama, Jon M. Corson, University of Alabama,
and Barry S. Spieler, Birmingham-Southern College.
Low-Dimensional Topology, Patrick M. Gilmer, Rick Lither­
land, and Neal W. Stoltzfus, Louisiana State University.
Nonlinear Partial Differential Equations, James R. Dorroh
and Giselle Ruiz Goldstein, Louisiana State University.
Number Theory and Quadratic Forms, Jurgen Hurrelbrink,
Jorge F. Morales, Robert V. Perlis, and Paul B. Van Wame­
len, Louisiana State University.
Real Algebraic Geometry and Ordered Algebraic Struc­
tures, Charles N. Delzell and James Joseph Madden,
Louisiana State University, and Scott Woodward, Southern
University. (Note: Some speakers are scheduled on April 17
and 18, during special premeeting sessions.)
Meetings and Conferences

Real Analytic Geometry and o-Minimal Structures, Lou P. van den Dries, University of Illinois, Urbana-Champaign, and Chris Miller, University of Illinois, Chicago.

Representations of Finite Groups, Algebraic Groups, and Lie Algebras, Randall R. Holmes, Auburn University, Auburn, and Cornellius Pilleen, University of South Alabama.

Rings and Modules, Ellen E. Kirkman, Wake Forest University, and Dan Zacharia, Syracuse University.


Transform Theory and Evolution Equations, Frank Neubrander and Lutz Weis, Louisiana State University.

Antwerp, Belgium

May 22-24, 1996

Meeting #912

First joint meeting of the AMS and the mathematical societies of the Benelux countries (Belgium, the Netherlands, and Luxembourg).

Associate secretary: Robert J. Daverman

Announcement issue of Notices: January 1996, p. 120

Program issue of Notices: May 1996

Issue of Abstracts: None

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: Expired

For abstracts: Expired

Invited Addresses

M. Van den Bergh, Limburgs Universitair Centrum, Belgium, Noncommutative geometry and regular algebras.

Jean Bourgain, Institute for Advanced Study, Princeton University, Title to be announced.

John Conway, Princeton University, Title to be announced (Beeger Lecture).

W. Hackbush, Recent developments in numerical mathematics (Brouwer Lecture).

Joyce R. McLaughlin, Rensselaer Polytechnic Institute, Title to be announced.

L. Schrijver, CWI, Amsterdam, The Netherlands, Combinatorial optimization with cohomology over groups.

Stephen Smale, University of California, Berkeley, and City University of Hong Kong, Relating the Hilbert Nullstellensatz to the problem: does \( P=NP \)?

Elias M. Stein, Princeton University, Title to be announced.

F. Takens, Rijksuniversiteit Groningen, The Netherlands, Chaotic dynamics in variations of the Lenon attractor.

Clifford Taubes, Harvard University, The geometry of the Selberg-Witten Equations.

Special Sessions

Algebraic Geometry, J. de Jong, Harvard University, and M. van der Put, Rijksuniversiteit Groningen, The Netherlands.

Algebra, S. Caenepeel, Vrije Universiteit Brussels, Belgium, and S. Montgomery, University of Southern California.

Buildings, H. Van Maldeghem, Rijksuniversiteit te Gent, Belgium, and M. Ronan, University of Illinois at Chicago.

Differential Geometry, L. Van Hecke, Katholieke Universiteit Leuven, Belgium, and L. Lemaire, Université Libre de Bruxelles, Belgium.


Dynamical Systems, F. Dumortier LUC, Hasselt, Belgium, and S. van Strien, University of Amsterdam, The Netherlands.

Harmonic Analysis, J. Ludwig, Université de Metz, France, and J.-P. Pier, Universitaire de Luxembourg, Luxembourg.

History of Mathematics, J. Mahwin, Université Catholique de Louvain, Belgium, and J.-P. Pier.

Inverse Problems, C. De Mol, Université Libre de Bruxelles, Belgium, and F. Santosa, University of Minnesota.

Logic, M. Boffa, Université de l’Etat à Mons, Belgium, and C. Michaux, Université de Mons-Hainaut.

Mathematical Physics, J. Bricmont, Université de Liège, Belgium, and B. Nachtegaele, Princeton University.


Motivic Cohomology and Algebraic K-Theory, E. Friedlander, Northwestern University, and J. Murre, Leiden University, The Netherlands.


Wavelets, I. Daubechies, Princeton University, and N. Temme, CWI, Amsterdam, The Netherlands.

Seattle, Washington

University of Washington

August 10-12, 1996

Meeting #913

Seattle Mathfest including the 98th Summer Meeting of the American Mathematical Society (AMS), the 74th meeting of the Mathematical Association of America (MAA), and the summer meetings of the Association for Women in Mathematics (AWM) and Pi Mu Epsilon (PME).
Meetings and Conferences

Associate secretary: Susan J. Friedlander
Announcement issue of Notices: May 1996
Program issue of Notices: August 1996
Issue of Abstracts: None

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: None
For abstracts: None
For summaries of papers to MAA organizers: April 22, 1996

Invited Addresses
Joel Hass, University of California, Davis, (AMS-MAA Invited Address) (Code: HASS)

MAA Contributed Papers
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 Submissions Procedures at the end of this section.

Sessions generally must limit presentations to ten minutes, but selected participants may extend their contributions up to twenty minutes. Each session room contains an overhead projector and screen; blackboards will not be available. Persons needing additional equipment should contact the MAA Associate Secretary as soon as possible and no later than May 3, 1996: Donovan H. Van Osdol, Department of Mathematics, University of New Hampshire, Durham, NH 03824; e-mail: dvanosdo@maa.org.

- Innovative Teaching in First-year College Mathematics Courses, Saturday and Sunday afternoons. Howard L. Penn*, Department of Mathematics, 572 Holloway Rd., U.S. Naval Academy, Annapolis, MD 21402-5002; phone: 410-293-6768; fax: 410-293-4883; e-mail: hlp@usna.navy.mil; and Aaron I. Stucker, Washburn University. This session will present talks describing innovative techniques in the teaching of mathematics courses typically taught in the first year of college. Innovative techniques include (but are not limited to) the use of technology, writing projects, and cooperative learning. Submission of proposals via electronic mail is preferred by the organizers.

- Reformed Calculus in Performance: What Works, What to Fix, Saturday and Sunday afternoons. Walter Kelley*, Department of Mathematics, University of Oklahoma, Norman, OK 73019; phone 405-325-3782; fax 405-325-7484; email: wkelley@ouknor.edu; and Curtis McKnight, University of Oklahoma. The continuing efforts at calculus reform have by now provided considerable information on what has worked well in reform efforts, what has not, and in what directions reform of various efforts should go. This session invites papers on the investigation of calculus reform projects, especially formal assessment studies, and on possible directions of future innovation.

- Mathematicians in the K-8 Classroom, Saturday and Monday afternoons. Una Bray*, Department of Mathematics and Computer Science, Skidmore College, Saratoga Springs, NY 12866-1632; phone: 518-584-5000, ext. 2246; e-mail: ubray@skidmore.edu; and R. Daniel Hurwitz, Department of Mathematics and Computer Science, Skidmore College. The elementary and middle school classrooms may be the most difficult and yet the most important arenas for mathematicians to make contributions to educational reform. But members of college and university faculties can make a difference in how young students (and teachers) perceive mathematics. Many are already doing so, but their efforts may not be well known. This session invites papers on experiences and programs, successful or otherwise, which mathematicians have dared to try.

- Innovations in Mathematics Courses Beyond Linear Algebra, Saturday and Sunday afternoons. Janet L. Beery*, University of Redlands, Department of Mathematics, 1200 E. Colton Ave., Redlands, CA 92373; phone: 909-793-2121; fax: 909-793-2029; e-mail: beery@ultrix.uor.edu; and Steven Morics, University of Redlands. Spurred by reforms in the lower division curriculum, mathematics educators now are making substantial revisions in upper division mathematics courses. We invite papers describing significant changes in content and/or pedagogy (e.g., computer use, cooperative and/or constructive learning) in these courses. While papers about curricular changes in all advanced mathematics courses will be considered, preference may be given to courses not featured in paper sessions at recent national meetings.

- Teaching and Learning Mathematics as a Laboratory Science, Sunday and Monday afternoons. Marcelle Bessman*, Department of Mathematics, Jacksonville University, Jacksonville FL 32211; phone: 904-745-7300; fax: 904-745-7573; e-mail: mbessma@junix.ju.edu. and David Smith, Duke University. Computers and graphing calculators can be used as tools for exploration of mathematical concepts and constructs as well as for "discovery of mathematical truths". Through integrated use of this technology the classroom becomes a laboratory for instruction and learning. For this session the organizers invite papers which focus on uses of technology in the mathematics classroom.

Submission Procedures For Contributed Paper Proposals
After you have selected a session to which you wish to contribute a paper, forward the name(s) and address(es) of the author(s) and a one-page summary of your paper directly to the organizer indicated above with an asterisk (*). 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.
Meetings and Conferences

Your summary must reach the designated organizer by Monday, April 22, 1996. Do not forward completed summaries to the MAA or the AMS.

The organizer will acknowledge receipt of all paper summaries. You will receive notification from the organizer by May 10, 1996, whether your paper has been accepted. Please note that, unlike previous Math-fests, there will be no published abstracts for this meeting.

Lawrenceville, New Jersey
Rider University
October 5-6, 1996

Meeting #914
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: August 1996
Program issue of Notices: October 1996
Issue of Abstracts: Volume 17, Issue 3

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: May 7, 1996 (This date is earlier than previously published.)
For abstracts: July 2, 1996

Invited Addresses
Louis J. Billera, Cornell University, Ithaca, Title to be announced. (Code: BILLERA)
Fred I. Diamond, University of Cambridge, United Kingdom, Title to be announced. (Code: DIAMOND)
Nicole Tomczak Jaegermann, University of Alberta, Title to be announced. (Code: TOMZCAK)
Karen E. Smith, Massachusetts Institute of Technology, Title to be announced. (Code: SMITH)

Special Sessions
Algebraic K-theory (Code: AMS SS I1), Charles A. Weibel, Rutgers University, New Brunswick.
Automorphic Forms (Code: AMS SS I1), Henri Rene Darmon and Fernando Rodriguez Villegas, Princeton University.
Combinatorial and Computational Geometry (Code: AMS SS K1), William Steiger, Rutgers University, New Brunswick, and Illeana Streinu, Smith College.
Commutative Algebra (Code: AMS SS M1), Karen E. Smith, Massachusetts Institute of Technology, and Irena Swanson, New Mexico State University.
Elliptic Surfaces (Code: AMS SS E1), William L. Hoyt, Rutgers University, New Brunswick, and Charles Freund Schwartz, Rider University.

Geometric Functional Analysis (Code: AMS SS N1), Edward Odell, University of Texas, Austin, and N. Tomczak Jaegermann, University of Alberta.
Geometric Topology (Code: AMS SS F1), Norman J. Levitt, Rutgers University, New Brunswick, and Georgia Triantafillou, Temple University.
Homotopy Theory (Code: AMS SS A1), Martin Bendersky, Hunter College, City University of New York, and Donald M. Davis, Lehigh University.
Infinite Groups and Group Rings (Code: AMS SS O1), Simon Thomas, Rutgers University, New Brunswick, and Samuel M. Vovsi, The Chubb Corporation, New Jersey.
Invariants of Smooth 4-manifolds (Code: AMS SS H1), John W. Morgan, Columbia University, and Frank S. Quinn, Virginia Polytechnic Institute and State University.
Mirror Symmetry and Toric Varieties (Code: AMS SS B1), Ciprian S. Borcea, Rider University, and Sylvain E. Cappell, Courant Institute of Mathematical Sciences, New York University.
Moduli Spaces of Vector Bundles Over Surfaces With or Without Additional Structure (Code: AMS SS L1), Hans Ulysses Boden, Max Planck Institute for Mathematics, Germany and McMaster University.
Operads, Hopf Algebras, and Categories (Code: AMS SS D1), Arthur M. Dupre, Rutgers University, New Brunswick, and James D. Stasheff, University of North Carolina, Chapel Hill.
Partial Differential Equations In Geometry (Code: AMS SS C1), Thomas Patrick Branson, University of Iowa, and Robert C. McOwen, Northeastern University.
Radon Transforms and Tomography (Code: AMS SS G1), Andrew G. Markoe, Rider University, and Eric Todd Quinto, Tufts University.

Chattanooga, Tennessee
University of Tennessee, Chattanooga
October 11-12, 1996

Meeting #915
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: August 1996
Program issue of Notices: October 1996
Issue of Abstracts: Volume 17, Issue 3

Deadlines
For organizers: Expired
For consideration of contributed papers in Special Sessions: May 7, 1996 (This date is earlier than previously published.)
For abstracts: July 2, 1996 (Please note this deadline is earlier than previously published.)

Invited Addresses

Orlando Alvarez, University of Miami, Title to be announced. (Code: ALVAREZ)

Christopher J. Bishop, State University of New York, Stony Brook, Title to be announced. (Code: BISHOP)

David Harbater, University of Pennsylvania, Title to be announced. (Code: HARBATER)

Joyce R. McLaughlin, Rensselaer Polytechnic Institute, Title to be announced. (Code: MCCLAUGHLIN)

Special Sessions

Applied Probability (Code: AMS SS J1), Thomas Kozubowski and Anna Katarzyna Panorska, University of Tennessee, Chattanooga.

Commutative Ring Theory (Code: AMS SS A1), David F. Anderson and David E. Dobbs, University of Tennessee, Knoxville.

Conformal Analysis (Code: AMS SS I1), David Howard Hamilton, University of Maryland, College Park.

Dynamical Systems and Continuum Theory (Code: AMS SS K1), John Clyde Mayer, University of Alabama, Birmingham.

Galois Theory (Code: AMS SS B1), Kevin R. Coombes, University of Maryland, College Park, and Helmut Voelklein, University of Florida.

Geometric Topology (Code: AMS SS E1), Alexander Nikolaevich Dranishnikov and James E. Keesling, University of Florida, and Jerzy Dydak, University of Tennessee, Knoxville.

Inverse Spectral Problems For Differential Operators. (Code: AMS SS M1), Peter Anton Perry, University of Kentucky.

Mathematical Aspects of Wave Propagation Phenomena (Code: AMS SS G1), B. Belinsky and Steve Xu, University of Tennessee, Chattanooga.

Matrix Theory (Code: AMS SS D1), Shu-An Hu, University of Tennessee, Chattanooga, Zhongshan Li, Georgia State University, Ronald Lee Smith, University of Tennessee, Chattanooga, and Frank Uhlig, Auburn University, Auburn.


Optimization (Code: AMS SS F1), Jerald P. Dauer and Oussama A. Saleh, University of Tennessee, Chattanooga.

Reform in Undergraduate Mathematics Education (Code: AMS SS H1), Betsy Darken, Aniekan Asukwo Ebiefung, Stephen W. Kuhn, and Robert Glenn Wynegar, University of Tennessee, Chattanooga.

Set-theoretic Topology (Code: AMS SS L1), Peter J. Nyikos, University of South Carolina.

Columbia, Missouri

University of Missouri

November 1-3, 1996

Meeting #916

Central Section

Associate secretary: Susan J. Friedlander

Program issue of Notices: September 1996

Issues of Abstracts: Volume 17, Issue 4

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions: May 15, 1996 (This date is earlier than previously published.)

For abstracts: July 31, 1996

Invited Addresses

Alejandro Adem, University of Wisconsin, Madison, Recent developments in the cohomology of finite groups. (Code: ADEM)

David E. Barrett, University of Michigan, Ann Arbor, Title to be announced. (Code: BARRETT)

Patricia E. Bauman, Purdue University, West Lafayette, Title to be announced. (Code: BAUMAN)

Ya S. Soibelman, Kansas State University, Title to be announced. (Code: SOIBELMAN)

Special Sessions

Algebraic Geometry (Code: AMS SS J1), Dan Edidin and Qi Zhang, University of Missouri.

Banach Spaces and Related Topics (Code: AMS SS K1), Peter G. Casazza and N. J. Kalton, University of Missouri, Columbia.

Classifying Spaces and Cohomology of Finite Groups (Code: AMS SS H1), Alejandro Adem, University of Wisconsin, and Stewart B. Priddy, Northwestern University.

Commutative Algebra (Code: AMS SS E1), Steven Dale Cutkosky and Hema Srinivasan, University of Missouri, Columbia.

Differential Equations and Dynamical Systems (Code: AMS SS D1), Carmen C. Chicone and Yuri D. Latushkin, University of Missouri, Columbia.

Differential Geometry (Code: AMS SS C1), John Kelly Beem and Adam D. Helfer, University of Missouri, Columbia.

Gauge Theory and Its Interaction With Holomorphic and Symplectic Geometry (Code: AMS SS F1), Stamatis A. Dostoglou, University of California, Santa Barbara, and Jan Segert and Shuguang Wang, University of Missouri, Columbia.

Meetings and Conferences

Lie Groups and Physics (Code: AMS SS II), Victor A. Ginzburg, University of Chicago, and Ya S. Soibelman, Kansas State University.

Partial Differential Equations and Mathematical Physics (Code: AMS SS A1), Mark S. Ashbaugh, University of Missouri, Columbia.


Pasadena, California
California Institute of Technology
November 16-17, 1996

Meeting #917
Western Section
Associate secretary: William A. Harris, Jr.
Announcement issue of Notices: September 1996
Program issue of Notices: November 1996
Issue of Abstracts: Volume 17, Issue 4

Deadlines
For organizers: March 29, 1996
For consideration of contributed papers in Special Sessions: May 15, 1996
For abstracts: August 6, 1996

San Diego, California
San Diego Convention Center
January 8-11, 1997

Joint Mathematics Meetings, including 103rd Annual Meeting of the AMS, 80th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM), the National Association of Mathematicians (NAM), and winter meeting of the Association for Symbolic Logic (ASL).

Associate secretary: Lesley M. Sibner
Announcement issue of Notices: October 1996
Program issue of Notices: January 1997
Issue of Abstracts: Volume 18, Issue 1

Deadlines
For organizers: April 8, 1996
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced
Detroit, Michigan
Wayne State University
May 2-4, 1997
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: March 1997
Program issue of Notices: May 1997
Issue of Abstracts: To be announced

Deadlines
For organizers: August 2, 1996
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Milwaukee, Wisconsin
University of Wisconsin
October 24-26, 1997
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: August 1997
Program issue of Notices: October 1997
Issue of Abstracts: To be announced

Deadlines
For organizers: January 4, 1997
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Montreal, Quebec
Canada
University of Montreal
September 26-28, 1997
Eastern Section
Associate secretary: Lesley M. Sibner
Announcement issue of Notices: To be announced
Program issue of Notices: To be announced
Issue of Abstracts: Fall 1997

Deadlines
For organizers: December 20, 1996
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Atlanta, Georgia
Georgia Institute of Technology
October 10–12, 1997
Southeastern Section
Associate secretary: Robert J. Daverman
Announcement issue of Notices: August 1997
Program issue of Notices: October 1997
Issue of Abstracts: To be announced

Deadlines
For organizers: January 10, 1997
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced

Baltimore, Maryland
Baltimore Convention Center
January 7–10, 1998
Joint Mathematics Meetings including the 104th Annual Meeting of the AMS, 81st Annual Meeting of the Mathematical Association of America (MAA), and annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM).
Associate secretary: Robert J. Daverman
Announcement issue of Notices: October 1997
Program issue of Notices: January 1998
Issue of Abstracts: Volume 19, Issue 1

Deadlines
For organizers: April 10, 1997
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
For summaries of papers to MAA organizers: To be announced

Manhattan, Kansas
Kansas State University
March 27–28, 1998
Central Section
Associate secretary: Susan J. Friedlander
Announcement issue of Notices: January 1998
Program issue of Notices: March 1998
Issue of Abstracts: To be announced

Deadlines
For organizers: June 26, 1997
For consideration of contributed papers in Special Sessions: To be announced
For abstracts: To be announced
### Presenters of Papers

**New York, New York; April 13-14, 1996**

*Numbers following the name indicate the speaker's position on the program.*

- **AMS Invited Lecturer**
- **Special Session Speaker**
- **Graduate Student**

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Program of the Sessions

New York, New York, April 13–14, 1996

Saturday, April 13

Meetings Registration

8:00 AM – 4:00 PM Lobby, Courant Institute Building

Special Session on Hyperbolic Geometry and Discrete Groups, I

8:30 AM – 10:50 AM Room 632, Shimkin Hall

Organizer: Jane P. Gilman, Rutgers University, Newark

8:30 AM A discreteness criteria with applications to small volumes.
Frederick W. Gehring, University of Michigan, Ann Arbor, Colin Maclachlan, University of Aberdeen, United Kingdom, Caven John Martin, University of Auckland, New Zealand, and Alan W. Reid*, University of Texas, Austin (910-57-92)

9:00 AM Invariants for n-dimensional Möbius groups.
Chun Cao*, University of Michigan, Ann Arbor, and Peter L. Waterman*, Northern Illinois University (910-30-118)

9:30 AM Discreteness conditions for n-dimensional Möbius groups.
Chun Cao*, University of Michigan, Ann Arbor, and Peter L. Waterman*, Northern Illinois University (910-30-121)

10:00 AM Discrete subgroups of \( SL_n(\mathbb{R}) \) generated by lattices in opposite horospherical subgroups.
Hee Oh, Yale University (910-30-140)

10:30 AM Are homotopy hyperbolic 3-manifolds hyperbolic?
Preliminary report.
Robert Meyerhoff*, Boston College, David Gabai, California Institute of Technology, and Nathaniel John Thurston, University of California, Berkeley (910-57-81)

Special Session on Gauge Field Theory, I

8:30 AM – 10:20 AM Room 626, Shimkin Hall

Organizers: Janet C. Talvacchia, Swarthmore College
Yisong Yang, Polytechnic University

8:30 AM Nonquadratic Yang-Mills energies.
Thomas H. Otway, Yeshiva University (910-35-32)

9:00 AM Existence of hyperbolic monopoles.
Lesley M. Sibner*, Polytechnic University, and Robert J. Sibner, Brooklyn College, City University of New York (910-35-28)

9:30 AM A Mayer-Vietoris principle for monopoles.
Eugene A. Durenard, Salomon Brothers, United Kingdom (910-58-86)

10:00 AM Renormalized energy for Ginzburg-Landau vortices on closed surfaces.
Jie Qing, Columbia University (910-53-71)

Special Session on Stochastic Models in Mathematical Finance, I

8:30 AM – 10:20 AM Room 109, Warren Weaver Hall

Organizer: Thaleia Zariphopoulou, University of Wisconsin, Madison

8:30 AM Efficient trees for option valuation.
David C. Heath, Cornell University (910-35-16)

9:00 AM Optimal investment processes for utility maximization problems with restricted information.
Peter Lakner, Courant Institute of Mathematical Sciences, New York University (910-35-08)

9:30 AM Optimal consumption and investment when investment opportunities are better for the rich than for the poor.
Hyeng Keun Koo* and Thaleia Zariphopoulou, University of Wisconsin, Madison (910-60-43)

10:00 AM Some probabilistic approaches to pricing and hedging multi-assets and path-dependent options.
Helyette G. Geman, ESSEC Finance Department, Cergy-Pontoise, France (910-60-46)

The time limit for each contributed paper in the sessions is ten minutes. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Papers flagged with a solid triangle (•) have been designated by the author as being of possible interest to undergraduate students.

Abstracts of papers presented in the sessions at this meeting will be found in the Spring 1996 issue of Abstracts of papers presented to the American Mathematical Society, ordered according to the numbers in parentheses following the listings. The middle two digits, e.g., 897-20-1136, refer to the Mathematical Reviews subject classification assigned by the individual author. Groups of papers for each subject are listed chronologically in the Abstracts. The last one to four digits, e.g., 897-20-1136, refer to the receipt number of the abstract; abstracts are further sorted by the receipt number within each classification.
Program of the Sessions – New York, NY, Saturday, April 13 (cont’d.)

Special Session on Differential Algebra, I
8:40 AM - 10:50 AM  Room 634, Shimkin Hall
Organizers: Phyllis J. Cassidy, Smith College
William F. Keigher, Rutgers University, Newark
Michael F. Singer, North Carolina State University

8:40 AM  (14)
Lie algebras of derivation operators in the context of differential algebra. Preliminary report.
Phyllis J. Cassidy, Smith College (910-12-111)

9:15 AM  (15)
The symbolic computation of differential invariants using trees.
Robert Grossman, University of Illinois, Chicago (910-17-123)

9:50 AM  (16)
Differentially homogenous differential polynomials.
Georg Martin Reinhart, Wellesley College (910-12-79)

10:25 AM  (17)
An arithmetic analogue of differential algebra.
Alexandru Buium, University of New Mexico (910-11-39)

Special Session on Partial Differential Equations, I
9:00 AM - 10:50 AM  Room 101, Warren Weaver Hall
Organizers: Patricia E. Bauman, Purdue University, West Lafayette
Fanghua Lin, Courant Institute of Mathematical Sciences, New York University
Peter J. Sternberg, Indiana University, Bloomington

9:00 AM  (18)
Some inequalities for second order elliptic equations and applications.
Louis Nirenberg, Courant Institute of Mathematical Sciences, New York University (910-35-108)

9:40 AM  (19)
Fast/slow diffusion and nonlocal geometric motion.
Lawrence Craig Evans, University of California, Berkeley, Mikhail Feldman*, University of Pennsylvania, and Ronald F. Gariepy, University of Kentucky (910-35-52)

10:20 AM  (20)
The singular limit of a vector-valued reaction-diffusion process.
Lisa Bronsard*, McMaster University, and Barbara Stoth, University of Bonn, Germany (910-35-56)

Special Session on Global Riemannian Geometry, I
9:00 AM - 10:50 AM  Room 102, Warren Weaver Hall
Organizers: Tobias H. Colding, Courant Institute of Mathematical Sciences, New York University
Claude R. LeBrun, State University of New York, Stony Brook
Santiago R. Simanca, Polytechnic University

9:00 AM  (21)
Sufficiently collapsed manifolds with bounded curvature and diameter have minimal volume zero.
Jeff Cheeger, Courant Institute of Mathematical Sciences, New York University (910-53-73)

9:30 AM  (22)
Minimal volume and finiteness theorems for manifolds with Gromov's hyperbolicity.
Jian Guo Cao, Cornell University (910-53-24)

10:00 AM  (23)
On function theory on spaces with a lower Ricci curvature bound. II.

10:30 AM  (24)
Metric constraints on exotic spheres via Alexandrov geometry.
K. Grove, University of Maryland, College Park, and Frederick H. Wilhelm, Jr.*, State University of New York, Stony Brook (910-53-50)

Special Session on Number Theory, I
9:00 AM - 10:50 AM  Room 613, Warren Weaver Hall
Organizers: William D. Duke, Rutgers University, New Brunswick
Ze’ev Rudnick, Tel Aviv University, Israel

9:00 AM  (25)
Estimates for Artin L-functions of degree two.
John B. Friedlander, University of Toronto, Henryk Iwaniec* and William D. Duke, Rutgers University, New Brunswick (910-11-97)

9:40 AM  (26)
Bounds for the Tate-Shafarevich group.
Dorian Goldfeld* and Daniel B. Lieman, Columbia University (910-11-136)

10:20 AM  (27)
On the variation of argument of Maass-Hecke L-functions.
Dennis A. Hejhal, Upsala University, Sweden, and Wenbo Luo*, Princeton University (910-11-31)

AMS Panel Discussion
9:00 AM - 10:30 AM  Room 1302, Warren Weaver Hall
Panelists: David Mumford, President, IMU
Jacob Palis, Secretary, IMU
Phillip A. Griffiths, Chairman, Program Committee, ICM 98
Martin Groetschel, President, Organizing Committee, ICM 98
Jeremy Kilpatrick, Vice President, ICMI
Herbert Clemens, Member Executive Committee, CDE

Special Session on Topological Methods, I
9:30 AM - 10:50 AM  Room 813, Warren Weaver Hall
Organizers: Charles R. Traina, Saint John's University
Lawrence Narici, Saint John's University
Edward Beckenste, Saint John's University

9:30 AM  (28)
A new look at biseparating maps. I.
Melvin Henriksen, Harvey Mudd College (910-06-85)

10:10 AM  Informal discussion

Invited Address
11:00 AM - 11:50 AM  Room 109, Warren Weaver Hall
Jose Scheinman, University of Chicago (910-09-03)
Invited Address

1:30 PM - 2:20 PM Room 109, Warren Weaver Hall
(30) On 4-dimensional Einstein manifolds.
Claude R. LeBrun, State University of New York, Stony Brook (910-53-01)

Special Session on Partial Differential Equations, II

2:30 PM - 5:00 PM Room 101, Warren Weaver Hall
Organizers: Patricia E. Bauman, Purdue University, West Lafayette
Fanghua Lin, Courant Institute of Mathematical Sciences, New York University
Peter J. Sternberg, Indiana University, Bloomington

2:30 PM Dynamics of Ginzburg-Landau vortices.

3:10 PM Constraints on formation of singularities for the small disturbance transonic flow equations.
Irene Martinez Gamba, Courant Institute of Mathematical Sciences, New York University (910-35-128)

3:50 PM Travelling fronts in cylinders and their stability.
Jerold W. Bebernes, Congming Li, University of Colorado, Boulder, and Yi Li*, University of Rochester (910-35-93)

4:30 PM Symmetry of solutions of non-linear PDE.
Sagun Chanillo, Rutgers University, New Brunswick (910-35-29)

Special Session on Global Riemannian Geometry, II

2:30 PM - 4:50 PM Room 102, Warren Weaver Hall
Organizers: Tobias H. Colding, Courant Institute of Mathematical Sciences, New York University
Claude R. LeBrun, State University of New York, Stony Brook
Santiago R. Simanca, Polytechnic University

2:30 PM On fundamental groups of manifolds of positive sectional curvature.
Xiaochun Rong, University of Chicago (910-53-14)

3:00 PM Disconnectedness of sublevel sets of some Riemannian functionals.
Alexander Nabutovsky, University of Toronto (910-53-65)

3:30 PM Positively curved metrics of cohomogeneity one.
Wolfgang Ziller*, University of Pennsylvania, and K. Grove, University of Maryland, College Park (910-53-137)

4:00 PM Degenerations of self-dual and related metrics on 4-manifolds. Preliminary report.
Michael T. Anderson, State University of New York, Stony Brook (910-53-75)

4:30 PM Spectral asymptotics and the geometry of degenerating hyperbolic three manifolds.
J. Dodziuk*, Queens College, City University of New York, and Jay A. Jorgenson, Yale University (910-58-38)

Special Session on Number Theory, II

2:30 PM - 5:00 PM Room 613, Warren Weaver Hall
Organizers: William D. Duke, Rutgers University, New Brunswick

Ze'ev Rudnick, Tel Aviv University, Israel

Special Session on Hyperbolic Geometry and Discrete Groups, II

2:30 PM - 4:50 PM Room 632, Shimkin Hall
Organizer: Jane P. Gilman, Rutgers University, Newark

2:30 PM Hyperbolic 3-manifolds with non-intersecting closed geodesics.
Ara S. Basmajian*, University of Oklahoma, and Scott A. Wolpert, University of Maryland, College Park (910-30-94)

3:00 PM 3-parabolic Fuchsian groups.
Todd A. Drumm, University of Pennsylvania (910-51-119)

3:30 PM Extended bisectors in complex hyperbolic and projective space.
William Mark Goldman, University of Maryland, College Park (910-53-66)

4:00 PM Geometrical finiteness for hyperbolic orbifolds.
Emily Hamilton, Rice University (910-57-69)

4:30 PM Shuffling homotopy equivalences and limits of Kleinian groups.
James W. Anderson, University of Southampton, United Kingdom, Richard D. Canary*, University of Michigan, Ann Arbor, and Darryl McCullough, University of Oklahoma (910-57-133)

Special Session on Gauge Field Theory, II

2:30 PM - 4:50 PM Room 626, Shimkin Hall
Organizers: Janet C. Talvacchia, Swarthmore College
Yisong Yang, Polytechnic University

2:30 PM Torus splittings and spectral flow of the twisted signature operator. Preliminary report.
Christopher M. Herald, McMaster University (910-53-63)

3:00 PM Euler characteristics of moduli spaces of instantons over four sphere. Preliminary report.
Youliang Tian, Courant Institute of Mathematical Sciences, New York University (910-53-62)

3:30 PM Multiple condensate solutions for the Chern-Simon-Higgs theory.
Gabriella Tarantello, Universita dis Roma Tor Vergata, Roma, Italy (910-35-47)

4:00 PM Instantons and the information metric. Preliminary report.
David Grosser*, University of Florida, and Michael K. Murray, University of Adelaide, Australia (910-53-95)
Program of the Sessions – New York, NY, Saturday, April 13 (cont’d.)

(D33) Dongho Chae*, Seoul National University, Seoul, Korea, and Namkwon Kim, Postech, Korea (910-53-138)

Special Session on Topological Methods, II
2:30 PM - 5:00 PM  Room 813, Warren Weaver Hall
Organizers: Charles R. Traina, Saint John’s University
Lawrence Narici, Saint John’s University
Edward Beckenstein, Saint John’s University

2:30 PM  How many $Q$-bounded subgroups?
(54) W. Wistar Comfort*, Wesleyan University, and Jan van Mill, Vrije University, (910-22-67)

3:00 PM  Informal discussion

3:50 PM  Transfinite induction with control. Preliminary report.
(55) Alan Dow, York University (910-54-112)

4:30 PM  Intersections of Fréchet-Schwartz spaces and their duals. Preliminary report.
(56) Jose Bonet, Universidad Polytechnica de Valencia, Spain (910-99-141)

Special Session on Stochastic Models in Mathematical Finance, II
2:30 PM - 4:20 PM  Room 109, Warren Weaver Hall
Organizer: Thaleia Zariphopoulou, University of Wisconsin, Madison

2:30 PM  Backward stochastic differential equations, finance and optimization.
(57) Nicole El Karoui*, University of Paris VI, France, Shing-Tung Yau, Duke University, (910-58-31)

3:00 PM  A compactness principle for bounded sequences of martingales with applications to mathematical finance.
(58) F. Delbaen, Vrije University of Brussels, Belgium, and W. Schachermayer*, Vienna University, Austria (910-35-07)

3:30 PM  Modeling and computation of international general financial equilibrium in the presence of transaction costs and price policy interventions: A variational inequality approach.
(59) Anna B. Nagurney* and Stavros Siokos, University of Massachusetts, Amherst (910-90-44)

4:00 PM  A new approach to analytic valuation in the Black Scholes Model.
(60) Peter P. Carr, Cornell University (910-60-42)

Special Session on Differential Algebra, II
2:30 PM - 4:40 PM  Room 634, Shimkin Hall
Organizers: Phyllis J. Cassidy, Smith College
Pavel G. Krylov, University of Wisconsin, Madison
Michael F. Singer, North Carolina State University

2:30 PM  Differential resultants revisited.
(61) Emma Previato, Boston University (910-14-102)

2:50 PM  The model theory of differential fields of finite characteristic.
(62) Carol S. Wood, Wesleyan University (910-14-135)

3:10 PM  Model theory and differential algebra.
(63) Anand Pillay, University of Notre Dame (910-14-99)

3:30 PM  Invariant derivations with no new constants.
(64) Preliminary report.
Andy R. Magid* and Lourdes Juan, University of Oklahoma (910-12-77)

Contributed Paper Session, I
2:30 PM - 5:10 PM  Room 1013, Warren Weaver Hall

2:30 PM  Giordano cubes. Preliminary report.
(65) Joseph Arkin*, David C. Arney and Rickey A. Kolb, United States Military Academy (910-11-10)

2:45 PM  A necessary and sufficient condition for lifting the hypereelastic involution.
(66) Peter Turbek, Purdue University, Calmuet (910-30-27)

3:00 PM  Relationships between various outer measures associated with lattice measures.
(67) Peter D. Stratigos, Long Island University, Brooklyn Center (910-28-33)

3:15 PM  Outer measures and measurable sets.
(68) Carmen Doina Vlad, Pace University, New York (910-28-34)

(69) Chung-Chung Yang, Hong Kong University of Science & Technology, Hong Kong (910-30-05)

3:45 PM  An integral operator for analytic solutions of the wave equation.
(70) Allan Fryant*, Greensboro College, and Murali Krishna Vemuri, University of Chicago (910-35-19)

4:00 PM  $L^p$-gradient estimates for viscosity solutions of fully nonlinear, uniformly elliptic equations. Preliminary report.
(71) Andrzej Janusz Swiec, Georgia Institute of Technology (910-35-26)

4:15 PM  The binomial coefficients and beyond.
(72) Larry Erickson, Millville, New Jersey (910-40-18)

4:30 PM  Powers of absolutely convergent Fourier series.
(73) Bogdan Baishanski* and Michael Snell, Ohio State University, Columbus (910-41-132)

4:45 PM  Disintegration of measures and a variational problem governed by a differential inclusion. Preliminary report.
(74) Toru Maruyama, University of California, Berkeley and Keio University, Japan (910-49-56)

5:00 PM  Non-orthogonal wavelet approximation with rates of deterministic signals. Preliminary report.
(75) George A. Anastassiou*, The University of Memphis, and Stamatis Cambanis, The University of North Carolina, Chapel Hill (910-99-144)

International Forum
2:30 PM - 4:30 PM  Room 1302, Warren Weaver Hall
 Perspectives on Doing Mathematics in the Electronic Age.
Panelists: John H. Ewing, American Mathematical Society
Martin Groetschel, Konrad-Zuse-Zentrum fuer Informationstechnik
Joachim Heinz, Springer-Verlag
Andrew M. Odlyzko, AT&T Research

Council
7:00 PM - 11:00 PM  Majestic Music Box, New York Marriott Marquis
Sunday, April 14

Meeting Registration

8:00 AM - NOON  Location To Be Announced

Special Session on Hyperbolic Geometry and Discrete Groups, III

8:30 AM - 10:50 AM  Room 101, Warren Weaver Hall
Organizer: Jane P. Gilman, Rutgers University, Newark

8:30 AM  Hyperbolicity in the complex of curves.
(76) Yair N. Minsky†, State University of New York, Stony Brook, and Howard A. Masur, University of Illinois, Chicago (910-57-120)

9:00 AM  Parametrization of Teichmüller space by geodesic length functions.
(77) Feng Luo, Rutgers University, New Brunswick (910-30-84)

9:30 AM  An algorithm to decide the discreteness of an explicit finitely generated elementary subgroup of \( SL_2(Q_{01}) \subset SL_2(C) \).
(78) Robert F. Riley, State University of New York, Binghamton (910-30-104)

10:00 AM  Pleating varieties in quasi-Fuchsian space.
(79) Linda Keen*, Herbert H. Lehman College, City University of New York, and Caroline Series, University of Warwick, United Kingdom (910-30-96)

10:30 AM  Iteration on the Bers slice.
(80) Jeffrey F. Brock, University of California, Berkeley (910-99-143)

Special Session on Gauge Field Theory, III

8:30 AM - 10:20 AM  Room 626, Shimkin Hall
Organizers: Janet C. Talvacchia, Swarthmore College
Yisong Yang, Polytechnic University

8:30 AM  Mass degeneracies in self-dual Chern-Simons theories.
(81) Gerald Dunne, University of Connecticut, Storrs (910-81-70)

9:00 AM  Hawking radiation and Einstein-Yang/Mills equations.
(82) Joel A. Smoller* and Arthur G. Wasserman, University of Michigan, Ann Arbor (910-83-59)

9:30 AM  Gauge theories of two-dimensional gravity.
(83) Roman Jackiw, Massachusetts Institute of Technology (910-81-57)

10:00 AM  Yang-Mills hierarchies in even dimensions and their descendants.
(84) D. H. Tchrakian, Saint Patrick's College, Ireland (910-81-113)

Special Session on Stochastic Models in Mathematical Finance, III

8:30 AM - 10:20 AM  Room 109, Warren Weaver Hall
Organizer: Thaleia Zariphopoulou, University of Wisconsin, Madison

8:30 AM  Managing market risk and volatility risk: A new approach using dynamic programming and portfolio optimization.
(85) Marco M. Avellaneda, Courant Institute of Mathematical Sciences, New York University (910-35-11)

9:00 AM  General properties of option prices.
(86) Bruce Grundy, University of Pennsylvania (910-90-45)

9:30 AM  Optimization models with stochastic volatility.
(87) Mohsen Mazaheri* and Thaleia Zariphopoulou, University of Wisconsin, Madison (910-60-40)

10:00 AM  Using nonstandard analysis methods to analyze non-standard asset price models.
(88) Walter Willinger, Bellcore, Morristown, New Jersey (910-60-13)

Special Session on Differential Algebra, III

8:40 AM - 10:50 AM  Room 634, Shimkin Hall
Organizers: Phyllis J. Cassidy, Smith College
William F. Keigher, Rutgers University, Newark
Michael F. Singer, North Carolina State University

8:40 AM  Differential modules defined by systems of equations.
(89) Alan C. Adolphson*, Oklahoma State University, Stillwater, and Steven Sperber, University of Minnesota, Minneapolis (910-14-129)

(90) Sabrina A. Hessinger, North Carolina State University (910-12-110)

9:50 AM  Computing the genus of a curve.
(91) Barry Trager, IBM T. J. Watson Research Center, Yorktown Heights, New York (910-14-134)

10:25 AM  Hurwitz series as formal functions.
(92) William F. Keigher* and Frank Leon Pritchard, Rutgers University, Newark (910-13-100)

Special Session on Partial Differential Equations, III

9:00 AM - 10:50 AM  Room 1302, Warren Weaver Hall
Organizers: Patricia E. Bauman, Purdue University, West Lafayette
Fanghua Lin, Courant Institute of Mathematical Sciences, New York University
Peter J. Sternberg, Indiana University, Bloomington

9:00 AM  Monotonicity formulas for solutions of equations in adjacent domains.
(93) Luis A. Caffarelli, Courant Institute of Mathematical Sciences, New York University (910-35-106)

9:40 AM  Gauged harmonic maps from \( R^2 \) to \( S^2 \). Preliminary report.
(94) Yisong Yang, Polytechnic University (910-35-87)

10:20 AM  On the existence and uniqueness of constant mean curvature hypersurfaces in hyperbolic space.
(95) Barbara Nelli, University of Paris VII, France, and Joel Spruck*, Johns Hopkins University (910-35-131)

Special Session on Global Riemannian Geometry, III

9:00 AM - 10:50 AM  Room 102, Warren Weaver Hall
Organizers: Tobias H. Colding, Courant Institute of Mathematical Sciences, New York University
Claude R. LeBrun, State University of New York, Stony Brook
Santiago R. Simanca, Polytechnic University
Program of the Sessions - New York, NY, Sunday, April 14 (cont'd.)

9:00 AM The geometry of the first Stekloff eigenvalue. Preliminary report.
Jose F. Escobar, Cornell University (910-53-76)

9:30 AM Gluing constructions for noncompact geometric problems.
Daniel Pollack, University of Chicago (910-58-98)

10:00 AM Gluing constructions of minimal surfaces.
Nicolaos Kapouleas, Brown University (910-53-127)

10:30 AM Real Kaehler submanifolds in low codimension.
Marcos Dajczer, Institute for Pure-Applied Mathematics, Brazil, and Detlef Gromoll*, State University of New York, Stony Brook (910-53-109)

Special Session on Number Theory, III

9:00 AM - 10:50 AM Room 613, Warren Weaver Hall
Organizers: William D. Duke, Rutgers University, New Brunswick
Ze'ev Rudnick, Tel Aviv University, Israel

9:00 AM Remarks about continued fractions and real quadratic fields.
Brian Conrey, Oklahoma State University, Stillwater (910-11-107)

9:40 AM The zeta function and the lap counting function of linear mod one transformations.
Leopold Flatto and Jeffrey C. Lagarias*, AT&T Research, Murray Hill, New Jersey (910-58-85)

10:20 AM The Cesaro mean of the \{nx\} sequence and real quadratic fields.
Jozsef Beck, Rutgers University, New Brunswick (910-11-37)

Special Session on Topological Methods, III

9:30 AM - 10:40 AM Room 813, Warren Weaver Hall
Organizers: Charles R. Traina, Saint John's University
Lawrence Narici, Saint John's University
Edward Beckenstein, Saint John's University

9:30 AM Discrete $C^*$-embedded subsets of a locally compact Abelian group with its Bohr topology.
Jorge Galindo and Salvador Hernandez*, Universitat Jaume I, Spain (910-99-142)

10:10 AM On the Borel theorem.
J. Schmets*, University of Liege, Belgium, and Manuel Valdivia, University of Valencia, Spain (910-46-68)

Invited Address

11:00 AM - 11:50 AM Room 109, Warren Weaver Hall
The Riemann zeta function and random matrix theory.
Ze'ev Rudnick, Tel Aviv University, Israel (910-11-02)

Invited Address

1:30 PM - 2:20 PM Room 109, Warren Weaver Hall
The inverse problem in differential Galois theory.
Michael F. Singer, North Carolina State University (910-12-04)

Special Session on Partial Differential Equations, IV

2:30 PM - 5:00 PM Room 1302, Warren Weaver Hall
Organizers: Patricia E. Bauman, Purdue University, West Lafayette
Fanghua Lin, Courant Institute of Mathematical Sciences, New York University
Peter J. Sternberg, Indiana University, Bloomington

2:30 PM Incompatibility, hysteresis, and the two well problem.
Robert V. Kohn*, Courant Institute of Mathematical Sciences, New York University, and Veronique Lods, University of Paris, France (910-73-48)

3:10 PM Higher gradient integrability of equilibria for functionals with rank-one convex local energies.
Michael M. Doughtery, Pennsylvania State University, Reading (910-35-105)

3:50 PM Regularity results in models for image segmentation, fracture and damage.
Irene Fonseca, Carnegie Mellon University (910-49-58)

4:30 PM Revisiting the paradigm of the calculus of variations: An extended variational principle.
David Kinderlehrer, Carnegie Mellon University (910-35-88)

Special Session on Global Riemannian Geometry, IV

2:30 PM - 4:50 PM Room 102, Warren Weaver Hall
Organizers: Tobias H. Colding, Courant Institute of Mathematical Sciences, New York University
Claude R. LeBrun, State University of New York, Stony Brook
Santiago R. Simanca, Polytechnic University

2:30 PM Manifolds of positive scalar curvature and the Baum-Connes conjecture.
Stephan A. Stolz, University of Notre Dame (910-53-122)

3:00 PM Hypercomplex geometry and 3-Sasakian manifolds.
Krzysztof Galicki, University of New Mexico (910-53-54)

3:30 PM Towards a classification of 3-Sasakian manifolds.
Charles P. Boyer, University of New Mexico (910-53-91)

4:00 PM Compact Einstein-Weyl manifolds with large symmetry group.
Yat Sun Poon*, University of California, Riverside, A. B. Madsen, Henrik Pedersen, Odense University, Denmark, and A. Swann, University of Bath, United Kingdom (910-52-35)

4:30 PM Extremal K"ahler metrics. Preliminary report.
Andrew D. Hwang, University of Toronto (910-58-21)

Special Session on Number Theory, IV

2:30 PM - 5:00 PM Room 613, Warren Weaver Hall
Organizers: William D. Duke, Rutgers University, New Brunswick
Ze'ev Rudnick, Tel Aviv University, Israel

512 Notices of the AMS

Volume 43, Number 4
2:30 PM - 4:50 PM  Room 101, Warren Weaver Hall

Organizer: Jane P. Gilman, Rutgers University, Newark

2:30 PM  Riemann surfaces with maximal reflections.  
(120) Preliminary report.  
Bernard Maskit, State University of New York, Stony Brook (910-30-83)

3:00 PM  Isomorphisms between Teichmuller spaces.  
(121) Preliminary report.  
Nikola B. Lakic, Cornell University, Ithaca (910-30-130)

3:30 PM  Subgroups of generalized Hecke groups.  
(122) Preliminary report.  
Shuechin Huang, Queens College, City University of New York (910-30-139)

4:00 PM  Projective embeddings of surfaces represented by subgroups of the modular group.  
(123) Preliminary report.  
Hershel M. Farkas, Hebrew University of Jerusalem, Israel, and Irwin Kra*, State University of New York, Stony Brook (910-30-61)

4:30 PM  Informal discussion

Special Session on Gauge Field Theory, IV

2:30 PM - 4:20 PM  Room 626, Shimkin Hall

Organizers: Janet C. Talvacchia, Swarthmore College  
Yisong Yang, Polytechnic University

2:30 PM  Non-abelian monopoles and invariants of smooth four-manifolds.  
(124) Preliminary report.  
Paul M.N. Feehan*, Harvard University, and Thomas G. Leness, Michigan State University (910-58-30)

3:00 PM  Negative tori and the Seiberg-Witten invariants.  
(125) Preliminary report.  
Daniel Ruberman, Brandeis University (910-57-117)

3:30 PM  Non-Abelian equivariant holomorphic Morse inequalities.  
(126) Preliminary report.  
Siyu Wu, International Center for Theoretical Physics, Italy (910-58-114)

4:00 PM  A gauge theoretic solution to the index number problem in mathematical economics.  
(127) Preliminary report.  
Pia N. Malaney, Harvard University, and Eric Weinsteins, Massachusetts Institute of Technology (910-53-126)

Special Session on Topological Methods, IV

2:30 PM - 4:30 PM  Room 813, Warren Weaver Hall

Organizers: Charles R. Traina, Saint John's University  
Lawrence Narici, Saint John's University

Edward Beckenstein, Saint John's University

2:30 PM  Similarities between bicompletion and Smyth completion.  
(126) Preliminary report.  
Robert Flagg, University of Southern Maine, Ralph D. Kopperman*, City College, City University of New York, and Philipp Sunderhauf, University of Southern Maine (910-54-116)

3:00 PM  Informal discussion

Special Session on Stochastic Models in Mathematical Finance, IV

2:30 PM - 3:50 PM  Room 109, Warren Weaver Hall

Organizer: Thaleia Zariphopoulou, University of Wisconsin, Madison

2:30 PM  Option pricing in the presence of transaction costs.  
(129) Preliminary report.  
H. Mete Soner, Carnegie Mellon University (910-60-12)

3:00 PM  Monotone numerical schemes for nonlinear partial differential equations arising in mathematical finance.  
(130) Preliminary report.  
Agnes Tourin, University of Paris-Dauphine, France (910-35-06)

3:30 PM  Imperfect competition among informed traders.  
(131) Preliminary report.  
Kerry Back*, Washington University, H. Henry Cao, University of California, Berkeley, and Gregory A. Willard, Washington University (910-90-41)

Special Session on Differential Algebra, IV

2:30 PM - 4:40 PM  Room 634, Shimkin Hall

Organizers: Phyllis J. Cassidy, Smith College  
William F. Keigher, Rutgers University, Newark  
Michael F. Singer, North Carolina State University

2:30 PM  Addition schemes for first integrals.  
(132) Preliminary report.  
William Y. Sit, City College, City University of New York (910-12-103)

3:05 PM  Prolongation theory from an algebraic viewpoint.  
(133) Preliminary report.  
Raymond T. Hoobler, City College, City University of New York (910-17-124)

3:40 PM  Differential specializations and observability in control theory.  
(134) Preliminary report.  
Sally D. Morrison, Bucknell University (910-12-125)

4:15 PM  Finitely obtainable classes of ideals.  
(135) Preliminary report.  
Richard M. Cohn, Rutgers University, New Brunswick (910-12-101)

Contributed Paper Session, II

2:30 PM - 4:40 PM  Room 1013, Warren Weaver Hall

2:30 PM  The hexagonal honeycomb: An existence theorem.  
(136) Preliminary report.  
Frank Morgan, Williams College (910-49-90)

2:45 PM  Solving nonlinear systems of equations using least-square Newton iterations.  
(137) Preliminary report.  
Yixun Shi, Bloomsburg University of Pennsylvania (910-65-115)

3:00 PM  Contact topology and the four-normal theorem.  
(138) Preliminary report.  
Juan Carlos Alvarez Palavra, University of Simon Bolivar, Venezuela (910-53-20)

3:15 PM  Singular Riemannian manifolds.  
(139) Preliminary report.  
Zhong-dong Liu*, University of South Carolina, Columbia, and Zhongmin Shen, Indiana University-Purdue University, Indianapolis (910-53-22)
INTERSECTION PAIRING
ON CONLEY INDICES

Henry L. Kurland, State University of New York, Albany

Features:
- Introduction
- Basic notation and background definitions
- The intersection pairings of \( L, \ell, \) and \( \ell' \)
- Statement of the continuation results and examples
- Construction of bilinear pairings on Conley indices
- Proofs of the continuation results
- Some basic computational tools
- \( L \) for normally hyperbolic invariant submanifolds
- Products of intersection pairings
- The cap product representation of \( L \) and the nonsingularity of \( \ell' \)
- Appendices
- References


Program of Sessions

3:30 PM  Variational techniques on the associated metrics of complex contact manifolds.
  Brendan J. Foreman, Michigan State University (910-58-23)

3:45 PM  Discrete surface groups actions with accidental parabolics on complex hyperbolic plane.
  Igor Belegradek, University of Maryland, College Park (910-57-64)

4:00 PM  On the mean curvature function of isometric immersions. Preliminary report.
  Georgi I. Kamberov, University of Massachusetts, Amherst (910-53-17)

4:15 PM  Asymptotic behavior of solutions and subsolutions of the stationary Schrödinger equation. Preliminary report.
  Alexander I. Kheyfits, Courant Institute of Mathematical Sciences, New York University (910-35-72)

4:30 PM  Ergodic theorems for Markov chains.
  Onesimo Hernandez-Lerma* and Jean B. Lasserre, CINVESTAV del IPN, Mexico (910-60-09)

Lesley M. Sibner
Associate Secretary
Brooklyn, New York
Presenters of Papers

Baton Rouge, Louisiana; April 19-21, 1996

Numbers following the name indicate the speaker's position on the program.
• AMS Invited Lecturer, * Special Session Speaker,  † University Student

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New Publications from The Fields Institute for Research in Mathematical Sciences

Pattern Formation and Lattice Gas Automata
—Anna T. Lawniczak, University of Guelph, ON, Canada, and Raymond Kapral, University of Toronto, ON, Canada, Editors

This book is the Proceedings of The Fields Institute Conference/NATO Advanced Research Workshop held in June 1993. Discussed are various aspects of the statistical analysis of the diverse recent progress in the theory and development of lattice gas and lattice Boltzmann methods and their applications, with emphasis on fluctuations and correlations, as well as computational prospects including development of dedicated hardware.

Fields Institute Communications, Volume 6; December 1995; 346 pp.; Hardcover; ISBN 0-8218-0258-5; List $99; Individual member $59; Order code FIC/6NA

Mechanics Day
—William F. Shadwick, Fields Institute, Waterloo, ON, Canada, Perintukulam Sambamarthy Krishnaprasad, University of Maryland, College Park, and Tudor Stefan Ratiu, University of California, Santa Cruz, Editors

This volume presents the proceedings of a workshop held at The Fields Institute in June 1992 both as a commemoration of the 25th anniversary of the publication of Foundations of Mechanics by Ralph Abraham and Jerrold Marsden and as a celebration of Marsden's 50th birthday.

Fields Institute Communications, Volume 7; December 1995; 260 pp.; Hardcover; ISBN 0-8218-0261-5; List $89; Individual member $53; Order code FIC/7NA

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**Wednesday, April 17**

*Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, I*

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<td>1:30 PM - 4:20 PM</td>
<td>Room E113, Pleasant Hall</td>
<td>organizers: Charles N. Delzell, Louisiana State University; James Joseph Madden, Louisiana State University; Scott Woodward, Southern University</td>
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<tr>
<td>1:30 PM</td>
<td>On bounding the Betti numbers and computing the Euler characteristic of semi-algebraic sets.</td>
<td>Saugata Basu, Courant Institute of Mathematical Sciences, New York University (911-12-212)</td>
</tr>
<tr>
<td>2:00 PM</td>
<td>Complexification and degree of a semi-algebraic set.</td>
<td>Marie-Francoise Roy, University of Reennes I, France (911-11-211)</td>
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<tr>
<td>2:30 PM</td>
<td>Real factors of analytic polynomials and an application to reparametrization algorithms of real curves.</td>
<td>Tomas Recio*, University of Cantabria, Spain, and J. R. Sendra, University Alcala de Henares, Spain (911-14-190)</td>
</tr>
<tr>
<td>3:00 PM</td>
<td>Virtual roots of real polynomials and its applications.</td>
<td>Laureano Gonzalez-Vega*, University of Cantabria, Spain, and Henri Lombardi, University of Besancon, France, and Louis Mahe, University of Rennes I, France (911-14-193)</td>
</tr>
<tr>
<td>3:30 PM</td>
<td>Critical point methods in computational real algebraic geometry.</td>
<td>Victoria Ann Powers*, Emory University, Eberhard Becker and Thorsten Woermann, University of Dortmund, Germany (911-11-139)</td>
</tr>
<tr>
<td>4:00 PM</td>
<td>On f -modules over partially ordered rings.</td>
<td>James Joseph Madden, Louisiana State University, Baton Rouge, and Scott Woodward*, Southern University (911-06-123)</td>
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**Thursday, April 18**

*Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, II*

<table>
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<tr>
<th>Time</th>
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<tr>
<td>9:00 AM - 11:20 AM</td>
<td>Room E113, Pleasant Hall</td>
<td>organizers: Charles N. Delzell, Louisiana State University; James Joseph Madden, Louisiana State University; Scott Woodward, Southern University</td>
</tr>
<tr>
<td>9:00 AM</td>
<td>Signature of higher level in a commutative ring.</td>
<td>Leslie J. Walter, University of Saskatchewan (911-13-228)</td>
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<td>9:30 AM</td>
<td>The nonreduced order spectrum of a commutative ring.</td>
<td>Gilbert A. Stengle*, Lehigh University, and James F. McEnerney, Princeton University (911-06-132)</td>
</tr>
<tr>
<td>10:00 AM</td>
<td>The 17-th Hilbert problem for real analytic functions.</td>
<td>Piotr Jaworski, University of Warsaw, Poland (911-14-97)</td>
</tr>
<tr>
<td>10:30 AM</td>
<td>Real-normal field extensions.</td>
<td>M. E. Alonso and M. Pilar Velez*, University Complutense de Madrid, Spain (911-14-257)</td>
</tr>
<tr>
<td>11:00 AM</td>
<td>On separation of semialgebraic sets.</td>
<td>C. Andradas, University Complutense de Madrid, Spain, F. Acquistapace* and F. Broglia, University of Pisa, Italy (911-14-137)</td>
</tr>
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**Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, III**

<table>
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<tbody>
<tr>
<td>1:30 PM - 4:50 PM</td>
<td>Room E113, Pleasant Hall</td>
<td>organizers: Charles N. Delzell, Louisiana State University; James Joseph Madden, Louisiana State University; Scott Woodward, Southern University</td>
</tr>
</tbody>
</table>

The time limit for each contributed paper in the sessions is ten minutes. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced.

For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Papers flagged with a solid triangle (•) have been designated by the author as being of possible interest to undergraduate students.

Abstracts of papers presented in the sessions at this meeting will be found in the Spring 1996 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings. The middle two digits, e.g., 897-20-1136, refer to the Mathematical Reviews subject classification assigned by the individual author. Groups of papers for each subject are listed chronologically in the Abstracts. The last one to four digits, e.g., 897-20-1136, refer to the receipt number of the abstract; abstracts are further sorted by the receipt number within each classification.
Program of the Sessions – Baton Rouge, LA, Thursday, April 18 (cont’d.)

Friday, April 19

Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, IV

9:00 AM – 11:50 AM  Room E113, Pleasant Hall
Organizers: Charles N. Delzell, Louisiana State University
James Joseph Madden, Louisiana State University
Scott Woodward, Southern University

9:00 AM  Classification of real algebraic curves on toric varieties.
(19) Anatoly Korchagin, Administrators for the Professions, Brooklyn, New York (911-13-268)

9:30 AM  Topological control of spatial real algebraic surfaces.
(20) Benoît Chevallier, University Toulouse le Mirail, France (911-14-66)

10:00 AM  Rokhlin conjecture and quotients of real algebraic surfaces by complex conjugation.
(21) Sergey Mikhailovich Finashin, Middle East Technical University, Turkey (911-14-58)

10:30 AM  Rigid isotopies of real algebraic curves on a hyperboloid. Preliminary report.
(22) Victor Ivanovich Zvonilov, Syktyvkar University, Russia (911-14-57)

11:00 AM  Combinatorial patchworking real algebraic surfaces. Preliminary report.
(23) I. V. Itenberg, University of Rennes I, France (911-14-86)

11:30 AM  On the decomposing algebraic curves. Preliminary report.
(24) G. M. Polotovskii, Nizhny Novgorod University, Russia (911-14-103)

Meeting Registration
NOON – 5:00 PM  Atrium, Howe-Russell Geoscience Complex Building

Invited Address

1:00 PM – 2:00 PM  Room E130, Howe-Russell Geoscience Complex Building

(25) Geography of smooth 4-manifolds. Ronald A. Fintushel, Michigan State University (911-57-01)

Special Session on Low-Dimensional Topology, I

2:15 PM – 5:05 PM  Room 124, A. P. Tureaud Building
Organizers: Patrick M. Gilmer, Louisiana State University
Rick Litherland, Louisiana State University
Neal W. Stoltzfus, Louisiana State University

2:15 PM  Average bending of convex hull boundaries.
(26) Martin J. Bridgeman, Loyola University (911-58-255)

2:45 PM  Knot groups, representations and symbolic dynamics.
(27) Daniel S. Silver and Susan Gayle Williams, University of South Alabama (911-57-224)

3:15 PM  Knot inversion and the isometry groups of hyperbolic 3-manifolds.
(28) Wilbur Whitten, Lynchburg, Virginia (911-57-36)

3:45 PM  4-manifolds are quotients of $R^4$.
(29) Donald D. Lawrence, University of New Orleans (911-57-95)

4:15 PM  An extremal property of Rohklin’s inequality for real algebraic curves.
(30) Steve Paris, Northeast Louisiana University (911-55-76)

4:45 PM  On the homology of branched cyclic covers of knots.
(31) Wayne H. Stevens, Louisiana State University, Baton Rouge (911-57-220)

Special Session on Fluid Dynamics

2:15 PM – 5:05 PM  Room 104, A. P. Tureaud Building
Organizers: Jerome A. Goldstein, Louisiana State University
Michael Mudi Tom, Louisiana State University

2:15 PM  Boussinesq systems for the two-way propagation of water waves.
(32) Jerry L. Bona, University of Texas, Austin (911-76-210)

2:45 PM  Ideal magnetofluid turbulence in two dimensions.
(33) Richard Jordan, Carnegie Mellon University (911-76-158)

3:15 PM  Stationary solutions of the Benjamin equation.
(34) John P. Albert, University of Oklahoma, Jerry L. Bona, University of Texas, Austin, and Juan Mario Restrepo, Argonne National Laboratory, Argonne, Illinois (911-35-206)

3:45 PM  On some nonlinear dispersive equations. Preliminary report.
(35) Mi Ai Park, Seoul National University, Korea (911-35-94)

4:15 PM  Computations of self-similar blow-up solutions of the generalized Korteweg-de Vries Equation.
(36) Daniel B. Dix*, University of South Carolina, Columbia, and William R. McKinney, North Carolina State University (911-35-199)

4:45 PM  Informal discussion
**Special Session on Number Theory and Quadratic Forms, I**

2:15 PM – 5:35 PM  
Room 203, A. P. Tureaud Building  
Organizers: Jurgen Hurrelbrink, Louisiana State University  
Jorge F. Morales, Louisiana State University  
Robert V. Perlis, Louisiana State University  
Paul B. Van Wamelen, Louisiana State University

- **2:15 PM**  
  Growth of number of spinor genera in \( \mathbb{Z}_p \)-extensions.  
  Wai Kiu Chan, Ohio State University, Columbus  
  (911-11-239)

- **2:45 PM**  
  Normsets and factorization properties of rings of integers.  
  James Barker Coykendall, IV, Lehigh University  
  (911-11-17)

- **3:15 PM**  
  The zeta function of Burkhardt’s quartic.  
  Jerome William Hoffman* and Steven H. Weintraub, Louisiana State University, Baton Rouge  
  (911-11-19)

- **3:45 PM**  
  Number of solutions of a pair of quadratic forms over a finite field. Preliminary report.  
  Laura Mann Schueller, University of Kentucky  
  (911-11-241)

- **4:15 PM**  
  Stark units for totally real cubic fields.  
  Brett A. Tangedal, University of Vermont  
  (911-11-30)

- **4:45 PM**  
  Witt-kernels for elliptic and hyperelliptic curves.  
  Jonathan Shick, Loyola University (911-11-240)

- **5:15 PM**  
  On certain corestriction principles. Preliminary report.  
  Nguyen Quoc Thang, McMaster University  
  (911-11-31)

**Special Session on Stochastic Analysis and Its Applications, I**

2:15 PM – 5:05 PM  
Room 105, A. P. Tureaud Building  
Organizers: Hui-Hsiung Kuo, Louisiana State University  
Ambar Niel Sengupta, Louisiana State University

- **2:15 PM**  
  \( L^p \)-estimates for stochastic integrals.  
  Klaus R. Bichteler, University of Texas, Austin  
  (911-60-162)

- **2:45 PM**  
  Area nullification of singular Levy flow.  
  Dhandapani Kannan, University of Georgia  
  (911-60-29)

- **3:15 PM**  
  A Harnack inequality for difference operators on groups. Preliminary report.  
  Kanji Ichihara, Nagoya University, Japan  
  (911-60-77)

- **3:45 PM**  
  A lattice approximation to the super process.  
  P. Sundar*, Louisiana State University, Baton Rouge, and A. Bose, Carleton University (911-60-113)

- **4:15 PM**  
  On SDE’s with boundary conditions.  
  Arturo Kohatsu-Higa, Kyoto University, Japan  
  (911-60-62)

- **4:45 PM**  
  Expectations for nonreversible Markov chains.  
  Ian H. Dinwoodie, Tulane University (911-60-10)

**Special Session on Rings and Modules, I**

2:15 PM – 4:35 PM  
Room 206, A. P. Tureaud Building  
Organizers: Ellen E. Kirkman, Wake Forest University  
Dan Zacharia, Syracuse University

- **2:15 PM**  
  Tilting modules over split-by-nilpotent extensions.  
  Ibrahim Assem*, University of Sherbrooke, and Nikolaos P. Marmaridis, University of Ioannina, Greece (911-16-37)

- **2:45 PM**  
  On regular rings with stalks artinian.  
  Walter D. Burgess*, University of Ottawa, and Robert Raphael, Concordia University (911-16-205)

- **3:15 PM**  
  Generic domains for domestic algebras.  
  Andrew P. Dean*, Bishop’s University, and Ibrahim Assem, University of Sherbrooke (911-16-232)

- **3:45 PM**  
  Standard decompositions of algebras.  
  Vlastimil Dlab, Carleton University (911-16-244)

- **4:15 PM**  
  Hereditary torsion theory counter equivalences.  
  Robert R. Colby, University of Hawaii, Honolulu, and Kent R. Fuller*, University of Iowa (911-16-153)

**Special Session on Geometric Group Theory, I**

2:15 PM – 5:05 PM  
Room 125, A. P. Tureaud Building  
Organizers: Stephen G. Brink, University of South Alabama  
Jon M. Corson, University of Alabama  
Barry S. Spieler, Birmingham-Southern College

- **2:15 PM**  
  Elements of finitely generated groups which belong to no proper tree factor.  
  John R. Stallings, University of California, Berkeley  
  (911-20-42)

- **2:45 PM**  
  Branched coverings of cubical complexes and subgroups of hyperbolic groups.  
  Noel Patrick Brady, University of Utah (911-20-75)

- **3:15 PM**  
  Remarks on some triangles of finite groups.  
  Preliminary report.  
  Roger C. Alperin, San Jose State University (911-20-166)

- **3:45 PM**  
  Embedded planes and torsion free subgroups of finite index in triangles of groups. Preliminary report.  
  Paul R. Brown, University of California, Berkeley  
  (911-20-39)

- **4:15 PM**  
  Daniel Wise, Princeton University (911-20-250)

- **4:45 PM**  
  Non-positively curved piecewise Euclidean structures on hyperbolic manifolds.  
  Gabor Moussong, Eotvos Lorand University, Budapest, Hungary, Ruth M. Charney* and Michael W. Davis, Ohio State University, Columbus (911-53-194)

**Special Session on Real Analytic Geometry and \( o \)-Minimal Structures, I**

2:15 PM – 5:05 PM  
Room 120, A. P. Tureaud Building  
Organizers: Chris Miller, University of Illinois, Chicago  
Lou P. van den Dries, University of Illinois, Urbana-Champaign

- **2:15 PM**  
  Are there any best Riemannian structures on a given compact differentiable manifold?  
  Alexander Nabutovsky, University of Toronto (911-53-33)
Program of the Sessions – Baton Rouge, LA, Friday, April 19 (cont’d.)

2:45 PM  Real analyticity stratifications, desingularization, and optimal control.  
   (62) Hector J. Sussmann, Rutgers University, New Brunswick (911-32-126)

3:15 PM  Complexity of the frontier and closure of semi-pfaffian sets and quantifier simplification for semi-pfaffian expressions.  
   Andrei Gabrielov, Purdue University, West Lafayette (911-14-119)

3:45 PM  Subpfaffian sets.  
   (64) Zbigniew Hajto, CRM, Institut d’Estudis Catalans, Spain (911-14-198)

4:15 PM  A new model complete and o-minimal expansion of the real field.  
   Lou P. van den Dries and Patrick U. Speissegger*, University of Illinois, Urbana-Champaign (911-03-50)

4:45 PM  Yet another extension of Tamm’s theorem.  
   Preliminary report.  
   Chris Miller, University of Illinois, Chicago (911-14-118)

Special Session on Representations of Finite Groups, Algebraic Groups, and Lie Algebras, I

2:15 PM – 5:05 PM  Room 205, A. P. Tureaud Building  
  Organizers: Cornelius Pillen, University of South Alabama  
              Randall R. Holmes, Auburn University, Auburn

2:15 PM  The principal block of a restricted Lie algebra.  
   (67) Jorg Feldvoss, Florida Atlantic University (911-17-146)

2:45 PM  Nonperiodic Auslander-Reiten components of reduced enveloping algebras.  
   Rolf Farnsteiner, University of Wisconsin, Milwaukee (911-22-89)

3:15 PM  Modular representations of Chevalley groups and finite projective geometry. Preliminary report.  
   Peter Sin, University of Florida (911-20-71)

3:45 PM  Affine schemes, irreducible characters of finite groups, and the Green correspondence.  
   Preliminary report.  
   Harald E. Ellers* and George F. Seelinger, Northern Illinois University (911-20-115)

4:15 PM  Stability of decomposition numbers for finite Chevalley groups. Preliminary report.  
   Leonard Chastkofsky, University of Georgia (911-20-143)

4:45 PM  Representations of Lie algebras.  
   (72) Iaroslav S. Kryliouk, University of Saskatchewan (911-17-251)

Special Session on Fixed Point Theory and Dynamical Systems, I

2:15 PM – 4:35 PM  Room 127, A. P. Tureaud Building  
  Organizer: Michael R. Kelly, Loyola University

2:15 PM  The topology of the boundaries of Siegel disks of polynomials.  
   James T. Rogers, Jr., Tulane University (911-58-98)

2:45 PM  Dynamically defined function spaces. Preliminary report.  
   Paul A. Fabel, Mississippi State University (911-57-161)

3:15 PM  A proof of the Arnold conjecture for homeomorphisms of orientable two dimensional closed manifolds. Preliminary report.  
   Edward E. Slaminka, Auburn University, Auburn (911-58-254)

3:45 PM  Parametrized fixed point theory.  
   (76) Ross Geoghegan*, State University of New York, Binghamton, and Andrew J. Nicas, McMaster University (911-55-88)

4:15 PM  On expanding endomorphisms of infranilmanifolds.  
   (77) Kyung Bai Lee, University of Oklahoma (911-99-269)

Special Session on Asymptotic Behavior of Difference Equations with Applications, I

2:15 PM – 6:05 PM  Room 109, A. P. Tureaud Building  
  Organizers: Saber N. Elaydi, Trinity University, San Antonio  
              Vlaiko Lj Kocic, Xavier University of Louisiana

2:25 PM  Traveling waves in lattice dynamical systems.  
   (78) Shui-Nee Chow, Georgia Institute of Technology (911-35-23)

2:45 PM  Asymptotic stability in linear Volterra difference equations. Preliminary report.  
   Saber N. Elaydi*, Trinity University, and Satoru Murakami, Okayama University, Japan (911-39-159)

3:15 PM  Asymptotic solutions to discrete Coulomb equations.  
   (80) Ronald E. Mickens, Clark Atlanta University (911-39-59)

3:45 PM  Open problems and conjectures.  
   (81) Gerasimos Ladas, University of Rhode Island (911-39-63)

4:15 PM  Boundedness and persistence of solutions of the nonautonomous Lyness and Max equation.  
   Edward A. Grove*, Candace Marie Kent and Gerasimos Ladas, University of Rhode Island (911-39-265)

4:45 PM  Positive solutions for nonlinear difference equations.  
   (83) Johnny L. Henderson, Auburn University, Auburn (911-39-173)

   Jia Li*, University of Alabama, Huntsville, and Saber N. Elaydi, Trinity University (911-39-259)

   Martin J. Bohner, University of Hohenheim, Germany (911-39-201)

Saturday, April 20

Meeting Registration

8:00 AM – 5:00 PM  Atrium, Howe-Russell Geoscience Complex Building

Special Session on Control Theory

8:00 AM – 10:50 AM  Room 104, A. P. Tureaud Building

  Organizers: Guillermo Segundo Ferreyra, Louisiana State University  
              Peter R. Wolenski, Louisiana State University

8:00 AM  Regularity of the value function for constrained optimization problems. Preliminary report.  
   Kevin A. Grasse, University of Oklahoma (911-49-104)
8:30 AM  Evoloutional semigroups and the stability radius for nonautonomous Cauchy problems. Preliminary report.
Yuri D. Latuushkin, University of Missouri, Columbia, and Timothy W. Randolph*, University of Missouri, Rolla (911-93-22)

9:00 AM  A numerical method for a class of stochastic control problems. Preliminary report.
Kurt Helmes, University of Kentucky (911-49-205)

9:30 AM  Bounds for capacities in terms of asymmetry.
Tilak Bhattacharya*, Indian Statistical Institute, India, and Allen W. Weissman, Purdue University, West Lafayette (911-31-27)

10:00 AM  Sup-norm stability for control problems with state constraints. Preliminary report.
Aksen L. Dontchev, Mathematical Reviews, Ann Arbor, Michigan, William W. Hager*, University of Florida, and Kazimierz Malanowski, Polish Academy of Sciences, Poland (911-49-197)

10:30 AM  How to use derivatives to estimate the extremal values of the function on convex sets: Applications of new mean-value theorems. Preliminary report.
F. H. Clarke, University of Montreal, Canada, and Yuri Ledyaev*, Steklov Institute of Mathematics, Russia (911-49-140)

Special Session on Low-Dimensional Topology, II

8:00 AM - 10:50 AM  Room 124, A. P. Tureaud Building
Organizers: Patrick M. Gilmer, Louisiana State University
Rick Litherland, Louisiana State University
Neal W. Stoltzfus, Louisiana State University

8:00 AM  Floer homology of ends of four-manifolds.
Zarko Bizaca*, University of Texas, Austin, and Daniel Ruberman, Brandeis University (911-57-91)

8:30 AM  The spectral flow of the odd signature operator and higher Massey products.
Paul A. Kirk, Indiana University, Bloomington, and Eric P. Klassen*, Florida State University (911-58-127)

9:00 AM  Some remarks on complex surfaces and smooth 4-manifolds. Preliminary report.
Ronald J. Stern, University of California, Irvine (911-57-234)

9:30 AM  Tight contact structures and Seiberg-Witten invariants.
Gordana Matic*, University of Georgia, and Paolo Lisca, Columbia University (911-57-225)

10:00 AM  Casson-Lin's invariant and Floer homology.
Weiping Li, Oklahoma State University, Stillwater (911-57-209)

10:30 AM  An equivariant Casson invariant for 3-manifold with cyclic group action.
Sylvain E. Cappell, Courant Institute of Mathematical Sciences, New York University, and Ronnie Lee*, Yale University, and Edward Y. Miller, Polytechnic University (911-57-73)

Special Session on Number Theory and Quadratic Forms II

8:00 AM - 10:50 AM  Room 203, A. P. Tureaud Building
Organizers: Jurgen Hurrelbrink, Louisiana State University
Jorge F. Morales, Louisiana State University

8:00 AM  Almost strong approximation for definite quadratic forms.
J. S. Hsia, Ohio State University, Columbus (911-11-116)

8:30 AM  Non-unimodular Hermitian forms over p-adic algebras.
Laura Fainsilber, University of Franche-Comte, France (911-11-262)

9:00 AM  Bianchi groups and integral quadratic forms.
Donald G. James, Pennsylvania State University, University Park (911-11-18)

9:30 AM  Commutators in orthogonal groups.
Alexander J. Hahn, University of Notre Dame (911-11-260)

10:00 AM  Orthogonal representations of finite groups.
Carl R. Riehm, McMaster University (911-11-28)

10:30 AM  Memories of Olga Taussky Todd.
Dennis R. Estes, University of Southern California (911-11-64)

Special Session on Stochastic Analysis and Its Applications, II

8:00 AM - 10:50 AM  Room 109, A. P. Tureaud Building
Organizers: Saber N. Elaydi, Trinity University, San Antonio
Vlajko Lj Kocic, Xavier University of Louisiana

8:00 AM  A discrete model of insect population dynamics.
Jim M. Cushing, University of Arizona (911-92-176)

8:30 AM  Extinction and persistence of species in discrete competitive systems with diffusion.
John E. Franke*, North Carolina State University, Raleigh, and Abdul-Aziz Yakubu, Howard University (911-92-138)

9:00 AM  Global behavior of solutions of \( x_{n+1} = a x_n + f(x_n, x_{n-1}) \).
Gur Dial and Vlajko Lj Kocic*, Xavier University (911-39-174)

9:30 AM  Local and global behavior of solutions of \( x_{n+1} = \frac{1-x_n}{1-x_{n-1}} \). Preliminary report.
Elia V. Eschenazi* and Vlajko Lj Kocic, Xavier University (911-39-175)

10:00 AM  On behavior of solutions of a forced difference equation I: Asymptotic representation of solutions.
John R. Graef* and Chuanxi Qian*, Mississippi State University (911-39-184)

10:30 AM  On behavior of solutions of a forced difference equation II: Convergence to zero.
John R. Graef* and Chuanxi Qian, Mississippi State University (911-39-204)

Special Session on Stochastic Analysis and Its Applications, II

8:30 AM - 10:50 AM  Room 105, A. P. Tureaud Building
Organizers: Hui-Hsiung Kuo, Louisiana State University
Ambar Niel Sengupta, Louisiana State University

8:30 AM  Critical intensities in continuum percolation.
Rahul Roy, Indian Statistical Institute, India (911-60-84)
Program of the Sessions – Baton Rouge, LA, Saturday, April 20 (cont’d.)

9:00 AM Transformations of measure via a homotopy technique.  
(111) Denis R. Bell, University of North Florida  
(911-60-155)

9:30 AM Exponential convergence for a system of conular space valued diffusions with mean-field interaction.  
(112) Jie Xiong, University of Tennessee, Knoxville  
(911-60-20)

10:00 AM The Levy Laplacian and a transformation in white noise calculus.  
(113) Kimiaki Saito, Meijo University, Japan  
(911-60-55)

(114) Fariborz Asadian, Fort Valley State College  
(911-60-133)

Special Session on Geometric Group Theory, II

8:30 AM – 10:50 AM Room 125, A. P. Tureaud Building
Organizers: Stephen G. Brick, University of South Alabama  
Jon M. Corson, University of Alabama  
Barry S. Spieler, Birmingham-Southern College

8:30 AM Aspherical group presentations.  
(115) Robert F. Craggs, University of Illinois, Urbana-Champaign  
(911-57-145)

9:00 AM On ribbon disc complements and related 2-complexes.  
(116) Catherine E. Cavagnaro, University of the South  
(911-20-218)

9:30 AM On split 2-complexes.  
(117) Will Haight, University of the South  
(911-20-216)

10:00 AM An equivariant Whitehead algorithm and conjugacy in Aut(F_2).  
(118) Sava Krstic, Tufts University, Martin Lustig, Ruhr University, Germany, and Karen Vogtmann*, Cornell University  
(911-20-249)

10:30 AM The conjugacy problem in C^{(2,p)}- T^{(q)} groups.  
(119) Karin Luisa Johngard*, Cornell University, and Mile P. Krajcevski, University of South Florida  
(911-20-122)

Special Session on Representations of Finite Groups, Algebraic Groups, and Lie Algebras, II

8:30 AM – 10:50 AM Room 205, A. P. Tureaud Building
Organizers: Cornelius Pillen, University of South Alabama  
Randall R. Holmes, Auburn University, Auburn

8:30 AM Blocks of reduced enveloping algebras. Preliminary report.  
(120) James E. Humphreys, University of Massachusetts, Amherst  
(911-17-152)

9:00 AM Quantum deformations of Verma modules of Borcherds superalgebras.  
(121) Georgia M. Benkart, University of Wisconsin, Madison, Seok-Jin Kang, Seoul National University, Korea, and Duncan J. Melville*, Saint Lawrence University  
(911-17-168)

9:30 AM Hopf algebras and representations.  
(122) Dmitriy Rumynin, University of Massachusetts, Amherst  
(911-16-44)

10:00 AM The dual Lie bialgebra of a Lie bialgebra.  
(123) Walter J. Michaelis, University of New Orleans  
(911-20-131)

10:30 AM Integrally closed Galois extensions.  
(124) Robert G. Underwood, Auburn University, Montgomery  
(911-13-68)

Special Session on Fixed Point Theory and Dynamical Systems, II

8:30 AM – 10:50 AM Room 127, A. P. Tureaud Building
Organizer: Michael R. Kelly, Loyola University

8:30 AM The topological theory of roots. Preliminary report.  
(125) Robert F. Brown, University of California, Los Angeles  
(911-55-70)

9:00 AM Fixed points of boundary-preserving maps of punctured surfaces. Preliminary report.  
(126) Jeanine Kay Nolan, University of Nevada, Reno  
(911-55-221)

(127) Peter N. Wong, Bates College  
(911-55-195)

10:00 AM Periodic points on solvmanifolds. Preliminary report.  
(128) Edward C. Keppelmann, University of Nevada, Reno  
(911-55-215)

10:30 AM Jezierski’s relative fixed point index and the location of fixed points.  
(129) Chi Wah Ng, CTS, San Diego, California  
(911-55-169)

Special Session on Rings and Modules, II

9:00 AM – 10:50 AM Room 206, A. P. Tureaud Building
Organizers: Ellen E. Kirkman, Wake Forest University  
Dan Zacharia, Syracuse University

9:00 AM Low dimensional cohomology and the Euler characteristic. Preliminary report.  
(130) Michael J. Bardzell, Virginia Polytechnic Institute and State University  
(911-16-191)

9:30 AM Quivers and matrix equations.  
(131) William H. Gustafson, Texas Tech University  
(911-16-154)

10:00 AM The representation type of a stable module category.  
(132) Henning Krause, University of Bielefeld, Germany  
(911-16-65)

10:30 AM Wild hereditary algebras.  
(133) Otto Kern, University of Dusseldorf, Germany  
(911-16-156)

Special Session on Real Analytic Geometry and o-Minimal Structures, II

9:00 AM – 10:50 AM Room 120, A. P. Tureaud Building
Organizers: Chris Miller, University of Illinois, Chicago  
Lou P. van den Dries, University of Illinois, Urbana-Champaign

9:00 AM Periodic points of definably continuous functions on dense o-minimal structures.  
(134) Chien-ning Yeh, University of Wisconsin, Madison  
(911-03-189)

9:30 AM Definably simple groups over o-minimal structures.  
(135) Preliminary report.  
Anand Pillay, University of Notre Dame  
(911-03-170)

10:00 AM A growth dichotomy for o-minimal expansions of ordered groups.  
(136) Chris Miller, University of Illinois, Urbana-Champaign, and Sergei Starchenko*, Vanderbilt University  
(911-03-120)

10:30 AM Real spectrum for o-minimal structures. Preliminary report.  
(137) Michel Coste, University of Rennes I, France  
(911-14-80)
Session on Analysis and Applications

9:00 AM - 10:55 AM Room 211, A. P. Tureaud Building

9:00 AM Some comments on the support of the Weyl functional calculus. Bernd Straub, The University of New South Wales, Australia (911-99-270)


9:30 AM Transformations of index set for Skorokhod integral with respect to Gaussian processes. Leszek Gawarczki, General Motors Engineering and Management Institute, Flint, Michigan (911-60-51)

9:45 AM Positive solutions to a competitive system with nonlocal growth rates. Roger W. Logan, College of Charleston (911-35-53)

10:00 AM On Hele-Shaw models with surface tension. Gieri Simonett*, Vanderbilt University, and Joachim Escher, University of Basel, Switzerland (911-35-54)

10:15 AM Quenching in infinite time on the N-dimensional ball. Chiu Yeung Chan and Hon-Hung T. Liu*, University of Southwestern Louisiana (911-25-213)

10:30 AM LQR problems governed by the linear elastostatic equation on Lipschitz domains with point observations. Zhonghai Ding, University of Nevada (911-49-72)


Invited Address

11:10 AM - NOON Room E130, Howe-Russell Geoscience Complex Building

(146) Limit theorems for time-varying queues. William A. Massey, AT&T Research, Murray Hill, New Jersey (911-60-04)

Invited Address

1:10 PM - 2:00 PM Room E130, Howe-Russell Geoscience Complex Building

(147) Computational algebra and finite dimensional modules. Preliminary report. Edward L. Green, Virginia Polytechnic Institute and State University (911-16-03)

Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, V

2:15 PM - 6:05 PM Room 120, A. P. Tureaud Building

Organizers: Charles N. Delzell, Louisiana State University
James Joseph Madden, Louisiana State University
Scott Woodward, Southern University

2:15 PM Local-global principles over real function fields. Claus Scheiderer, University of Regensburg, Germany (911-14-109)

2:45 PM Prüfer extensions. Preliminary report. Manfred Knebusch* and Digen Zhang, University of Regensburg, Germany (911-14-15)

3:15 PM Noetherian space of abstract locally Nash sets. Ronan Quarez, University of Rennes 1, France (911-14-129)

3:45 PM Epimorphism of reduced partially ordered rings. Niels C. Schwartz, University of Passau, Germany (911-14-99)

4:15 PM Algebraic moduli of real algebraic curves. Johannes Huisman, University of Rennes I, France (911-14-96)

4:45 PM Radial vector fields and Poincaré-Hopf theorem. Jean-Paul Brasselet, CIRM - Luminy, France (911-14-148)

5:15 PM Work of L. Noirel on semialgebraic realizations of compact abstract stratified sets. David J.A. Trotman, University of Provence, France (911-14-203)

5:45 PM Holomorphic rank two vector bundles on blow-ups. Preliminary report. Elizabeth Terezinha Gasparim, CINVESTAV del IPN, Mexico (911-14-79)

Special Session on Low-Dimensional Topology, III

2:15 PM - 4:35 PM Room 124, A. P. Tureaud Building

Organizers: Patrick M. Gilmer, Louisiana State University
Rick Litherland, Louisiana State University
Neal W. Stoltzfus, Louisiana State University

2:15 PM Symmetries of the Chern manifold. Slawomir Kwasik*, Tulane University, and Reinhard E. Schultz, Purdue University, West Lafayette (911-57-266)

2:45 PM Lissajous knots, billiard knots and their symmetry. Jozef H. Przytycki, George Washington University (911-57-78)

3:15 PM The asymptotic density of alternating links. Preliminary report. Morwen B. Thistlethwaite, University of Tennessee, Knoxville (911-57-105)


4:15 PM Arrangements of complex hyperplanes and representations of braid groups. Daniel C. Cohen, Louisiana State University, Baton Rouge, and Alexandru I. Suciu*, Northeastern University (911-20-227)

Special Session on Number Theory and Quadratic Forms, III

2:15 PM - 5:35 PM Room 203, A. P. Tureaud Building

Organizers: Jurgen Hurrelbrink, Louisiana State University
Jorge F. Morales, Louisiana State University
Robert V. Perlis, Louisiana State University
Paul B. Van Wamelen, Louisiana State University

2:15 PM Bihomogenous nullstellensatz for p-fields. Martin Kruskemper, University of Munster, Germany (911-11-07)

2:45 PM On trace forms of Galois extensions. Martin Epkenhans, University of Paderborn, Germany (911-12-32)
Program of the Sessions – Baton Rouge, LA, Saturday, April 20 (cont’d.)

3:15 PM  Quadratic form invariants and the minors of a matrix.
David W. Lewis, University College of Dublin, Republic of Ireland (911-11-11)

3:45 PM  Hasse invariant of the trace form. Preliminary report.
A. Queguiner, University of Franche-Comte, France (911-11-34)

4:15 PM  The space of composition algebras.
Daniel B. Shapiro, Ohio State University, Columbus (911-11-61)

4:45 PM  Excellent algebraic groups.
Ina Kersten, University of Bielefeld, Germany (911-11-243)

5:15 PM  Anisotropic splitting of reductive groups.
Ulf Rehmann, University of Bielefeld, Germany (911-11-242)

Special Session on Stochastic Analysis and Its Applications, III

2:15 PM – 4:35 PM  Room 105, A. P. Tureaud Building
Organizers: Hui-Hsiung Kuo, Louisiana State University
Ambar Niel Sengupta, Louisiana State University

2:15 PM  White noise approach to quantum stochastic processes.
Nobuaki Obata, Nagoya University, Japan (911-60-48)

2:45 PM  Characterization of the optimal filter: The non Markov case.
Abhay G. Bhatt and Rajeeva Karandikar*, Indian Statistical Institute, India (911-60-67)

David E. Betounes, University of Southern Mississippi (911-60-142)

3:45 PM  New classes of white noise generalized functions.
W. George Cochran*, Hui-Hsiung Kuo and Ambar Niel Sengupta, Louisiana State University, Baton Rouge (911-60-229)

4:15 PM  Stochastic Volterra equations with singular kernels.
W. George Cochran, Louisiana State University, Baton Rouge, Jung-Soon Kim Lee*, Southern University, and Jurgen K. Potthoff, University of Mannheim, Germany (911-60-222)

Special Session on Transform Theory and Evolution Equations

2:15 PM – 5:35 PM  Room 104, A. P. Tureaud Building
Organizers: Frank Neubrander, Louisiana State University
Lutz Weis, Louisiana State University

Jan Pruss, MLU Halle-Wittenberg, Germany (911-47-182)

2:45 PM  Some new results in the theory linear elliptic and parabolic equations.
Yuliy A. Semenov, University of Toronto (911-35-46)

3:15 PM  The spectrum of the kinematic dynamo operator for an ideally conducting fluid.
Carmen C. Chicone, Yuri D. Latushkin* and Stephen John Montgomery-Smith, University of Missouri, Columbia (911-46-14)

3:45 PM  On Besicovitch almost-periodic generalized functions and applications to evolution equations.
Ioana Cioranescu, University of Puerto Rico, Rio Piedras (911-47-172)

Quoc-Phong Vu, Ohio University, Athens (911-47-111)

4:45 PM  Abstract Cauchy problems with rapidly growing fundamental solutions. Preliminary report.
Peer C. Kustmann, University of Kiel, Germany (911-47-102)

5:15 PM  The Stieltjes transform for vector valued functions.
Humberto E. Prado* and Carlos Lizama, University of Santiago, Chile (911-47-43)

Special Session on Rings and Modules, III

2:15 PM – 4:35 PM  Room 206, A. P. Tureaud Building
Organizers: Ellen E. Kirkman, Wake Forest University
Dan Zacharia, Syracuse University

2:15 PM  Homological dimensions of semigroup rings.
James J. Kuzmanovich, Wake Forest University (911-16-151)

2:45 PM  Structures of prime ideals in birational extensions over Z[x].
Aihua Li*, Loyola University, and Sylvia Margaret Wieand, University of Nebraska (911-13-93)

3:15 PM  Strongly simply connected algebras. Preliminary report.
Ibrahim Assem and Shiping Liu*, University of Sherbrooke (911-16-202)

3:45 PM  Some Koszul algebras. Preliminary report.
James Jian Zhang, University of Washington (911-16-85)

4:15 PM  Bounded Picard groups.
Gene D. Abrams and Jeremy A. Haeffner*, University of Colorado, Boulder (911-16-164)

Special Session on Geometric Group Theory, III

2:15 PM – 5:35 PM  Room 125, A. P. Tureaud Building
Organizers: Stephen G. Brick, University of South Alabama
Jon M. Corson, University of Alabama
Barry S. Spieler, Birmingham-Southern College

2:15 PM  Tame combings of groups.
Michael L. Mihalik, Vanderbilt University (911-20-165)

2:45 PM  Kernels of actions on non-positively curved spaces.
Robert Bieri, University of Frankfurt, Germany, and Ross Geoghegan*, State University of New York, Binghamton (911-20-87)

3:15 PM  An algebraic annulus theorem.
Peter Scott*, University of Michigan, Ann Arbor, and G. A. Swarup, University of Melbourne, Australia (911-20-246)

3:45 PM  Test elements, primitivity and automorphisms.
Benjamin Fine, Fairfield University, and Gerhard Rosenberger*, University of Dortmund, Germany (911-20-157)

4:15 PM  Generalized small cancellation theory.
Guenther P. Huck*, Northern Arizona University, and Stephan Rosebrock, Kelkheim, Germany (911-20-233)
2:15 PM - 4:25 PM Room 205, A. P. Tureaud Building

Organizers: Cornelius Pillen, University of South Alabama
Randall R. Holmes, Auburn University, Auburn

2:15 PM New developments in coherent tensor operators.
(192) Dan Flath, University of South Alabama (911-20-192)

2:45 PM Symplectic and orthogonal Schur algebras.
(193) Preliminary report.
Stephen R. Doty, Loyola University of Chicago (911-20-92)

3:15 PM The submodules of Weyl modules and Ext\(^1\) for quantum groups at roots of 1.
(194) Leonid Krop, DePaul University (911-22-81)

3:45 PM Good filtrations for representations related to Cartan type Lie algebras. Preliminary report.
Zongzhu Lin*, Kansas State University, and Daniel Ken Nakano, Utah State University (911-17-82)

4:15 PM Extensions of module over Lie algebras of Cartan type. Preliminary report.
Zongzhu Lin, Kansas State University, and Daniel Ken Nakano*, Utah State University (911-11-83)

4:45 PM Half-Littlewood polynomials and infinite dimensional Lie algebras.
Naihuan Jing, North Carolina State University (911-17-252)

Special Session on Fixed Point Theory and Dynamical Systems, III

2:15 PM - 4:05 PM Room 127, A. P. Tureaud Building

Organizer: Michael R. Kelly, Loyola University

2:15 PM Rotational entropy.
(198) William Geller and Michal Misiurewicz*, Indiana University-Purdue University, Indianapolis (911-54-214)

2:45 PM Periodic points, symbolic dynamics and stability in piecewise isometries. Preliminary report.
Arek Jozef Goetz, University of Illinois, Chicago (911-55-144)

3:15 PM The geometry of minimal sets in the circle and the torus. Preliminary report.
Alec Norton, University of Texas, Austin (911-58-245)

3:45 PM Maximal entropy even orbit types.
(200) William Geller*, Indiana University-Purdue University, Indianapolis, and Zhenhua Zhang, Tufts University (911-58-261)

Special Session on Asymptotic Behavior of Difference Equations with Applications, III

2:15 PM - 6:00 PM Room 109, A. P. Tureaud Building

Organizers: Saber N. Elaydi, Trinity University, San Antonio

2:15 PM Type K equations over torsion-free groups.
(190) Andrew P. Clifford, University of Wisconsin, Parkside (911-20-233)

M. Paul Latiolais*, Portland State University, and Wolfgang Metzler, Johann Wolfgang Goethe University, Germany (911-57-217)

Special Session on Representations of Finite Groups, Algebraic Groups, and Lie Algebras, III

2:15 PM - 5:05 PM Room 205, A. P. Tureaud Building

Organizers: Cornelius Pillen, University of South Alabama
Randall R. Holmes, Auburn University, Auburn

2:15 PM New developments in coherent tensor operators.
(192) Dan Flath, University of South Alabama (911-20-192)

2:45 PM Symplectic and orthogonal Schur algebras.
(193) Preliminary report.
Stephen R. Doty, Loyola University of Chicago (911-20-92)

3:15 PM The submodules of Weyl modules and Ext\(^1\) for quantum groups at roots of 1.
(194) Leonid Krop, DePaul University (911-22-81)

3:45 PM Good filtrations for representations related to Cartan type Lie algebras. Preliminary report.
Zongzhu Lin*, Kansas State University, and Daniel Ken Nakano, Utah State University (911-17-82)

4:15 PM Extensions of module over Lie algebras of Cartan type. Preliminary report.
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4:45 PM Half-Littlewood polynomials and infinite dimensional Lie algebras.
Naihuan Jing, North Carolina State University (911-17-252)
Sunday, April 21

Meeting Registration

8:00 AM - NOON Atrium, Howe-Russell Geoscience Complex Building

Special Session on Nonlinear Partial Differential Equations

8:00 AM - 10:50 AM Room 104, A. P. Tureaud Building
Organizers: James R. Dorroh, Louisiana State University
Gisele Ruiz Goldstein, Louisiana State University

8:00 AM On wave motions in moving penetrable media.
(217) Gary Francis Roach, University of Strathclyde, United Kingdom (911-35-24)

8:30 AM The Neumann Laplacian on generalized ridged domains.
(218) David E. Edmunds, University of Sussex, United Kingdom, and Robert M. Kaufmann*, University of Alabama, Birmingham (911-35-171)

9:00 AM Non-quenching, quenching and beyond quenching for degenerate semilinear parabolic equations.
(219) Chiu Yeung Chan*, University of Southwestern Louisiana, and Pui Kan Catherine Kong, Carson-Newman College (911-35-56)

9:30 AM Regular and singular solutions of a nonlinear Keldysh equation.
(220) Suncica Canic, Iowa State University, and Barbara L. Keyfitz*, University of Houston (911-35-16)

10:00 AM Sobolev gradients and boundary conditions for systems of nonlinear partial differential equations.
(221) J. W. Neuberger, University of North Texas (911-35-74)

10:30 AM Recent results for semipositone problems.
(222) Ratnasingham Shivaji, Mississippi State University (911-35-149)

Special Session on Number Theory and Quadratic Forms, IV

8:00 AM - 10:50 AM Room 203, A. P. Tureaud Building
Organizers: Jurgen Hurrelbrink, Louisiana State University
Jorge F. Morales, Louisiana State University
Robert V. Perlis, Louisiana State University
Paul B. Van Wamelen, Louisiana State University

8:00 AM The Caloix number.
(223) Patricia Wright Beaulieu, University of Southwestern Louisiana, and Thomas Palfrey*, Xavier University (911-11-237)

8:30 AM Annihilators of scaled trace forms.
(224) Patricia Wright Beaulieu*, University of Southwestern Louisiana, and Robert V. Perlis, Louisiana State University, Baton Rouge (911-11-49)

9:00 AM A partial generalized of Kaplan's theorem.
(225) Stella Roberson Ashford, Southern University (911-11-235)

9:30 AM On the preservation of root numbers and behavior of Weil characters under reciprocity equivalence.
(226) Jenna Price Carpenter, Louisiana Tech University (911-11-47)

10:00 AM Splitting numbers and multiplicity.
(227) Donna J. Stuart, Southern University (911-11-236)

10:30 AM A relationship between twin primes and their indices.
Ali R. Fazely, Southern University (911-11-238)

Special Session on Asymptotic Behavior of Difference Equations with Applications, IV

8:00 AM - 10:50 AM Room 109, A. P. Tureaud Building
Organizers: Saber N. Elaydi, Trinity University, San Antonio
Vlajko Lj Kocic, Xavier University of Louisiana (911-39-167)

8:00 AM A periodically - forced system with application to population dynamics.
(229) Shandelle M. Henson, University of Arizona (911-39-264)

8:30 AM WKB and turning point theory for 2nd order difference equations with applications.
(230) Jeffrey S. Geronimo, Georgia Institute of Technology (911-30-264)

9:00 AM Dynamic systems on time scales and superlinear convergence.
(231) A. S. Vatsala, University of Southwestern Louisiana (911-34-147)

9:30 AM On the boundedness of the orbit of the gingerbreadman map.
(232) Elias Camouzis*, Richard C. DeVault and Gerasimos Ladas, University of Rhode Island (911-39-134)

10:00 AM On difference equations with nonhyperbolic equilibria.
(233) George K. Tzanetopoulou, University of Rhode Island (911-39-62)

10:30 AM Stability and summability of the zero solution of Volterra systems of difference equations.
(234) Youssef N. Raffoul, Southern Illinois University, Carbondale (911-39-183)

Special Session on Real Algebraic Geometry and Ordered Algebraic Structures, VI

8:30 AM - 10:50 AM Room 120, A. P. Tureaud Building
Organizers: Charles N. Delzell, Louisiana State University
James Joseph Madden, Louisiana State University
Scott Woodward, Southern University

8:30 AM Elliptic curves and level of quartics.
(235) Louis Mahe, University of Rennes I, France (911-14-136)

9:00 AM About the image of the signature map in the two dimensional case.
(236) Jean-Philippe Monnier, University of Rennes I, France (911-14-121)

9:30 AM Exponentiation in power series fields.
(237) Salma Kuhlmann*, Franz Viktor Kuhlmann, University of Heidelberg, Germany, and Saharon Shelah, Hebrew University of Jerusalem, Israel (911-12-124)

10:00 AM Old and new constructions of Hilbert identities.
(238) Bruce A. Reznick, University of Illinois, Urbana-Champaign (911-11-114)

10:30 AM A complex version of the Baer-Krull theorems.
(239) Gregory W. Brumfiel, Stanford University, and Maria Jesus de la Puente*, Universidad Complutense, Spain (911-12-13)
Special Session on Low-Dimensional Topology, IV

8:30 AM - 10:50 AM  Room 124, A. P. Tureaud Building

Organizers: Patrick M. Gilmer, Louisiana State University
Rick Litherland, Louisiana State University
Neal W. Stoltzfus, Louisiana State University

8:30 AM  Lower central series of finitely-presented 3-manifold groups.
Tim D. Cochran*, Rice University, and Kent Orr, Indiana University, Bloomington (911-57-101)

9:00 AM  Genus two positive Heegaard diagrams. Preliminary report.
John P. Hempel, Rice University (911-57-90)

9:30 AM  Bounding the number of boundary components of an essential surface in a knot exterior. Preliminary report.
John Edwin Luecke, University of Texas, Austin (911-57-207)

10:00 AM  A combinatorial Cartan theorem.
Jon M. Corson and Bruce S. Trace*, University of Alabama, Tuscaloosa (911-57-100)

10:30 AM  Tangle analysis of DNA Int recombination.
De Witt L Summers, Florida State University (911-57-106)

Special Session on Geometric Group Theory, IV

8:30 AM - 10:50 AM  Room 125, A. P. Tureaud Building

Organizers: Stephen G. Brick, University of South Alabama
Jon M. Corson, University of Alabama
Barry S. Sieler, Birmingham-Southern College

8:30 AM  Artin groups, rewriting systems, and three manifolds.
Susan M. Hermiller*, New Mexico State University, Las Cruces, and John E. Meier, Lafayette College (911-20-196)

9:00 AM  Finiteness conditions and abelian quotients of graph groups.
John E. Meier*, Lafayette College, and Leonard A. VanWyk, Hope College (911-20-231)

9:30 AM  Boundaries of \( G \times H \) CAT(0) groups. Preliminary report.
Kim E. Ruane, Florida State University (911-20-247)

10:00 AM  Generating functions for finite group actions on surfaces.
Colin MacLachlan, University of Aberdeen, United Kingdom, and Andy Miller*, University of Oklahoma (911-20-248)

10:30 AM  Higher order Dehn functions of groups.
Juan M. Alonso, Stockholm University, Sweden, William Aubrey Bogley*, Robert M. Burton, Jr., Oregon State University, Stephen J. Pride and X. Wang, University of Glasgow, United Kingdom (911-20-163)

Special Session on Representations of Finite Groups, Algebraic Groups, and Lie Algebras, IV

8:30 AM - 10:50 AM  Room 205, A. P. Tureaud Building

Organizers: Cornelius Pillen, University of South Alabama
Randall R. Holmes, Auburn University

8:30 AM  Cells of Harish-Chandra modules for real classical groups.
William M. McGovern, University of Washington (911-17-21)

9:00 AM  Orbits, invariants and representations associated with a pair of commuting involutions.
Aloysius G. Helminck*, North Carolina State University, and Gerald W. Schwarz, Brandeis University (911-20-130)

9:30 AM  Modules for the dual nil Hecke ring.
Matthew J. Dyer, University of Notre Dame (911-20-107)

10:00 AM  Stratifying endomorphism algebras, I.
Edward T. Cline*, University of Oklahoma, Brian J. Parshall and Leonard L. Scott, Jr., University of Virginia (911-16-256)

10:30 AM  Representations of finite and algebraic groups.
Leonard L. Scott, Jr., University of Virginia (911-20-208)

Special Session on Rings and Modules, IV

9:00 AM - 10:50 AM  Room 206, A. P. Tureaud Building

Organizers: Ellen E. Kirkman, Wake Forest University
Dan Zacharia, Syracuse University

9:00 AM  The Yoneda algebra of a self-injective Koszul algebra. Preliminary report.
Roberto Martinez Villa, University Nacional Autonoma de Mexico, Mexico (911-16-187)

9:30 AM  A tiled order having large global dimension.
Willem G. Jansen, Compuware Corporation, Farmington Hills, Michigan, and Charles J. Odenthal*, University of Toledo (911-16-186)

10:00 AM  Affine subsemigroups of rings that are complete intersections.
Klaus G. Fischer, Walter D. Morris and Jay A. Shapiro*, George Mason University (911-13-112)

10:30 AM  Finitistic projective dimension for some algebras.
Preliminary report.
Birge Zimmermann, University of California, Santa Barbara, and Sverre O. Smalø*, University of California, Santa Barbara and The Norwegian University for Science and Technology, Norway (911-19-160)

Special Session on Fixed Point Theory and Dynamical Systems, IV

9:00 AM - 10:50 AM  Room 127, A. P. Tureaud Building

Organizer: Michael R. Kelly, Loyola University

9:00 AM  The G-sequence of a map and its applications.
Moo Ha Woo, Korea University, Korea (911-55-180)

9:30 AM  Relating relative, fibred and absolute Nielsen numbers of fixed and periodic points.
Philip R. Heath, Memorial University of Newfoundland (911-55-128)

10:00 AM  Computation of Nielsen numbers for maps of closed surfaces.
Owen Davey, State University of New York, Binghamton, Evelyn L. Hart*, Colgate University, and Kathryn A. Trapp, Dartmouth College (911-55-141)

10:30 AM  Minimal entropy of transitive tree maps. Preliminary report.
Stewart Baldwin, Auburn University, Auburn (911-55-150)
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Program of Sessions

Invited Address
11:10 AM - NOON
Room E130, Howe-Russell Geoscience Complex Building

(263) Variations on a theme of Picard.
Fritz Gesztesy, University of Missouri, Columbia (911-35-02)

Robert J. Daverman
Associate Secretary
Knoxville, Tennessee
**Handbook of Numerical Analysis**
- Edited by P.G. Ciarlet and J.L. Lions

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- Edited by F. Buekenhout

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**Handbook of Algebraic Topology**
- Edited by I.M. James

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