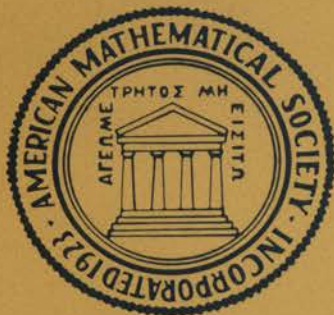


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Calendar of AMS Meetings

THIS CALENDAR lists all meetings which have been approved by the Council prior to the date this issue of the **Notices** was sent to press. The summer and annual meetings are joint meetings of the Mathematical Association of America and the American Mathematical Society. The meeting dates which fall rather far in the future are subject to change; this is particularly true of meetings to which no numbers have yet been assigned. *Programs* of the meetings will appear in the issues indicated below. *First* and *second* announcements of the meetings will have appeared in earlier issues.

ABSTRACTS OF PAPERS presented at a meeting of the Society are published in the journal *Abstracts of papers presented to the American Mathematical Society* in the issue corresponding to that of the **Notices** which contains the program of the meeting. Abstracts should be submitted on special forms which are available in many departments of mathematics and from the office of the Society in Providence. Abstracts of papers to be presented at the meeting must be received at the headquarters of the Society in Providence, Rhode Island, on or before the deadline given below for the meeting. Note that the deadline for abstracts submitted for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information consult the meeting announcement and the list of organizers of special sessions.

MEETING NUMBER	DATE	PLACE	ABSTRACT DEADLINE	ISSUE
805	August 8–11, 1983 (87th Summer Meeting)	Albany, New York	Expired	August
806	October 28–29, 1983	Fairfield, Connecticut	AUGUST 23, 1983	October
807	November 11–12, 1983	San Luis Obispo, California	AUGUST 25, 1983	October
808	November 11–12, 1983	Evanston, Illinois	AUGUST 29, 1983	October
809	January 25–29, 1984 (90th Annual Meeting)	Louisville, Kentucky	NOVEMBER 2, 1983	January 1984
	April 6–7, 1984	Notre Dame, Indiana		
	November 9–10, 1984	San Diego, California		
	January 9–13, 1985 (91st Annual Meeting)	Anaheim, California		
	January 21–25, 1987 (93rd Annual Meeting)	San Antonio, Texas		

DEADLINES: Advertising	(October Issue) September 8, 1983	(November Issue) October 6, 1983
News/Special Meetings:	(October Issue) August 22, 1983	(November Issue) September 19, 1983

Other Events Sponsored by the Society

June 5–August 13, 1983, Joint Summer Research Conferences in the Mathematical Sciences, University of Colorado, Boulder, Colorado. January issue, page 74.

July 11–29, 1983, AMS Summer Research Institute on Nonlinear Functional Analysis and Applications, University of California, Berkeley. April issue, page 332.

August 6–7, 1983, AMS Short Course: Population Biology, Albany, New York. This issue, page 496.

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Notices

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The following article is the sixth in the series of Special Articles published in the *Notices*. Its author, ROBERT RUMELY, was educated at Princeton University where he received his Ph.D. in 1978 with a thesis prepared under the supervision of Goro Shimura. He was a C.L.E. Moore Instructor at the Massachusetts Institute of Technology from 1978 to 1980 and a visiting postdoctoral fellow at Harvard University in 1981. Since 1981 he has been an assistant professor at the University of Georgia. His current research is in capacity theory on algebraic curves. He has been awarded a Sloan Foundation Fellowship for 1983-1984.

The series of Special Articles was created to provide a place for articles on mathematical subjects of interest to the general membership of the Society. The Editorial Committee of the *Notices* is especially interested in the quality of exposition and intends to maintain the highest standards in order to assure that the Special Articles will be accessible to mathematicians in all fields. The articles must be interesting and mathematically sound. They are first refereed for accuracy and (if approved) accepted or rejected on the basis of the breadth of their appeal to the general mathematical public.

Items for this series are solicited and, if accepted, will be paid for at the rate of \$250 per page up to a maximum of \$750. Manuscripts to be considered for this series should be sent to Ronald L. Graham, Associate Editor for Special Articles, *Notices of the American Mathematical Society*, Post Office Box 6248, Providence, Rhode Island 02940.

Recent Advances in Primality Testing

by Robert Rumely

Prime numbers are one topic in mathematics the public can relate to. People seem fascinated by the RSA "trap door" coding scheme, and by records for large primes. (Currently the largest known prime is the Mersenne number $2^{86243} - 1$.) Likewise, the primality test recently developed by Adleman, Pomerance, and Rumely [1] has received a great deal of attention in the press. That test, as significantly improved by Cohen and Lenstra [2], is the main subject of this article.

Recent developments in commerce and security aside, the problems of testing numbers for primality and factoring them have serious algorithmic interest. It may be a surprise to some that much better methods are available for both than trial division up to \sqrt{n} . Further, the two problems are distinct: it is possible to determine whether a number is prime or composite without attempting to factor it. In fact, it is very easy to decide as a practical matter whether a number is likely to be prime or composite. The idea is to apply a pseudo-primality test: to check a property (such as Fermat's congruence) which all primes share, but most composites do not. A number which is free of small prime divisors and which passes even a single pseudo-primality test is almost certain to be prime.

However, finding a rigorous proof of primality or compositeness is more difficult. Some numbers of special form, such as Mersenne numbers ($2^p - 1$, with p prime) can actually be proved prime by checking a single appropriately chosen pseudo-primality test. It is in this way that "record primes" are found. For a number n of general form, the classical method of proving primality was to show the existence of a generator for the multiplicative group $(\mathbf{Z}/n)^\times$, making use of a factorization of $n - 1$. (The school of D. H. Lehmer extended this idea significantly.) The breakthrough in the APR test was the discovery of a collection of pseudo-primality tests, such that the possible divisors of a number passing them all are limited to a small, computable set.

The Cohen-Lenstra version of the APR algorithm is the fastest general primality test known; its running time is bounded by

$$(1) \quad (\log n)^{C \log \log \log n} \\ = \exp(C \log \log n \log \log \log n)$$

bit operations. For comparison, the asymptotically fastest factoring algorithms have expected

running time

$$(2) \quad \exp(C \sqrt{\log n \log \log n}).$$

In complexity theory, a problem is considered "tractable" if it can be solved by an algorithm which runs in a polynomial number of steps in the length of the input: $(\log n)^C$ if the input is n . Thus, the APR algorithm just misses being polynomial. Miller [6] has given a primality algorithm which runs in polynomial time, but depends on the Extended Riemann Hypothesis for its correctness. Interestingly, because of the constants in the running time bounds, the Cohen-Lenstra algorithm is faster than Miller's for numbers of some tens to several thousands of digits.

Most modern primality tests have their roots in Fermat's congruence: if n is prime, and $(q, n) = 1$, then

$$(3) \quad q^{n-1} \equiv 1 \pmod{n}.$$

The left side of this can be calculated very quickly, by forming the powers $q^{2^k} \pmod{n}$ by repeated squarings, and then multiplying together appropriate powers as indicated by the binary expansion of $n - 1$. Given a fixed $q \neq 1$, for most composite n , (3) is false. However, there is a sparse set of composites known as Carmichael numbers (including 561 and 1729) for which (3) holds for all q with $(q, n) = 1$. Thus, to obtain a proof of primality, it is necessary to strengthen Fermat's congruence.

Solovay and Strassen [11] (and independently, Shanks, and Lehmer [3]) suggested using the congruence defining the quadratic residue symbol as a pseudo-primality test: if n is an odd prime, and $(q, n) = 1$, then

$$(4) \quad q^{(n-1)/2} \equiv \left(\frac{q}{n}\right) = \pm 1 \pmod{n}.$$

This time, if n is composite, (4) fails for at least half the numbers $q < n$. Hence, a number passing it for k randomly chosen q 's can be asserted prime with "probability of error" less than $1/2^k$.

It was Adleman's insight that the Solovay-Strassen test gives more information than just pass-or-fail: it also tells about the structure of divisors of n . Loosely, if n passes the Solovay-Strassen test for each q in a collection \mathcal{Q} of prime numbers then, for any divisor r of n , the order (mod 2) of r in one of the multiplicative groups

$(\mathbf{Z}/q)^\times$ determines its order (mod 2) in all of them. This is proved using the quadratic reciprocity law and something called the “extraction lemma”. Rumely found a collection of pseudo-primality tests, performed in cyclotomic fields $\mathbf{Q}(\zeta_p)$, which gave a similar result for odd primes p , linking the indices (mod p) of r in the groups $(\mathbf{Z}/q)^\times$. (For any m , ζ_m denotes a primitive m th root of unity.) Adleman suggested a scheme whereby these results could be used to reconstruct the divisors of n . Starting with a set I of “initial primes” p , let \mathcal{Q} be the set of all primes of the form $q = 1 + \prod_{p \in S} p$, $S \subset I$ (called “Euclidean primes”, after Euclid’s proof of the infinitude of the primes). Put

$$(5) \quad Q = \prod_{q \in \mathcal{Q}} q.$$

Suppose n passes all the necessary pseudo-primality tests. By guessing the index (mod p) of r for each $p \in I$, a possible divisor r of n can be located mod q for each $q \in \mathcal{Q}$. This is because of the linkage between the indices (mod p) of r in the various $(\mathbf{Z}/q)^\times$, and because each of the numbers $q - 1$ is square-free, with its prime factors in I . By the Chinese Remainder Theorem, r can be found mod $Q (= \prod q)$; if $Q > n$, it can be determined, period. The number of possible divisors to be tested is

$$(6) \quad P = \prod_{p \in I} p.$$

Clearly there is a tension between the numbers P and Q : P should be kept small, so the number of divisors to be tested will be small; but it must be large enough that $Q > n$. Pomerance and Odlyzko showed that the initial primes can be chosen so that

$$(7) \quad P \approx (\log n)^{C \log \log \log n}.$$

This is a best possible estimate, apart from the constant C ; it accounts for the running time of the algorithm. Heuristically, C can be any number greater than $1/\log 2$.

Lenstra [5] simplified and recast the APR test. He saw that the set of possible divisors of n was simply the set of powers of n (mod Q). To show this, he focused on the characters of $(\mathbf{Z}/Q)^\times$. The pseudo-primality tests he used were congruences satisfied by Gauss sums formed with generators for the character group. In the proofs, he replaced the deep power reciprocity laws, used by APR, with elementary properties of Gauss sums. One version of the test is short enough to present here in its entirety.

Lenstra’s pseudo-primality tests are based on an easy computation. Let p and q be prime numbers with $p|q - 1$, and let χ be a character of $(\mathbf{Z}/q)^\times$ having order p . Define the Gauss sum

$$(8) \quad \tau(\chi) = \sum_{a=1}^{q-1} \chi(a) \zeta_q^a \quad (\in \mathbf{Z}[\zeta_{pq}]).$$

It is elementary to show that if n is prime, then

$$(9) \quad \tau(\chi)^{n^{p-1}-1} \equiv \chi(n) \pmod{n\mathbf{Z}[\zeta_{pq}]}.$$

This congruence can of course be checked whether n is prime or composite. Under a mild technical condition, if (9) holds, then for any prime divisor r of n , there is a number b (mod p) independent of χ and q , such that

$$(10) \quad \chi(n)^b = \chi(r).$$

The technical condition is that for some character χ of order p , and some q , (9) should hold with $\chi(n) \neq 1$. It implies that the power of p dividing $r^{p-1} - 1$ is greater than or equal to the power of p dividing $n^{p-1} - 1$, so there exist integers $c \equiv 1 \pmod{p}$, and b , with $b(n^{p-1} - 1) = c(r^{p-1} - 1)$. To derive (10), note that (9) certainly holds with r replacing n . Therefore, since r divides n ,

$$(11) \quad \begin{aligned} \chi(n)^b &\equiv \tau(\chi)^{b(n^{p-1}-1)} \\ &\equiv \tau(\chi)^{c(r^{p-1}-1)} \equiv \chi(r)^c = \chi(r) \end{aligned}$$

mod $r\mathbf{Z}[\zeta_{pq}]$. Assuming $(n, pq) = 1$, this yields (10).

The Gauss sums primality test is as follows. First, one constructs the sets I and \mathcal{Q} of “initial” and “Euclidean” primes as in Adleman’s schema, with $Q > n$, and checks that $(n, PQ) = 1$. For each pair p, q with $p \in I$, $q \in \mathcal{Q}$, and $p|q - 1$, one finds a character χ of $(\mathbf{Z}/q)^\times$ having order p , and carries out the pseudo-primality test (9). If any of the tests fail, n is of course composite. Most likely, during the tests, for each p a character χ will have been found for which $\chi(n) \neq 1$, verifying the technical condition. If not, one checks (9) for other characters until one is found for which $\chi(n) \neq 1$, or n is shown composite. Finally, for each b , $1 \leq b \leq P$, one constructs the least positive residue of n^b mod Q , and checks whether it is a proper divisor of n . If no divisors are found, n is prime.

The test is correct, because if r is a prime dividing n , by the Chinese Remainder Theorem there is a number b in the range $1 \leq b \leq P$ such that (10) holds for all the characters χ above: that is, $\chi(n^b) = \chi(r)$. These characters generate the character group of $(\mathbf{Z}/Q)^\times$, so $n^b \equiv r \pmod{Q}$.

The test as presented here is what is called a “nondeterministic” algorithm, because of the possibility of trying a large number of characters χ in verifying the technical condition. However, there is a deterministic form with the running time (1).

The Gauss sums pseudo-primality tests involve calculations in the number ring $\mathbf{Z}[\zeta_{pq}]$. It may be worth remarking how these can be carried out. The minimal polynomial $\Phi(x)$ of ζ_{pq} is known explicitly and has degree $(p-1)(q-1)$. Elements in $\mathbf{Z}[\zeta_{pq}]$ can be represented by polynomials in $\mathbf{Z}[x]$ of degree less than $(p-1)(q-1)$. Addition and subtraction in $\mathbf{Z}[\zeta_{pq}]$ correspond to addition and subtraction of polynomials; multiplication

corresponds to multiplication of polynomials, followed by taking the remainder upon division by $\Phi(x)$. To check a congruence mod $n\mathbf{Z}[\zeta_{pq}]$, one checks the corresponding congruence mod n for each of the coefficients.

The version of the test given above is simple theoretically, but is not practical for a computer. Cohen and Lenstra [2] have given another version which is computer-practical. They replace the Gauss sums pseudo-primality tests by tests in the smaller rings $\mathbf{Z}[\zeta_p]$, using so-called "Jacobi sums". They permit the use of characters χ with prime power (rather than just prime) order; especially in the case $p=2$, due to Cohen, this is nontrivial. Clearly the condition $Q > n$ can be replaced by $Q > n^{1/2}$; Lenstra showed that even $n^{1/3}$ is sufficient. In addition to many other improvements, they have taken great care to perform arithmetic operations efficiently. Their program, now running on a CDC Cyber 170-750 computer in the SARA computer center in Amsterdam, is able to deal with 100 digit numbers in about 30 seconds and 200 digit numbers in 8 minutes.

The running time of deterministic versions of the algorithm, and the expected running time of nondeterministic versions, are polynomial in the number P . To shed light on the bound (7), we present a heuristic argument for the size of P , based on estimating Q when P is the product of an initial segment of primes. Exactly 2^t "Euclidean numbers" of the form $1 + \prod p_i$ can be built up from the first t primes. By the Prime Number Theorem, the "average size" of these numbers should be $e^{(1/2)t \log t}$. Assuming that these are no less likely to be prime than ordinary numbers, about $2^{t/2} t$ of them should be prime. Thus we expect

$$(12) \quad Q \approx \exp\left(\left(\frac{1}{2}t \log t\right) \frac{2^t}{(1/2t \log t)}\right) = e^{2^t}.$$

$Q = n$ and solving for t gives $t \approx \log \log n / \log 2$, and the Prime Number Theorem yields

$$(13) \quad P \approx e^{t \log t} \approx (\log n)^{\log \log \log n / \log 2}.$$

Thus, the triple log in the exponent is ultimately due to the logarithm factor in the Prime Number Theorem. Pomerance and Odlyzko's proof of (7) uses an entirely different idea; it is based on sieve methods, and follows an averaging argument, showing that most multiples of the product of a sufficiently long initial segment of primes can be taken for P .

It has only been possible to touch on the topics of primality testing and factoring here. For

those interested in an overview of the subject, we recommend the survey articles of Williams [13], Lenstra [4], and Pomerance [8], which contain further references. On primality testing, we note the original paper of Adleman, Pomerance, and Rumely [1], and the paper of Cohen-Lenstra [2], which contains a very complete description of their algorithm. On factorization, Brillhart-Morrison [7] present the continued fraction algorithm, and the papers of Pomerance [9], Schoof [10], and Voorhoeve [12] analyze a number of methods and their running times.

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Mathematical Problems and Training in Robotics

by Jacob T. Schwartz and Micha Sharir

Robotics, the technology and science which supports the application of computer-controlled manipulators to the tasks of manufacturing, has begun to grow quite rapidly within U.S. universities, largely in departments of computer science and engineering. However, this young field has potentially rich mathematical connections and promises to develop as an interdisciplinary field in which mathematics will play an essential role in combination with various more pragmatic disciplines such as control theory, mechanical engineering, manufacturing technology, physics, materials science, industrial engineering, and computer science. Most current research in robotics concerns itself with immediate goals and thus concentrates on hardware issues such as design of more precise mechanical manipulators and improved sensory devices. However, mathematically oriented studies of the fundamental problems of robotics have also begun, specifically attempts to develop much more powerful control software, which can be used easily and flexibly to program robot systems to perform tasks involving sophisticated adaptation to the robot's environment. Though 'theoretical robotics' is still in an infant stage, partly because of the mathematical difficulties of the problems it has begun to suggest, it is now developing swiftly. This note aims to advertise robotics as an area of study to mathematicians by surveying some of the interesting

mathematical connections which it has begun to develop, and projecting other connections which can be expected to become important in future research.

By way of illustration of the mathematical questions that arise, we begin with a typical problem in robotics, namely *motion planning*. We shall see that this potentially important pragmatic problem raises a complex of questions involving algebraic geometry, topology, and also design of efficient numerical procedures and geometric algorithms.

Suppose that the geometry of a robot's working environment (i.e. the shape and location of all obstacles within that environment) is known, and that we are given an initial position of the robot system and a desired final position. How can this information be used to plan a continuous motion of the system between these two positions, given that this motion must avoid any collision with the obstacles present? Since the manifold of allowable positions (in which the robot does not collide with any obstacle) is defined by a finite collection of algebraic equalities and inequalities, this motion problem reduces to that of finding the connected components of a certain algebraic manifold (with boundary) and thus to an 'applied' problem in real algebraic geometry.

It is interesting to note in this connection that algebraic geometry began as a machinery for organizing and expediting geometric computations before its attention turned to more abstract and general problems; robotics can be expected to encourage revival of the applied aspects of this field. It is also significant that in robotics we cannot be satisfied with a purely abstract analysis of a problem, but instead require a constructive procedure for the solution of each problem posed. Moreover, we need to find efficient procedures, since these procedures may have to be executed in real time during actual robot motions. Robotic research must therefore emphasize the algorithmic aspects of the problems it handles and the design of high-efficiency algorithms for their solution.

To see what this may mean we review a few recent techniques for solving motion planning problems of this kind. A first technique partitions the algebraic manifold F of allowable robot configurations (this is a k -dimensional algebraic manifold with boundary, k being the number of degrees of freedom of the system) into connected subregions of simple structure (which we will

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call 'cells'), and then computes the adjacency relationships between these cells. To find a computationally manageable partitioning of F into cells, recursion on the dimension of F can be used. That is, we can project F by a projection p onto a subspace A of lower dimension, and then consider the subset of A consisting of 'critical' positions X at which the combinatorial structure of the connected components of the 'fiber' $p^{-1}(X)$ changes discontinuously. By analyzing the relationship of A to this 'critical' subspace we can recursively decompose A into cells C , and use these to decompose the higher dimensional space F into connected regions D , each of which projects into one of these cells. Adjacency relationships between the regions thereby obtained can then be determined by defining appropriate 'crossing rules' between adjacent cells of A .

The scheme just outlined is related to Tarski's decision procedure for the elementary theory of reals [Ta]. Recent improvements of this procedure by Collins [Co] and by Arnon [Ar] have led to general cell decomposition procedures for semi-algebraic sets, similar in nature to that just outlined. Adaptation of these techniques shows that the general motion planning problem for an arbitrary (but fixed) 'algebraic' robot system can be solved in time polynomial in the number of geometric constraints involved (see [SS2]).

However, the resulting procedures are still very inefficient and attempts to find much more effective motion planning techniques are called for. Other approaches to motion planning which lead to more efficient motion planning algorithms, some of them having interesting connections with methods used in differential topology, have begun to emerge (see [OSY]).

Though little is known about the inherent computational cost of motion planning, interesting lower bounds have been derived for certain very general motion planning problems (see [HJW] and [Re]).

Many interesting generalizations of the above basic motion planning problem suggest themselves: e.g. finding paths which are optimal (according to some reasonable criterion, e.g. shortest, fastest), or planning geometrically constrained paths (for bodies moving in contact). These latter problems can be expected to make use of ideas drawn from the theory of convex bodies, differential geometry, and from more classical areas of geometry. Control of robot motions near 'singular' manipulator positions, e.g. positions in which a joint of the manipulator has opened to a straight angle, may relate to some of the analysis of singularities of differentiable maps developed by Mather and others.

Since, as has already been noted, efficiency is a crucial issue for robotics, the geometric processes of which it makes use must be supported by efficient geometric algorithms. Robotics suggests many problems in computational geometry and

will lend considerable impetus to this rapidly growing field, which up to now has been primarily motivated by applications outside robotics (e.g. applications in computer graphics, image processing, and integrated circuit design). The following are a few typical geometric problems having application to robotics: Given a set of objects of known shape in various rotated/translated positions, how rapidly can we tell whether any two of them intersect? If a small spherical robot with only a tactile sense, wishes to find its way between points x and y around 3-dimensional obstacles of shape not known *a priori*, what exploration procedure can it use to ensure that a path will be found if one exists? How does the availability of a sense of sight change the answer to this question?

An area closely related to robotics, which can also be expected to draw ideas from algebraic geometry and topology, is that of *geometric modeling*, i.e. description and analysis of the structure of 3-D objects for such purposes as graphical display and computation of various geometric and physical characteristics. This area of investigation, fundamental to all applications in which object shapes must be dealt with computationally, raises interesting problems of symbolic and numerical computation. For example, given a set of k real polynomial equations in k unknowns, how many solutions do they have, and how efficiently can these solutions be approximated? Presently only relatively inefficient continuation techniques for dealing with this important question seem to be available; improved methods would be most desirable. Another question: how rapidly can the volume and moments of a region defined by a set of algebraic inequalities be calculated?

Still rarer problems are encountered if we go beyond the purely geometric domain and attempt to deal more fully with the physical properties of bodies. In this area, the theory available is quite fragmentary, and in fact even the initial step of identifying the right questions to ask is incomplete. Typical problems of this sort include:

(1) *Compliant motions*. The motion-planning problems discussed in the preceding paragraphs, which arise when bodies move in empty space, are purely geometric. However, once we allow contact between a moving robot arm and other bodies, there arise other questions, which involve both the shapes of surfaces in contact and the forces generated at the points of contact, and hence are characterized by a combination of geometric and force considerations. A typical problem of this kind is how to use the fingers of one or more dextrous multi-fingered hands to touch, grasp, and manipulate objects, e.g. to turn a crank, rotate a tool handle, move long objects held by two or more grippers, hand objects between grippers, etc. Through analysis of the fundamental mathematics and physics of these problems one hopes to comprehend them completely enough to be able to

implement applications-oriented robot commands such as

Turn grasped object d degrees about axis a at d degrees per second, maintaining k kilograms of gripping force.

Motions of this sort must adapt to bodies of imperfectly known shape, raising interesting problems in the control theory of multidimensional systems, and also suggesting geometric problems having to do with management of the geometric information gathered by sensitive fingers moving over the surface of a body being manipulated.

(2) *Frictional motions.* Robots are used to perform various forms of close-tolerance assembly, typified by the problem of inserting a peg of diameter d into a hole whose diameter is only slightly larger than d . Experience shows that such insertion operations will commonly fail because of frictional effects which cause the peg to 'jam' or 'wedge' during insertion. For effective adaptive control programs to be designed, theoretical understanding of these frictional phenomena is required. However, classical studies of motion in the presence of friction have dealt almost exclusively with motions in one dimension only. In two or more dimensions, new problems arise which possess very interesting force-space geometries. One wants to understand the manner in which the geometry and friction coefficients of two bodies moving in contact at several points determine the motion (or lack of motion) which ensues when given forces and torques are applied to one of the bodies in contact. Since Newtonian mechanics is not always deterministic in the presence of friction, one also wants to understand the situations in which these motions are uniquely defined, and more generally to limit the various motion ambiguities which can arise.

(3) *Image analysis.* Many new robot sensors (visual, acoustical, tactile) are being developed. These devices produce various forms of raw data concerning object locations and shape, which must then be used to identify the bodies present in a scene and determine their orientation. Though progress in this extremely elusive area is still quite limited, image analysis has received concentrated attention.

In the industrial vision situation, the general problem of scene analysis is simplified considerably by the fact that only objects drawn from a finite family whose geometric details are known to the analyzing computer will be present. In less limited situations, e.g. that faced by a hypothetical 'household' robot, more complex scenes may have to be decomposed into objects drawn from known categories but with sizes and details of shape not known in advance; and finally, complex outdoor scenes can involve areas of boundlessly complex detail, such as tree leaves, grass, gravel, and shrubbery, which can only be described statistically.

Even simple scenes have proved quite difficult to deal with. Since objects can be partially

occluded and can be perceived from any angle, object identification will rest on the use of local geometric invariants of the body surface, together with procedures for determining those parts of a body from which observed patches having given invariants might come. The invariants most useful for this purpose and most resistant to misidentification because of sensor-related inaccuracies need to be determined. Notions drawn from differential and integral geometry, and from probability theory, may be useful for this.

Analysis of object textures, e.g. the 'roughness' of rocks and the 'bushiness' of shrubs, has made use of ideas drawn from the theory of stochastic processes and from topological dynamics (e.g. fractal geometry, involving study of the asymptotic behavior of high iterates of continuous maps.)

Though still in extremely raw condition, the robotic problems listed above, and the many others that could be enumerated, hint at a wealth of mathematical connections, which include but go far beyond the classical concerns of applied mathematics. Their study will present mathematicians with many vivid and challenging problems, and with a chance to contribute substantially to an accelerating subject which is important for the nation's economic well-being. It is to be hoped that the importance and inherent appeal of this subject will draw the mathematical community into a sustained and productive relationship with it.

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Mathematical Engineering: Problems and Opportunities

by Robert Hermann

I attended the National Conference of Mathematics Department Chairmen in Washington, April 8–9, 1983, and was amazed at how times have changed. Gone was the arrogance (and naiveté) which had engendered all those agonized debates within mathematics in the 1960s about the “nature of applied mathematics” and “whether computer science deserves to be in a mathematics department.” Instead, many of the speakers expressed regret that the mathematics profession had so foolishly lost so many opportunities and had driven out so many subjects closely akin to “core” mathematics. I was especially interested, because the two subjects in which I have been involved throughout my own career—the development and use of mathematics in physics and control-system theory—were mentioned as examples which could have developed within mathematics if the dominant ethos were not so fanatically “pure.”

One might begin by asking *why* we as a profession so enthusiastically threw away our long tradition of maintaining contact with the rest of the scientific world and contributing to its development. I believe that the fundamental error was an intellectual one: Let us call it The Hubris of Bourbaki. Great mathematics has always had three intertwined features: Development of the internal, conceptual structure; of the computational and algorithmic aspects; and working on problems coming from the outside world. (I saw this early on in my study of the work of Cartan.) The generation of mathematicians before mine thought that the latter two aspects could now be relegated to a ghetto called “applied mathematics” and the main thrust of the profession could be on the first front. They were tragically mistaken, and it was clear in this conference that the generation of “pure” mathematicians now coming into maturity are paying the price!

However, we must look to the future. The meeting was held to formulate a response to the initiative by the NSF substantially increasing the level of funding for mathematics, but emphasizing that which would improve our national scientific and technological structure rather than, as would have been the case in the past, the primacy of the

traditional “summer research grant” of the teacher and part-time scholar. Many speakers emphasized how important was the establishment on both the local and national level of interaction with the full spectrum of scientists and engineers who are using mathematics, and the training of mathematics students in the methodology they would need to survive in a non-academic environment.

The only unrealistic aspect of these comments was the expectation that salvation was in subjects like physics and computer science. The physicists by-and-large do not need our massive help in their endeavors (of course there are always opportunities around the edges) and computer science is not in a particularly mathematical stage at the moment. (I believe that it will get there some day, but these things cannot be hurried.) Although the real opportunities lie in engineering, there was no discussion of what needed to be done to improve our relations with the various engineering disciplines. While the mathematics world has slept like Rip Van Winkel, engineering has experienced a mathematical explosion, which mathematicians have, as a group, not responded to in any serious, non-condescending way, nor perhaps even been aware of. Since this meeting of department chairman is to be a regular affair, I hope that later meetings will deal with some of the concrete issues which a reorientation of the mathematical world might involve.

The documents which went along with this meeting, printed in the *Notices* in the issues of January and April of 1983, were also of interest as indicators of the state of mind of the leaders of mathematics. For example, consider Glimm’s article *Mathematics program review: Problems and opportunities*, printed in the January 1983 issue. Since he is an analyst and a part-time mathematical physicist, he emphasizes the considerable progress which has been made in the last fifteen years in reviving the marriage between the subject of partial differential equations and theoretical physics. This development is indeed very important, but there is little indication of the extent of the possibilities in engineering. The only specific reference to the vast area of systems, communication, control, etc., is to application of work by Norbert Wiener to Petroleum Seismology: This is like mentioning Einstein only in the context of his work on refrigerators. (Of course, I do not mean to be condescending towards Refrigerator or Petroleum Engineering. Einstein

ROBERT HERMANN is one of the founders of The Association for Physical and Systems Mathematics, Inc. of Brookline, Massachusetts.

and Wiener shared a charming love for the practical; perhaps this arose from their youth as “impractical dreamers”.) From evidence in Glimm’s essay, it is clear that his “internal model” of engineering is that it is Applied Physics. While this may have been so at one time, the last twenty-five years have considerably changed this picture. Further, the areas of systems and control that I work in provide problems, mathematical stimulus and intuition as rich as those that accompany quantum field theory.

Physics has a centralized, hierarchical structure in comparison to engineering. Fundamental Physics, i.e. the foundations of quantum mechanics and the theory of elementary particles and the basic fields and interactions relating them, plays a role in the minds of many physicists analogous to the position of set theory, basic algebra and analysis in the minds of mathematicians. Physicists place Einstein, Dirac and Feynman on a pedestal as we do Poincaré, Hilbert and von Neumann. However, there is much less of this mainstream in engineering: Virtually the only useful and realistic definition of “engineering research” is the circular one of what is being done at the major engineering universities and laboratories and published in the major engineering journals! Of course, this situation has its roots in the fact that engineering is not anchored in the search for Fundamental Laws as is physics or, increasingly, biology.

This difference is often used to downplay the need for quality mathematical work in engineering. However, this argument can be turned around quite effectively: Often it is the mathematical roots of the engineering discipline of the day which provides the crucial link to past successes (and failures) and that makes it a “science.” Thus an engineer who is presented with the job of designing a synthetic fuel plant or a new aircraft will be interested in the lessons learned from the development of rocket fuels or the Apollo program. For much the same reasons cited by physicists, the famous Wignerian “unreasonable effectiveness of mathematics,” these lessons are often mathematical in nature. The increasing dominance of computers in engineering research also leads to an increased appreciation for the power of mathematical thought. Notice how General Motors has tried to counter its “low-tech” image in contrast to Toyota et al. by saturating the quality magazines with advertisements bragging about how much mathematics its engineers know and are using in their computer programs! By contrast, in their ultimate wisdom many government agencies (and Congressmen) decided ten or so years ago that the development of computers would reduce the country’s need for mathematics and mathematicians.

However, if there is any historical core to contemporary theoretical engineering research which plays a role analogous to that of quantum

mechanics and relativity in the development of the physical sciences, it might be the research in circuit and communication theory at Bell Laboratories and MIT in the 1930s and 1940s. After all, there is nothing like having to build a continent-wide telephone system and develop a fundamentally new technology like radar to concentrate the mind on the necessity for getting the fundamental principles right and hiring the best available minds. It was contact with this culture that also stimulated Wiener to some of his finest mathematics and his romantic speculations about Cybernetics. (Wiener seems to have been a physics-engineering groupie: He was also present and contributing at the foundation of quantum mechanics.) There are some who deplore this “soft” side of Wiener’s work, but I consider it in the same class as Whittaker’s book on mechanics or Weyl’s on relativity and quantum mechanics. There is something very fresh and stimulating in a first-rate mathematician writing about an area of science in a fundamental and semi-popular way which also involves his mathematical side.

This historical impulse to electrical engineering seems to have persisted, and the center-of-gravity of theoretical/mathematical engineering research is in electrical engineering departments. Certainly, the EE’s are the most mathematically-oriented group of engineers, and the best educated in basic mathematics. (Often too much so: A tendency I have noticed lately is that many young mathematically-oriented engineers know very little physics.) There is also a tendency for new mathematical/theoretical technique to start in EE and percolate out to the other engineering disciplines. Thus, Wiener’s work on Prediction Theory was already applied in EE in the 1940s and recently, as Glimm noted, ended up in petroleum! EE’s have also been extensively involved with Computer Science as an academic discipline—many departments are called EE-CS—and they have often taken the lead in the coding/communication aspects of CS. Conversely, the EE’s have a subdiscipline called Adaptive Control which has many of the same goals as Artificial Intelligence but which is founded and run on more realistic scientific principles.

There are also great differences in the way research is done in theoretical engineering and mathematics, which must be understood if an effective program of interactive research is to be considered. Engineers are often enthusiastically ready to respond to the research buzz-words of the day, and throw big mathematical words at them without necessarily understanding them sufficiently well. It is sometimes disturbing to someone of a mathematical temperament to see the way research is done: When a useful quasi-mathematical idea appears, at a certain stage relatively large amounts of research money are made available by the “mission” agencies, attracting a mob which furiously churns out work in one narrow, temporarily fashionable, area.

The basic mathematics had often been done long before, but had been neglected or forgotten. Of course, this activity is not necessarily to be condemned since it seems to be needed if the ideas are to become available to the "working" engineer. My concern is that Gresham's Law seems to inhibit the systematic development of the new mathematics underlying the topic of the hour. One would also think that the record of the last twenty years would convince these agencies that it would also be important to fund development of the underlying mathematics, using the criteria of originality and power which we use, but this is a case that has never been made.

People trained in the mainstream subjects of contemporary mathematics are needed in mathematical engineering to suggest new directions and to guide the correct use of the powerful tools. This is the role I have played in control theory research, and I have found it very stimulating, but also frustrating; on the one hand for lack of understanding from the mathematical community, and on the other hand to have to cope (and to compete for research support) with people who do not have much appreciation of the critical importance of originality and the long-term scholarly virtues. I believe that research on the mathematical side of engineering has suffered because it has been totally dominated by people (and support agencies) whose main concern is the short-term. It is on this point that the attitude of physicists is much better, and in fact mathematical physics is at the moment in a much healthier and more creative state than the similar parts of engineering.

I must emphasize that realizing the possibilities of successful research interaction between mathematics and engineering requires new thought, institutions and modes of organization. Before starting The Association for Physical and Systems Mathematics, Inc., Clyde Martin and I made suggestions along these lines to the AMS and SIAM in 1977, which were rebuffed. We proposed setting up a committee within the basic AMS/SIAM structure which would deal directly with the issues of mathematical research in the engineering context. As Applied Mathematics has diversified (in a very encouraging way!) in recent years, we felt that the interests of the engineering world were not being served. Due to my political ineptitude, the

"establishment" saw this suggestion as a threat, and hurriedly covered things up by putting a few mathematically-oriented engineers on existing committees, but little else. After the Washington meeting, I believe that the time might be right to start again.

At the moment, I see two issues of primary importance. First, development of a research journal which will play the role in the work of the theoretical/mathematical engineering research community that the *Journal of Mathematical Physics* does for mathematical physics, i.e. serving the mathematical interests of the wide spectrum of researchers in the varied disciplines of physics while maintaining scholarly standards. I propose that SIAM take the lead in such a project.

Second, development of mini-Centers of research mathematicians and mathematical engineers who actively keep up with what is going in the engineering world and alert the rest of us to what is going on. (For example, I find it strange that no systematic treatise, perhaps equivalent to Abraham and Marsden's *Foundations of mechanics*, exists in the systems and control area.) The Mathematics Research Institutes in Berkeley and Minnesota are the obvious candidates, but, to the best of my knowledge, they are doing very little along these lines. There are possibilities and models within the National Laboratories. For eight years I have been informally associated with a group of "working" aircraft control engineers at the Ames Research Center of NASA, who are designing control systems for advanced types of aircraft and helicopters and have found it useful to be in contact with (and support financially) a group of us who apply differential and algebraic geometry to control theory. The Center for Non-linear Studies at Los Alamos is another example of a small-scale institution embedded within a gigantic one which has had success in making new and exciting mathematical ideas available to the "working" physicist and engineer.

In my conversations with officials of the National Science Foundation they have emphasized to me that they can only respond to initiatives from the scientific community. I hope the mathematical world will understand how much is at stake and begin to develop these new institutions.

Marshall Stone Awarded National Medal of Science

At ceremonies in the East Room of the White House on May 24, 1983, President Reagan awarded the National Medal of Science to twelve American scientists including Marshall Stone, the only mathematical scientist in the group.

The citation for Stone, who was unable to attend the ceremonies, read as follows: "Marshall H. Stone, for his original synthesis of analysis, algebra, and topology into the new, vital area of functional analysis in modern mathematics."

Marshall Harvey Stone was born in New York City, April 8, 1903 and educated at Harvard University (B.A., 1922, M.A., 1924, Ph.D., 1926). Except for two years as an instructor at Columbia University in the twenties and two years as an associate professor at Yale University in the thirties, Stone served on the faculty at Harvard University from 1922 to 1946 and then moved to the University of Chicago as Andrew Macleish Distinguished Service Professor. In 1968 he retired from the University of Chicago as Professor Emeritus. He then served as George David Birkhoff Professor at the University of Massachusetts, Amherst, from 1968 to 1973, and as professor of mathematics from 1973 until he retired as Emeritus Professor in 1980. He has served the mathematical profession, and the Society, in many ways during his long career. He was President of the Society in 1943 and 1944.

Nelson Dunford, when asked by the EDITORS of the *Notices* to summarize Stone's work less succinctly than the Presidential Citation, responded with the following words:

Marshall Stone is one of the few great leaders of this century and his inspiring discoveries spawned much of the recent work in functional analysis and operator theory. His synthesis of analysis, algebra and topology contains the Stone Representation Theorem, i.e., every Boolean ring with unit is isomorphic with the Boolean ring of all opened and closed subsets of a totally disconnected compact Hausdorff space, the Banach-Stone Theorem and the Stone-Čech Compactification Theorem. His operational calculus for unbounded self adjoint operators on a Hilbert space \mathcal{H} , his spectral theorem for such operators and his representation of a strongly continuous semi-group of unitary operators on \mathcal{H} by the exponential e^{itA} where A is a self adjoint operator on \mathcal{H} are all basic to quantum mechanics.

Newly Elected Members of the National Academy of Sciences

The following mathematical scientists were elected to membership in the U.S. National

Academy of Sciences in April 1982: Richard E. Bellman, University of Southern California; David Gale, University of California, Berkeley; Harry Kesten, Cornell University; Dennis P. Sullivan, City University of New York, Graduate School and University Center; William P. Thurston, Princeton University; and Alar Toomre, Massachusetts Institute of Technology. Vladimir I. Arnol'd, USSR, and Michael E. Fisher, United Kingdom, were elected foreign associates of the Academy.

Newly Elected Members of the American Academy of Arts and Sciences

The following mathematicians were elected to membership in the American Academy of Arts and Sciences in April 1983: Bradley Efron, Stanford University; Herman H. Goldstine, IBM Corporation; Victor W. Guillemin, Massachusetts Institute of Technology; Martin D. Kruskal, Princeton University; Nicholas C. Metropolis, Los Alamos Scientific Laboratory; Harold M. Stark, Massachusetts Institute of Technology; Shmuel Winograd, IBM Watson Research Center; and Shing-Tung Yau, Institute for Advanced Study.

Everett Pitcher Lecture Series

The second series of Everett Pitcher Lectures will be held on Lehigh University's Bethlehem, Pennsylvania campus on December 5-7, 1983. They will be delivered by Jean-Pierre Serre of the Collège de France. The lectures are open to the public and are in honor of Everett Pitcher, Secretary of the AMS, who served in the Mathematics Department at Lehigh from 1938 until 1978, retiring as Distinguished Professor of Mathematics.

AMS Research Fellowships

The terms of the AMS Postdoctoral Research Fellowship are being changed. It has been the case that fellowships were open to individuals who had recently received the Ph.D. degree. This was ordinarily interpreted by the judging panel as meaning no more than four years past the Ph.D. degree. The new version of the fellowship will be open to persons in early mid-career. This will ordinarily be interpreted as meaning four to ten years past the Ph.D. (or equivalent), regardless of age, but below the academic rank of professor. Moreover, the vita must include some postdoctoral work experience, i.e. non-fellowship years.

The stipend has been set by the Trustees of the Society at \$30,000 for eleven months of full-time research or its equivalent. In addition, there will

be an expense allowance of \$1,000. Applicants must be citizens or permanent residents of a country in North America. Fellowships may be held at any institution the Fellow selects or at more than one in succession. There is flexibility in the choice of time interval(s) and manner in which the Fellow may draw funds. For instance, given the opportunity, a Fellow may elect to hold a half-time academic appointment with a teaching responsibility not exceeding one course per term while holding the fellowship at one-half stipend over a two-year period. The fellow should consult the Secretary of the Society to learn whether the proposed arrangement is acceptable to the Society.

The number of fellowships depends on the amount of money contributed to the program. The Trustees have arranged the matching program from general funds in such fashion that funds for at least one fellowship are guaranteed.

The deadline for receipt of applications is December 1, 1983. Awards will be announced late in January 1984.

For further information and application forms, write to William J. LeVeque, Executive Director, American Mathematical Society, P.O. Box 6248, Providence, RI 02940.

AMS Surveys and Monographs Series

In the last two years, the Mathematical Surveys Series, published by the AMS, has been significantly expanded to provide increased service to the mathematical community, authors and readers. The underlying purpose of the Mathematical Surveys Series has been broadened, and this is reflected in the change of title to Mathematical Surveys and Monographs Series. The purpose of the Series is now to publish scholarly and research monographs as well as books which are surveys of a particular field.

With this new purpose in view, the Editorial Committee is seriously searching for appropriate manuscripts to publish in the Series. There are several important advantages to the author who publishes in this Series. Beyond the obvious advantage of the imprint of a scholarly publisher, there are three practical considerations.

1. The AMS pays royalties which are competitive with or larger than the royalties paid by most publishers. The present royalty rate paid by the AMS is 15% on the *list* price (with division of that amount among multiple authors). This means that even when the book is sold at a reduced rate (for example, at the standard rate for an individual member of the AMS or during a special sale) the author nevertheless receives 15% of the full price.

2. Books in the Series are kept in print permanently. For the author who is struggling to finish a manuscript, it may be hard to believe that the book will reach publication, much less

that it will go out of print. But more than one distinguished scholarly book has met this fate. The unfortunate author must then undergo the hassle of arranging for reprinting while listening to the complaints of frustrated would-be readers.

3. The AMS maintains steady promotion of its publications. At the summer and annual meetings of the AMS, recent books and books of continuing popularity are displayed and are for sale to registered attendees of the meeting at 40% of list price. (This low sale price does *not* decrease the author's royalty.) There are also displays of AMS books at some sectional meetings of the AMS and a regular display at the British Mathematical Colloquium. AMS books are displayed from time to time at international book fairs: in recent years in Moscow, Warsaw and New Delhi. Advertisements for AMS books appear in the AMS *Notices*, *Abstracts* and *Mathematical Reviews*. Finally, a separate catalogue of the Mathematical Surveys and Monographs Series is presently being planned.

Prospective authors for the Mathematical Surveys and Monographs Series are invited to communicate with one of the members of the Mathematical Surveys Editorial Committee: Donald W. Anderson, Jane Cronin Scanlon (chair), or R. O. Wells, Jr.

Sociedad de Matemática de Chile

The American Mathematical Society and the Sociedad de Matemática de Chile have recently concluded a "reciprocity agreement" under which members of either of these societies may join the other at reduced rates. Members of the Sociedad de Matemática de Chile receive as a privilege of membership a free subscription to *Gaceta de la Sociedad*.

See the section entitled **Reciprocity Agreements** in this issue of the *Notices* for further details.

Fulbright Awards Available for 1984-1985

The Council for International Exchange of Scholars (CIES) has recently published a booklet, *1984-1985 Fulbright Senior Scholars: Awards Abroad*. This booklet lists awards available for university lecturing and advanced research in mathematics and in the physical sciences in countries throughout the world. In recent years from ten to fifteen annual awards have been made to specialists in mathematics and statistics.

To obtain a copy of the 1984-1985 announcement, write to CIES, Eleven Dupont Circle, N.W., Suite 300, Washington, DC 20036.

John von Neumann Lecture

The Society for Industrial and Applied Mathematics selected Joseph B. Keller of Stanford University to deliver the 1983 John von Neumann

Lecture. The prestigious lecture, SIAM's oldest award, was delivered at the SIAM 1983 National Meeting, held June 6-8, 1983 in Denver. The title was *Recent developments in applied mathematics*.

Members of the 1983 John von Neumann Lecture Committee were Hirsh G. Cohen and Jane K. Cullum, both of IBM T. J. Watson Research Laboratory, and Seymour V. Parter of the University of Wisconsin, Madison.

-SIAM News Release

U.S. Mathematical Olympiad Winners

Eight U.S. contestants have earned Olympiad medals in a mathematics competition involving over 400,000 high school students. The final round in this competition was the Twelfth USA Mathematical Olympiad (USAMO) in which fifty-four students competed in a challenging examination designed to test ingenuity as well as mathematical background. The finalists were the top performers in the American High School Mathematics Examination and the American Invitational Mathematics Examination which were held in high schools throughout the United States and Canada in March 1983.

The eight USAMO winners are John M. Steinke, San Antonio, Texas; Michael Reid, Woodhaven, New York; C. James Yeh, Mountain Brook,

Alabama; Jeremy A. Kahn, New York, New York; Steven Newman, Ann Arbor, Michigan; Douglas S. Jungreis, North Woodmere, New York; Douglas R. Davidson, McLean, Virginia; and John T. O'Neil III, Princeton, New Jersey.

Following an awards ceremony, the eight winners and sixteen other students who did well in the USAMO Examination participated in an intensive three-week seminar at the U.S. Military Academy at West Point in preparation for the 1983 International Mathematical Olympiad held in France in July.

The Mathematical Olympiad and the High School Mathematics Contests are sponsored by five national organizations in the mathematical sciences. Financial support is provided by IBM, the Army Research Office, and the Office of Naval Research.

-MAA News Release

1983 American Book Awards

The 1983 American Book Awards, sponsored by the American Association of Publishers, were announced in April. The awards for science went to Abraham Pais for his book *Subtle is the Lord... The science and life of Albert Einstein* (hardcover) and to Phillip J. Davis and Reuben Hersh for their book *The mathematical experience* (paperback).

NSF Mathematical Sciences Postdoctoral Research Fellowship (with research instructorship option)

The National Science Foundation has announced the sixth year of its Mathematical Sciences Postdoctoral Research Fellowship Program.

The Foundation plans to select in February 1984 approximately thirty applicants for fellowships for postdoctoral research in the mathematical sciences. The Fellowships are designed to permit recipients to choose research environments that will have maximal impact on their future scientific development. Awards of these fellowships will be made for appropriate research in pure mathematics, applied mathematics, and statistics.

The format of this Fellowship program has recently (in 1983) been changed significantly to provide increased flexibility in the manner in which the recipient can perform as a Fellow. The support period has also been lengthened considerably. In particular, the stipend portion provides support for two nine-month academic years and six summer months for a total of twenty-four months of support. The awardee will have two options for the academic years' stipend: as full-time support for any eighteen academic-year months in a three-year period, in intervals not shorter than three consecutive months (the Research Fellowship option), or as a combination of full-time and half-time support over a period of three academic years, usually one academic year full-time and two academic years half-time (the Research Instructorship option).

The stipend will be paid at the rate of \$2,300 per full-time month or \$1,150 per half-time month, for a total of \$55,200 for the eighteen academic-year months and six summer months.

National Science Foundation Mathematical Sciences Postdoctoral Research Fellowships will be offered only to persons who (1) are citizens or nationals of the United States as of January 1, 1984, (2) will have earned by the beginning of their fellowship tenure a doctoral degree in one of the mathematical sciences listed above or have had research training and experience equivalent to that represented by a Ph.D. degree in one of those fields, (3) will have held the doctorate for no more than five years as of January 1, 1984, and (4) will not previously have held any other NSF Postdoctoral Fellowship. The Foundation welcomes proposals on behalf of all qualified scientists and engineers, and strongly encourages women and minorities to compete fully in all of the research and research programs it supports.

Application forms and additional information are available from: Mathematical Sciences Postdoctoral Research Fellowships, Mathematical Sciences Section, National Science Foundation, Washington, D.C. 20550. **The deadline for complete applications is November 15, 1983.**

Research Proposals Mathematical Sciences Section

The purpose of this announcement is to focus attention on the preparation of NSF research proposals. Prospective applicants are referred to the brochure *Grants for Scientific and Engineering Research* (NSF 81-79 or NSF 81-79F) available from institutional research offices or directly from NSF (Forms and Publications, NSF, Washington, D.C. 20550).

Applicants should allow six to nine months for review and processing. Proposals may be submitted at any time.

The requested duration should be appropriate to the scope of the project. Requests for two or three years' support are suggested. A separate itemized budget for each year, together with a summary budget, should be provided.

Proposal cover sheets should display prominently in the upper left-hand corner, but separately from the title, the first two digits of the 1980 Mathematics Subject Classification used in *Mathematical Reviews*. Individual topics proposed for research should be identified with the appropriate full Subject Classification codes. Include, also, the probable program assignment (Classical Analysis, Modern Analysis, Geometric Analysis, Topology, Foundations, Algebra and Number Theory, Applied Mathematics, Statistics or Probability).

Particular attention must be paid to the required 200-word summary of work being proposed, following the format of the NSF Project Summary Form (see NSF 81-79, page 18, or NSF 81-79F, page 45). The summary must satisfy the following conditions:

- (a) it must be self-contained;
- (b) the pertinent subfield of science (e.g., algebraic number theory, global analysis, decision theory, etc.) should be stated explicitly in the first sentence;
- (c) symbols should not be used;
- (d) first person pronouns and such phrases as "proposer" and "it is proposed" should be avoided; in their place, use "principal investigator" and "Professor X plans to," etc.; and

William G. Rosen Heads Binational Science Foundation

William G. Rosen, who has served as head of the Mathematical Sciences Section of NSF since 1979 has assumed a new position as Deputy Executive Director, U.S.-Israel Binational Science Foundation, Jerusalem, Israel.

(e) the summaries should be expressed, insofar as possible, in language that can be understood by a scientifically literate reader.

Summaries of awards will be published. **Proposals with summaries which are too short, unintelligible, or otherwise inappropriate will be returned.** Delays can be avoided by paying careful attention to this important element of the proposal.

Recent Ph.D. recipients should be aware of the difficulties faced by reviewers in commenting on the applicant's ability to complete the proposed research and focus on the elements of good proposal writing, whether applying alone or together with others. These include a clear description of proposed research and of methods to be used, as well as evidence of past research accomplishments. With each copy of the proposal include summaries of theses and preprints of completed research not yet available in readily accessible journals. Junior investigators are urged to show drafts of their proposals to experienced senior members of their department for comment.

In addition, each proposal should contain:

(1) a full description of all other current research support or pending applications for such, for all proposed investigators. In case there is no other support and no other application is pending or contemplated, the proposal must contain an unequivocal and explicit statement to that effect (e.g., "None of the listed investigators has any other research support and no other application is pending or contemplated"). This must include all possible sponsors, not just NSF;

(2) in requests for renewed support, reference to the previous award should include a summary of what was proposed, what was accomplished, and what tasks remain. Estimates both of total expenditures and commitments under the existing award up to the new starting date and of the projected residual balance, if any, must be included;

(3) justification for unusual items of support; in particular this should be done in requests for partial support of sabbatical leaves, dedicated computation equipment, etc.;

(4) a bibliography of important publications relevant to the proposed research; and

(5) *curricula vitae* of the proposed investigators, including for each, a chronological list of publications.

The telephone numbers of the department and the principal investigator(s) should be listed. Inclusion of the principal investigator's home telephone number has proved to be particularly useful.

Checklist for proposal submission:

- Cover page (use requested format)
- Appropriate boxes on cover page checked
- All required signatures (principal investigator, co-principal investigators, and organizational)
- Table of contents
- Project summary
- Summary of progress to date and its relation to proposed work (renewals only)
- For each investigator:
 - Detailed description of proposed research
 - Bibliography of pertinent literature
 - Curriculum vitae*
 - Current list of main publications of senior personnel (major publications currently in press may be listed)
- Budget in requested format
- Current and pending support statement
- List or description of available facilities and major items of equipment to be used in the proposed research
- Required number of copies of the proposal, including the original signed copy
- Residual Funds Statement, if required

Ten copies of the proposal and any attachments should be addressed to: Data Support Services Section, National Science Foundation, Washington, D.C. 20550. Program officers can be reached by calling 202-357-9764.

William G. Rosen, Head
Mathematical Sciences Section

Proposals for Regional Conferences in the Mathematical Sciences

The National Science Foundation is seeking proposals from prospective host institutions in the U.S. for five-day regional conferences, each to feature 10 lectures by a distinguished guest lecturer on a subject of current research interest in the mathematical sciences. Topics for conferences may be concerned with any of the subdisciplines of the mathematical sciences. An applying institution should have at least a minimal research competence in the area of its proposal. The conferences should be planned for a summer week in 1983 (not earlier than May 1) or held during a recess in the succeeding academic year. The objective of the project is to stimulate and broaden mathematical research activity. The organization of the conferences, evaluation of proposals, and arrangements for publication of expository papers based on the guest speakers' lectures are expected to be carried out by the Conference Board of the Mathematical Sciences under contract with the Foundation. The conference awards themselves, however, are made by the NSF.

Each conference must plan for a single principal guest lecturer from outside the host institution and about twenty-five other participants. It is expected that the lecturer will give two lectures per day during the five days of the conference, with the remainder of the time available for study, informal discussion, and exchange of ideas.

Participants in a conference receive allowances for travel and subsistence under the host institution's grant from the Foundation for the

conference. In addition, the principal lecturer receives from the Conference Board a fee for delivering his lectures and second fee for organizing these into a substantial expository paper. The Conference Board arranges for editing and publication of these papers.

Proposals by prospective host institutions (twenty copies) should be sent directly to Data Support Systems Branch, National Science Foundation, 1800 G Street, N.W., Washington, D.C. 20550, and must be received by November 15, 1983. Proposals will be evaluated by a panel of the Conference Board and awards of conference grants will be made by the National Science Foundation with advice of the panel.

During most of the eleven years since the establishment of the regional conference program, many more proposals of very high quality were submitted to the NSF than could be funded. This seems to have led to a certain degree of unevenness from year to year in the number of high-quality proposals submitted. It is to be hoped that a sufficient number of very high quality proposals will be submitted this year, including updates of some of those which, for some reason, could not be funded previously.

Inquiries regarding details of proposals for these regional conferences should be addressed to the Conference Board of the Mathematical Sciences, 1529 Eighteenth Street, N.W., Washington, D.C. 20036.

Presidential Young Investigator Awards Program Announced by NSF

A new program of research awards to the nation's most outstanding and promising young science and engineering faculty members, initiated by the National Science Foundation at the request of President Reagan, is expected to help universities meet a wide demand for highly qualified personnel for academic and industrial research and for teaching.

The Presidential Young Investigator Awards will provide cooperative research funds from \$25,000 to \$100,000 per year for up to five years to a maximum of 200 young science and engineering faculty members each year. "Young" in this case means faculty members who are no more than seven years beyond receiving the doctorate degree. The program is aimed at providing the incentive to remain on campus to those top quality faculty members who would educate the students needed by industry. The program calls for cooperative funding by the industrial sector.

Minimum awards will consist of \$25,000 of Foundation funds. To help forge strong links between the academic and industrial sectors, NSF will provide additional funds of up to \$37,500 on a dollar-for-dollar matching basis for contributions from industrial sources. The institutions concerned will be responsible for

providing full academic-year salary for each awardee and arranging for the industrial support.

NSF expects that in the first year up to 100 awards will be made in engineering fields, up to 60 in mathematical and physical sciences, up to 25 in the biological sciences and up to 15 in the astronomical, atmospheric, earth and ocean sciences.

U.S. institutions granting doctorates in fields supported by NSF may nominate outstanding faculty members who have received their doctorates after September 1, 1976 and who hold full-time, regular appointments in tenure-track or tenure positions when nominated. Graduate and post-doctoral students who have accepted appointments to such positions may also be nominated. Nominations are open to citizens or nationals of the United States and permanent residents of the U.S.

Individuals nominated may conduct research in any branch of the mathematical, physical, and biological sciences and engineering. NSF will emphasize those fields where there are substantial needs for faculty development.

For further information write Presidential Young Investigator Awards, National Science Foundation, Room 414, Washington, DC 20550; 202-357-7536. *-NSF News Release*

New Submission Deadlines for the Scandinavia and The Netherlands Cooperative Science Program

The U.S.-Scandinavia and The Netherlands programs have announced new submission deadlines for proposals. For proposals to be funded on or after March 1, 1984, the deadline is September 1, 1983. Program guidelines should be requested before submitting proposals. Further information and guidelines may be obtained from the U.S.-Scandinavia and The Netherlands Cooperative Science programs; 202-357-7554.

-NSF Bulletin

Cooperative Research with Eastern Europe

NSF's Eastern Europe Cooperative Science programs seek to foster and support scientific and technological cooperation between the U.S. and Bulgaria, Hungary, and Romania.

The program offers financial support for three types of activities: cooperative research projects, seminars and workshops, and scientific visits for planning purposes.

Proposals must be submitted to NSF by American institutions, and to the appropriate foreign agency by foreign institutions. Proposals should be prepared according to standard NSF guidelines, but must also contain a section on "International Cooperation," which describes the cooperative aspects of the work plan and the mutual benefits to be obtained. Proposals for joint research should be submitted at least nine months before the requested starting date; for seminars twelve months, and for short-term visits, six months.

For further information, write or phone Deborah Wince, Division of International Programs; 202-357-9516. *-NSF Bulletin*

Establishment of the U.S.-India Initiative Program Office

A U.S.-India Initiative Program Office has been established to coordinate related U.S. agency activities, develop integrated agency approaches, set priorities within available funding and provide overall management of the program.

Further information may be obtained from Roger Doyon, Head, Africa and Asia Section; 202-357-9550. *-NSF Bulletin*

Positions Open in NSF

Applicants for the following positions should submit résumés to NSF, Personnel Administration Branch, Room 212, 1800 G Street, N.W., Washington, D.C. 20550, Attn: E. Paul Broglio; 202-357-7840. NSF is an Equal Opportunity Employer.

NSF's Division of Mathematical and Computer Sciences is seeking qualified applicants for positions which periodically become available in computer research. The positions will be filled on a one- or two-year rotational basis and are excepted from the competitive civil service. The salaries range from \$34,930 to \$63,115 per annum (GS-13/14/15 equivalent). One anticipated opening in academic year 1983-1984 will be in the field of Intelligent Systems. Applicants should have a Ph.D. or equivalent experience and training in an appropriate field, plus six years of successful scientific research experience. A broad general knowledge of computer research and some administrative experience are also required.

-NSF Bulletin

Queries

Edited by Hans Samelson

QUESTIONS ARE WELCOMED from AMS members regarding mathematical matters such as details of, or references to, vaguely remembered theorems, sources of exposition of folk theorems, or the state of current knowledge concerning published or unpublished conjectures.

REPLIES from readers will, when appropriate, be edited into a composite answer and published in a subsequent column. All answers received will be forwarded to the questioner.

QUERIES and RESPONSES should be typewritten if at all possible and sent to Professor Hans Samelson, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940.

Queries

280. Howard Kleiman (Department of Mathematics, Queensborough Community College (CUNY), Bayside, New York 11364). Does there exist in the literature a polynomial-time mapping of "the traveling salesman" problem onto the problem of obtaining a hamilton circuit in a directed graph?

281. Abdel-Raouf A. H. Omar (P. O. Box 2807, Cairo 11511, Egypt). If a primitive group G has at least one nontrivial block system with length m for each nontrivial divisor m of the degree of G , the group G is called a superimprimitive group. In the $(2, 3, 6k)$ -subgroups of the symmetric group of degree $6k$, where the generators of the subgroups are fixed point free, there is only one conjugate class of superimprimitive subgroups for $k = 1, 3$, and 5 (by direct computation). Does anyone have suggestions to prove it for any odd value of the integer k ?

282. John Banks (Division of Natural Sciences, University of California, Santa Cruz, California 95064). What is the state of the problem of finding the number of nonisomorphic hamiltonian cycles of the n -cube (see E. N. Gilbert, *Gray codes and paths on the n -cube*, Bell Systems Tech. J. **37** (1958), 815–826). I am interested in the general solution as well as the case when $n = 5$. I would greatly appreciate any information about attempts to solve it, whether or not these attempts were computer assisted.

283. Michael K. Mills (1548 Fincroft Drive, Claremont, California 91711). Has any work been done in the calculus of indications since G. Spencer-Brown's *Laws of form*?

Responses

The editor would like to thank all those who sent in replies.

271. (vol. 30, p. 302, April 1983, Jean Paul Van Bendegem) Is there any information about Alexander Yessenin-Volpin [A. S. Esenin-Vol'pin] available? **Reply:** In 1954, Esenin-Vol'pin published *Nedokazymost' gipotezy Suslina bez pomoshchi aksiomy vybora v sisteme aksiom Bernaisa-Mostovskogo* in Dokl. Akad. Nauk **96** (1954), 9–12; a translation, as I am certain you are aware,

appears in the AMS Translations, Series 2, vol. **23** (1963), 83–88, as *The unprovability of Suslin's hypothesis without the aid of the axiom of choice in the Bernays-Mostowski axiom system*. (This bibliographic information is obtainable in Gregory H. Moore, *Zermelo's axiom of choice: its origins, development, and influence*, Springer-Verlag, New York, Heidelberg, Berlin, 1982.) (Contributed by Irving H. Anellis)

273. (vol. 30, p. 302, April 1983, David Mescheloff) Is there an analytic expression for inverting $y = x + \sin x$, in particular near π ? **Reply:** This is essentially the Kepler equation for $\epsilon = 1$. There are standard solutions (Kapteyn series), sine series whose coefficients involve values of Bessel functions. One can also develop ad hoc Puiseux expansions. Details available from the Queries column. (Contributed by N. Grossman and W. A. J. Luxemburg)

The Multiple Stochastic Integral

David Douglas Engel

Norbert Wiener laid down the foundation of the theory of stochastic integration in his classic papers on homogeneous chaos and discrete chaos (which are now called Brownian motion and the Poisson process, respectively). Modern researchers find these papers difficult to read and even more difficult to relate to today's viewpoint of stochastic integration. The Multiple Stochastic Integral is an attempt to show the beauty and simplicity of the original theories and how they provide a geometric interpretation of many of the well-known formulas involving stochastic integrals. This is accomplished by employing certain Banach space valued measures on \mathbf{R}^n which yield the desired stochastic integrals when evaluated on appropriate subsets.

1980 *Mathematics Subject Classifications*. 60H05; 28A35, 28B05, 28C20

Memoirs of the American Mathematical Society
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Bulletin of the AMS

During a recent trip to the United States, I have been told that the idea of publishing research-expository papers in the *Bulletin* is under review and discussion, the experience started with the New Series not being considered entirely satisfactory.

I was astounded and dismayed by this. In my view, the research expository papers of the *Bulletin* have been the most successful editorial experience, and the most useful contribution to the dissemination and advancement of mathematical knowledge, in the past twenty years. Together with the book reviews, they have turned the *Bulletin* into the most readable and useful mathematical journal there is today. I became a member of the AMS to have a subscription to the *Bulletin*.

Let me stress that:

- (a) research-expository papers are useful;
- (b) without the *Bulletin* they would not exist.

Point (b) is easily proved. No other journal has a systematic policy of publishing research-expository papers. Nor is it only a matter of publishing, as if such papers were just lying around, waiting for an outlet. The truth is that they would not even be written if the editorial policy of the AMS, and the prestige of the *Bulletin*, did not put beyond doubt the importance of this kind of work, and the interest of the mathematical community in it. Moreover, we are all carried away by our own spade work; to step aside for a moment and try to get an overview of the field requires quite an effort, all the more so if you are supposed to guide a tour, and very few of us would do so without external solicitation. I myself would never have written the survey on *Nonconvex minimization problems* if I had not been asked to do it—not to mention the constant proddings of the editors while it was in the works.

Point (a) seems to me beyond dispute. We are flooded with research papers which no one dreams of reading outside the narrow circle of specialists, and which widen the gap between the various branches of mathematics, thereby slowing down the progress of science. Now, asking a knowledgeable person to write a survey paper has several beneficial effects:

- (1) it will make the main results and methods available to people in other domains, and perhaps introduce newcomers into the field, thereby furthering the unity of mathematics, and promoting the cross-exchanges which are so fundamental to progress in science;

- (2) it will pinpoint the open problems and assess their importance, thereby calling attention to them.

Note that we make a living by writing about what we know. But, for a scientist, what is *not* known is much more important than what is known, because it is a problem to be solved. Unfortunately, textbooks and research papers all describe what is known, and information about open problems is usually transmitted by word of mouth among the experts. Even experts sometimes believe that problems have been solved which in fact are still open (see the survey by Bass, Connell and Wright on the Jacobian conjecture).

Only in a survey (research-expository) paper will we describe at length a problem we consider important, but have no idea how to solve. If such problems are stated clearly, for everyone to see, the whole field is seen in better perspective, and they might even get solved, as, I believe, has been the case with some problems in the classification of finite groups which appeared in Gorenstein's survey.

Personally, I have always found the research-expository papers of the *Bulletin* very readable and enjoyable. I feel confident I will never work in commutative algebra or number theory, for instance, but I am glad I have been told about the Jacobian conjecture and elementary methods in the distribution of prime numbers.

These papers have also had an impact on my day-to-day research. Take, for instance, Bott's survey: *Morse theory, old and new*. Bott makes the point that the analyst's approach to equivariant Morse theory, when there is an underlying symmetry group, is wrong, and suggests another one from his experience as a topologist. I have used the first approach in several papers, but after reading Bott's survey, I agree with him, and will switch to the one he suggests.

Recently, after hearing a seminar which particularly interested me, I went to the lecturer and asked for background information. The answer was "Just read Sullivan's survey in the *Bulletin*." This is the kind of positive answer I like to hear, which does not send you back to twenty papers scattered in the literature with incompatible notations or to the lecturer's unwritten book. It was made possible by a deliberate editorial policy, and I hope you keep it up.

Ivar Ekeland
Université de Paris-
Dauphine

South Africa

Peter Hilton's recent tour of South Africa was undertaken on behalf of their mathematical community, of course, not as a gesture of support for their regime. Now you have published his letter exposing the hypocrisy of those who would rationalize their attendance at the Warsaw Congress by similar arguments. Lengthy citations of detail would be meaningless; the differences between the two states are qualitative rather than quantitative, as between razor-blade apples and mercury oranges. I will only thank Professor Hilton for his firm display of principle. Better late than never.

Robert Wake
University of California,
Santa Cruz

Policy on Letters to the Editor

Letters submitted for publication in the *Notices* are reviewed by the Editorial Committee, whose task is to determine which ones are suitable for publication. The publication schedule requires from two to four months between receipt of the letter in Providence and publication of the earliest issue of the *Notices* in which it could appear.

Publication decisions are ultimately made by majority vote of the Editorial Committee, with ample provision for prior discussion by committee members, by mail or at meetings. Because of this discussion period, some letters may require as much as seven months before a final decision is made.

The committee reserves the right to edit letters.

The *Notices* does not ordinarily publish complaints about reviews of books or articles, although rebuttals and correspondence concerning reviews in the *Bulletin of the American Mathematical Society* will be considered for publication.

Letters should be mailed to the Editor of the *Notices*, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, and will be acknowledged on receipt.



MATHEMATICAL SURVEYS AND MONOGRAPHS

ESSENTIALS OF BROWNIAN MOTION AND DIFFUSION

by Frank B. Knight

This work was first-drafted five years ago but it was never used for its original purpose. The first half of the work is little changed from the original, a fact which may partly explain both the allusions to applications and the elementary approach. It was written to be understood by a reader having minimal familiarity with continuous time stochastic processes. The most advanced prerequisite is a discrete parameter martingale convergence theorem.

General summary and outline:

0. Introduction. Some gratuitous generalities on scientific method as it relates to diffusion theory.

1. Brownian motion is defined by the characterization of P. Lévy. Then it is constructed in three basic ways and these are proved to be equivalent in the appropriate sense. Uniqueness theorem.

2. Projective invariance and the Brownian bridge presented. Probabilistic and absolute properties are distinguished. Among the former: the distribution of the maximum, first passage time distributions, and hitting probabilities. Among the latter: law of iterated logarithm, quadratic variation, Hölder continuity, non-recurrence for $r \geq 2$.

3. General methods of Markov processes adapted to diffusion. Analytic and probabilistic methods are distinguished. Among the former: transition functions, semigroups, generators, resolvents. Among the latter: Markov properties, stopping times, zero-or-one laws, Dynkin's formula, additive functionals.

4. Classical modifications of Brownian motion.

Absorption and the Dirichlet problem. Space-time process and the heat equation. Killed processes, Green functions, and the distributions of additive functionals. Time-change theorem (classical case), parabolic equations and their solution semigroups, some basic examples, distribution of passage times.

5. Local time: construction by random walk embedding. Local time processes. Trotter's theorem. The Brownian flow. Brownian excursions. The zero set and Lévy's equivalence theorem. Local times of classical diffusions. Sample path properties.

6. Boundary conditions for Brownian motion. The general boundary conditions. Construction of the processes using local time. Green functions and eigenfunction expansions (compact case).

7. This chapter is a "finale" on nonsingular diffusion. The generators $(d/dm)(d^+/dx^+)$ are characterized. The diffusions on open intervals are constructed. The conservative boundary conditions are obtained and their diffusions are constructed. The general additive functionals and nonconservative diffusions are developed and expressed in terms of Brownian motions.

The audience for this survey is anyone who desires an introduction to Markov processes with continuous paths which is both coherent and elementary. The approach is from the particular to the general. Each method is first explained in the simplest case and supported by examples. Therefore, the book should be readily understandable to anyone with a first course in measure-theoretic probability.

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Election Information

The ballots for election of members of the Council and Board of Trustees of the Society for 1984 will be mailed on or shortly after August 29, in order for members to receive their ballots well in advance of the November 10 deadline. Prior to casting their ballots members are urged to consult the following articles and sections of the Bylaws of the Society: article I, section 1; article II, sections 1, 2; article III, sections 1, 2, 3; article IV, sections 1, 2, 4; article VII, sections 1, 2, 5. The complete text of the Bylaws appears on pages 646-649 of the November 1981 issue of the *Notices*. A list of the members of the Council and Board of Trustees serving terms during 1983 appears in the **AMS Reports and Communications** section of this issue.

SUGGESTIONS FOR 1984 NOMINATIONS

Each year the members of the Society are given the opportunity to propose for nomination the names of those individuals they deem both qualified and responsive to their views and needs as part of the mathematical community. Candidates will be nominated by the Council to fill positions on the Council and Board of Trustees to replace those whose terms expire December 31, 1984. See the **AMS Reports and Communications** section of this issue for the list of current members of the Council and Board of Trustees. Members are requested to write their suggestions for such candidates in the appropriate spaces on the form in the next column.

REPLACEMENT BALLOTS

This year ballots for the AMS election will be mailed August 29, 1983 or within a day or two thereafter. The deadline for receipt of ballots in Providence is November 10, 1983.

There has been a small but recurring and distressing problem concerning members who state that they have not received ballots in the annual election. It occurs for several reasons, including failure of local delivery systems on university or corporate properties, failure of members to give timely notice of changes of address to the Providence office, failures of postal services, and other human errors.

To help alleviate this problem, the following replacement procedure has been devised: A member who has not received a ballot by October 10, 1983, or who has received a ballot but has accidentally spoiled it, may write after that date to the Secretary of the AMS, Post Office Box 6248, Providence, RI 02940, asking for a second ballot. The request should include the individual's member code and the address to which the replacement ballot should be sent. Immediately upon receipt of the request in the Providence office, a second ballot, which will be indistinguishable from the original, will be sent by first class mail. It must be returned in an inner envelope, which will be supplied, on the outside of which is the following statement to be signed by the member:

The ballot in this envelope is the only ballot that I am submitting in this election. I understand that if this statement is not correct then no ballot of mine will be counted.

signature

Although a second ballot will be supplied on request and will be sent by first class mail, the deadline for receipt of ballots will not be extended to accommodate these special cases.

SUGGESTIONS FOR 1984 NOMINATIONS

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Member of the *Mathematics of Computation* Editorial Committee (1)

Member of the *Proceedings* Editorial Committee (1)

Members of the Committee to Monitor Problems in Communication (2)

Members-at-large of the Council (5)

Member of the Board of Trustees (1)

The completed form should be addressed to AMS Nominating Committee, Post Office Box 6248, Providence, RI 02940, to arrive no later than **November 10, 1983**.

Albany Meetings, August 8–11, 1983

Program

The August 1983 Joint Mathematics Meetings, including the 87th summer meeting of the American Mathematical Society, the 63rd summer meeting of the Mathematical Association of America, and the 1983 annual meeting of Pi Mu Epsilon, will be held August 8–11, 1983 (Monday–Thursday), at the State University of New York, Center at Albany. The meetings will be preceded by the AMS Short Course on August 6 and 7 (Saturday and Sunday). Sessions will take place on the campus of the State University of New York, Center at Albany.

The members of the Local Arrangements Committee are Lindsay N. Childs (publicity director), William W. Fairchild, Richard Z. Goldstein (chairman), Timothy L. Lance, Violet Larney, William J. LeVeque (ex officio), David P. Roselle (ex officio), Hugo Rossi (ex officio), B. David Saunders, Edward S. Thomas, Edward C. Turner, and Nura D. Turner.

87th Summer Meeting of the AMS August 8–11, 1983

Colloquium Lectures

A series of four Colloquium Lectures will be presented by BERTRAM KOSTANT of the Massachusetts Institute of Technology at 1:00 p.m., Monday through Thursday, August 8–11. The title of this lecture series is *On the Coxeter element and the structure of the exceptional Lie groups*.

Steele Prizes

The 1983 Leroy P. Steele Prizes will be awarded at a session at 4:45 p.m. on Wednesday, August 10.

Invited Addresses

By invitation of the AMS Program Committee, there will be eight invited one-hour addresses. The list of speakers, their affiliations and titles, and the dates and times of the talks follow:

SELMAN AKBULUT, Michigan State University, *The topology of real algebraic sets*, 2:15 p.m. Wednesday; JAMES EELLS, University of Warwick, England, *Harmonic maps of Riemann surfaces*, 8:30 a.m. Monday; ROBERT C. GUNNING, Princeton University, *Riemann surfaces and their associated Wirtinger varieties*, 5:00 p.m. Monday; LEO A. HARRINGTON, University of California, Berkeley, *Reverse mathematics*, 8:30 a.m. Wednesday; IRA W. HERBST, University of Virginia, *The Schrödinger equation*, 9:45 a.m. Wednesday; HERVÉ JACQUET, Columbia University, *On the residual spectrum of the linear group*, 2:15 p.m. Tuesday; J. H. B. KEMPERMAN, University of Rochester, *Functional equations over a group, and the mean value property*, 3:30 p.m. Wednesday; and WEN-CH'ING WINNIE LI, Pennsylvania State University, University Park, *Fourier transforms and representations of general linear groups*, 11:00 a.m. Monday.

Special Sessions

By invitation of the same committee, there will be eleven special sessions of selected twenty-minute

The Albany meetings will repeat an experiment tried for the first time at the Toronto meetings in August of 1982, in that the program will be "joint" in a stronger sense than before. AMS and MAA sessions will run concurrently and simultaneously, and the meetings have been shortened from five days to four. In order to evaluate the effects of this new type of program, a questionnaire will be distributed to all registrants at the Albany meetings requesting opinions and comments. A central location will be established for the collection of these questionnaires at the meeting registration desk. It is hoped that all participants will find time to respond, since this information will be a valuable guide in future planning of summer meetings.

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IMPORTANT DEADLINES

AMS Abstracts,	
For consideration for special sessions	Expired
Of contributed papers	Expired
MAA Abstracts	
Of contributed papers	Expired
Summer List of Applicants	Expired
Preregistration and Housing	Expired
Housing cancellations (full refund)	July 15
Housing cancellations (partial refund)	After July 15
Motions for AMS Business Meeting	July 10
Preregistration cancellations (50% refund)	August 5
Dues credit for nonmembers/students	September 11

Population Biology

Albany, New York, August 6-7, 1983

The American Mathematical Society, in conjunction with its eighty-seventh summer meeting, will present a one and one-half day short course titled *Population Biology* on Saturday and Sunday, August 6 and 7, 1983, at the State University of New York, Center at Albany. The program is under the direction of Simon A. Levin of Cornell University.

Population biology is probably the oldest area in mathematical biology, but remains a constant source of new mathematical problems and the area of biology best integrated with mathematical theory. The need for mathematical approaches has never been greater, as evolutionary theory is challenged by new interpretations of the paleontological record and new discoveries at the molecular level, as world resources for feeding populations become limiting, as the problems of pollution increase, and as both animal and plant epidemiological problems receive closer scrutiny.

The purpose of this course is to acquaint the participant with the mathematical ideas that pervade almost every level of thinking in population biology. The mathematical methods to be discussed include dynamical systems theory, partial differential equations, stochastic processes, matrix algebra, control theory and optimization, game theory, and differential geometry.

Synopses of the talks and accompanying reading lists appeared in the April issue of the *Notices*, pages 350 and 351. A basic knowledge of ordinary and partial differential equations, linear algebra, and probability theory will be assumed. Other mathematical methods to be discussed will be drawn from stochastic processes, control theory and optimization, game theory, and differential geometry. Background reading may be found in *Studies in mathematical biology*, Part II: *Populations and communities*, Simon A. Levin, editor, Volume 16 in *Studies in Mathematical Biology*, MAA, 1978. The reading lists also give a variety of sources for study prior to the course.

The course will consist of six 60-minute lectures and interpolatory material by Simon A. Levin. Ethan Akin (City College, CUNY) will speak about evolution, game theory and economics, James C. Frauenthal (Bell Laboratories, Holmdel) about population dynamics and demography, Wayne M. Getz (University of California, Berkeley) about optimal control theory in population biology, Thomas Nagylaki (University of Chicago) about mathematical population genetics, George Sugihara (Oak Ridge National Laboratory) about graph theory and food webs, and James A. Yorke (University of Maryland) about epidemiology. Simon A. Levin will supplement with material on models of population dispersal, and on the theory of evolution of interacting populations.

The short course is open to all who wish to participate upon payment of the registration fee. There are reduced fees for students and unemployed individuals. Please refer to the section titled **Registration at the Meetings** for details.

The short course was recommended by the Society's Committee on Employment and Educational Policy, whose members are Lida K. Barrett, Lisl Novak Gaal, Irwin Kra, Robert W. McKelvey, Donald C. Rung (chairman), and Barnet M. Weinstock. The short course series is under the direction of the CEEP Short Course Subcommittee, whose members are Stefan A. Burr (chairman), Robert W. McKelvey, Cathleen S. Morawetz, Barbara L. Osofsky, and Philip D. Straffin, Jr.

papers. The topics of these special sessions, the names and affiliations of the mathematicians arranging them, the days and times they will meet, and lists of speakers, are as follows:

The calculus of variations in the large and its applications, MEL S. BERGER and ALEXANDER EYDELAND, University of Massachusetts, Amherst, 2:00 p.m. Wednesday; 8:30 a.m. and 1:00 p.m. Thursday. F. Almgren, Charles J. Amick, Mel S. Berger, Kung-chin Chang, Alexander Eydeland, L. E. Fraenkel, George H. Knightly, Wei-Ming Ni, Martin Schechter, Jean E. Taylor, and Michael I. Weinstein.

Dynamical systems, LOUIS BLOCK, University of Florida, 1:00 p.m. Wednesday; 8:00 a.m. and 1:00 p.m. Thursday. Steve Batterson, Chris Bernhardt, Philip Boyland, Sue Goodman, Glen R. Hall, David Hart, Chung-wu Ho, Mike Hurley, Tien-Yien Li, Michael Maller, R. McGehee, Kenneth Meyer, John Milnor, Dennis Pixton, Clark Robinson, Stephen Schechter, James Selgrade, Russell B. Walker, R. F. Williams and Helena S. Wisniewski.

Ergodic theory concerning point transformations with finite invariant measure, NATHANIEL A. FRIEDMAN, SUNY, Center at Albany, 2:15 p.m. Monday and 9:00 a.m. Tuesday. Alexandra Bellow, Jane M. Hawkins, Roger L. Jones, Nelson G. Markley, N. F. G. Martin, Kyewon Park, Karl Petersen, V. S. Prasad, William L. Reddy, Robert Sine, and Sherman Wong.

Tensor products and p -summing operators in harmonic analysis, COLIN C. GRAHAM, Northwestern University, and BERTRAM SCHREIBER, Wayne State University, 2:15 p.m. Monday and 9:15 a.m. Tuesday. John J. F. Fournier, Colin C. Graham,

D. Hajela, Michael B. Marcus, Cora Sadosky, Bertram M. Schreiber, Brent Smith, and Martin Walter.

Applications of algebraic topology, TIMOTHY L. LANCE, SUNY, Center at Albany, 3:00 p.m. Wednesday and 8:30 a.m. Thursday. Douglas R. Anderson, Paul Baum, Michael Chisholm, David Handel, Norman Levitt, Jack Morava, and Mark Steinberger.

Automorphic functions and automorphic representations, WEN-CH'ING WINNIE LI, Pennsylvania State University, University Park, 2:15 p.m. Monday and 8:00 a.m. Tuesday. A. O. L. Atkin, Solomon Friedberg, Paul Gerardin, Guy Henniart, Martin L. Karel, Wen-Ch'ing Winnie Li, Carlos Julio Moreno, I. Piateckii-Shapiro, Arnold K. Pizer, Steve Rallis, and Stephen V. Ullom.

Several complex variables, R. MICHAEL RANGE, SUNY, Center at Albany, 2:15 p.m. Tuesday; 1:00 p.m. Wednesday; 8:00 a.m. and 1:00 p.m. Thursday. H. Alexander, Frank Beatrous, Steve Bell, Daniel M. Burns, Jr., Joseph Cima, John P. D'Angelo, Frank Farris, B. L. Fridman, Daryl Geller, C. Robin Graham, J. J. Kohn, John M. Lee, Ngaiming Mok, Hugo Rossi, Walter Rudin, Jerzy Ryczaj, Bernard Schiffman, Yum-Tong Siu, David S. Tartakoff, Boguslaw Thomaszewski, Sidney M. Webster, John Wermer, Paul Yang, and William R. Zame.

Summability methods, BILLY E. RHOADES, Indiana University, Bloomington, 9:00 a.m. and 1:00 p.m. Thursday. Wolfgang Beekmann, Shao-Chien Chang, David Borwein, Martin G. Buntinas, J. DeFranza, Allen R. Freedman, Billy E. Rhoades, William H. Ruckle, J. J. Sember, Bruce L. R. Sawyer, A. K. Snyder, and Albert Wilansky.

Solutions of operator equations and fixed points, V. M. SEHGAL, University of Wyoming, and S. P. SINGH, Memorial University, Newfoundland, 2:15 p.m. Tuesday; 2:15 p.m. Wednesday; and 1:00 p.m. Thursday. M. Altman, David G. Bourgin, Patrick M. Fitzpatrick, Gilles Fournier, W. A. Kirk, Anthony To-Ming Lau, Teck-Cheong Lim, Mario Martelli, M. Zuhair Nashed, W. V. Petryshyn, L. B. Rall, Simeon Reich, V. M. Sehgal, K. L. Singh, S. P. Singh, and S. Thomeier.

Differential analysis in infinite dimensional spaces, SRINIVASA SWAMINATHAN, Dalhousie University, 2:15 p.m. Monday; 2:15 p.m. Tuesday; and 2:15 p.m. Wednesday. Mel S. Berger, Sean Dineen, E. P. Hamilton, M. P. Heble, Boris Mityagin, Louis D. Nel, C. C. A. Sastri, T. N. Subramanian, K. Sundaresan, and Kok-Keong Tan.

Topological methods in combinatorial group theory, EDWARD C. TURNER, SUNY, Center at Albany, 8:20 a.m. and 2:15 p.m. Tuesday. A. M. W. Glass, Guenther Huck, R. Kramer, Alexander Lubotzky, Darryl McCullough, Allan J. Sieradski, Craig Squier, John R. Stallings, Marvin Tretkoff, and Thomas W. Tucker.

April 26 was the deadline for submission of abstracts for consideration for inclusion in these special sessions.

Committee on the Agenda for Business Meetings

The Society has a Committee on the Agenda for Business Meetings. The purpose is to make Business Meetings orderly and effective. The committee does not have legal or administrative power. It is intended that the committee consider what may be called "quasi-political" motions. The committee has several possible courses of action on a proposed motion, including but not restricted to

- (a) doing nothing;
- (b) conferring with supporters and opponents to arrive at a mutually accepted amended version to be circulated in advance of the meeting;
- (c) recommending and planning a format for debate to suggest to a Business Meeting;
- (d) recommending referral to a committee;
- (e) recommending debate followed by referral to a committee.

There is no mechanism that requires automatic submission of a motion to the committee. However, if a motion has not been submitted through the committee, it may be thought reasonable by a Business Meeting to refer it rather than to act on it without benefit of the advice of the committee.

The committee consists of Everett Pitcher (chairman), Marian B. Pour-El, David A. Sanchez, and Guido L. Weiss.

In order that a motion for the Business Meeting of August 10, 1983 receive the service offered by the committee in the most effective manner, it should have been in the hands of the secretary by July 11, 1983.

Everett Pitcher, Secretary

Contributed Papers

There will be sessions for contributed papers on Monday at 2:15 p.m., Tuesday at 8:20 a.m. and 2:15 p.m., Wednesday at 2:15 p.m., and Thursday at 8:30 a.m. **The deadline for submission of abstracts of contributed papers was May 17. Late papers will not be accepted.**

Council Meeting

The Council of the Society will meet at 5:00 p.m. on Sunday, August 7, in the Squire Room of the Ramada Inn.

Business Meeting

The Business Meeting of the Society will take place immediately following the Steele Prize Session on Wednesday, August 10. The secretary notes the following resolution of the Council: Each person who attends a Business Meeting of the Society shall be willing and able to identify himself as a member of the Society. In further explanation, it is noted that *each person who is to vote at a meeting is thereby identifying himself as and claiming to be a member of the American Mathematical Society.* For additional information on the Business Meeting, please refer to the announcement titled Committee on the Agenda for Business Meetings.

63rd Summer Meeting of the MAA August 8–11, 1983

Business Meeting

The Business Meeting of the MAA will take place at 4:30 p.m. on Tuesday, August 9, at which the Carl B. Allendoerfer, Lester R. Ford, and George Pólya awards will be presented.

Board of Governors

The MAA Board of Governors will meet at 9:00 a.m. on Sunday, August 7, in the Squire Room of the Ramada Inn.

Hedrick Lectures

The 32nd Earle Raymond Hedrick Lectures will be given by ELIAS M. STEIN of Princeton University. The title of this series of three lectures is *Some ideas in the development of Fourier analysis.* These lectures will be given at 11:00 a.m. on Tuesday, Wednesday, and Thursday, August 9–11.

Invited Addresses

There will be nine invited fifty-minute addresses. The list of speakers, their affiliations, the dates and times of the talks, and titles follow:

HAROLD M. EDWARDS, New York University, Courant Institute of Mathematical Sciences, *Galois' version of Galois theory*, 2:00 p.m. Thursday; BRANKO GRÜNBAUM, University of Washington *Have you ever met a polyhedron you did not like?* 9:50 a.m. Tuesday; ROBERT HERMANN, University of Texas, Austin, *Theoretical and experimental contributions to the development of*

a science of vehicular traffic, 1:00 p.m. Wednesday; KATHERINE P. LAYTON, Beverly Hills High School, *Progress report of the Commission on Precollege Education in Mathematics, Science, and Technology*, 8:40 a.m. Thursday; RICHARD LEWONTIN, Harvard University, *Analysis of complex genetic systems*, 2:15 p.m. Tuesday; THOMAS H. MACGREGOR, State University of New York, Center at Albany, *Convexity ideas in geometric function theory*, 9:40 a.m. Thursday; BARBARA L. OSOFSKY, Rutgers University, New Brunswick, *Some connections between algebra and set theory*, 8:40 a.m. Thursday; CARL POMERANCE, University of Georgia, *Primality testing*, 1:00 p.m. Thursday; and ALAN SCHOENFELD, University of Rochester, *Understanding and teaching problem-solving skills*, 8:40 a.m. Tuesday.

Other MAA Sessions

The MAA Committee on Exchange of Information in Mathematics will sponsor an evening session at 8:00 p.m. on Tuesday, August 9, on *The MAA newsletters: A dialogue among editors*, featuring *Focus* editor, MARCIA P. SWARD. Also participating in the session will be various section newsletter editors and public information officers.

Minicourses

The MAA is planning six Minicourses, as follows:

Minicourse #1: *PASCAL for Mathematicians*, organized by HARLEY FLANDERS, Florida Atlantic University. Given from 7:30 p.m. to 9:30 p.m. on Monday, August 8, and on Tuesday, August 9. The course is aimed at mathematicians who do not presently (or can barely) program in PASCAL, but who have access to PASCAL on a microcomputer or larger system. No previous knowledge of PASCAL or programming will be assumed. The talks will cover the whole PASCAL programming language with emphasis on solving mathematical programming problems. There will be special emphasis on recursion, linked memory allocation, and scientific uses of the unique data structure flexibility of PASCAL. A wide range of applications will be demonstrated, including matrix manipulations, integration, differentiation, differential equations, invariant factors of integer matrices, set theory, series inversion, etc. The Minicourse will be conducted in a lecture-demonstration mode. The block structured nature of PASCAL makes it particularly flexible for programming intricate mathematical computations, and easier to read than most other popular programming languages. It is becoming the first programming language taught in many colleges and universities, but the emphasis in almost all current courses is on data processing applications. Probably mathematics departments should offer PASCAL courses for mathematics, sciences, and engineering students.

Minicourse #2: *Problems from industry for use in the undergraduate classroom*, is being organized by JEANNE L. AGNEW and MARVIN S. KEENER, and will be given from 8:30 a.m. to 10:30 a.m. on

Monday, August 8, and Wednesday, August 10. This Minicourse is based on problems obtained under the direction of the organizers from representatives of industries who were willing to share their expertise in order to help provide the undergraduate student an opportunity to deal with a real-world problem in its raw form. These problems have arisen in the work of the industry presenting them, and can be solved, at least in part, using only undergraduate mathematics. They have been written up by the organizers in the format suitable for classroom use. A catalog of these industrial problems will be available to the participants. The Minicourse will focus on a discussion of selected problems already developed, and on the identification and development of a new problem with the help of an industrial representative. The cooperating representative will be Dr. Jerry Cline from McDonnell Douglas Astronautics in St. Louis. The first part of the first session will be devoted to a brief description of the creation of the problem collection, and a discussion of several of the problems, their solution, and the ways in which they can be used in the classroom. Each participant will receive in advance one of the problems to be discussed in detail. Following these discussions, Dr. Cline will present a possible new problem for development, giving its background and the reasons why it is important to McDonnell Douglas. Between sessions the participants will have an opportunity to work on the solution of Dr. Cline's problem. He will be available during this time to discuss it informally with interested participants. If necessary, computing facilities will be available. During the second session Dr. Cline will present his solution of the problem. Any alternate approaches suggested by the participants will be discussed. Dr. Cline will describe generalizations of this particular problem, and he will also be available to discuss the place of the mathematically trained individual in industry, and the curricular needs implied by employment in industry.

Minicourse #3: *An introduction to the mathematical techniques and applications of computer graphics* is being organized by JOAN WYZKOSKI of Bradley University, and will be given from 8:30 a.m. to 10:30 a.m. on Monday, August 8, and Wednesday, August 10. Graphs and illustrations of geometrical objects are useful tools in the teaching of mathematics. Computer graphics simplifies the production of these teaching aids. This Minicourse will present some of the mathematical techniques used to produce realistic pictures on graphics terminals. Emphasis will be on the use of these techniques to complement mathematics instruction. Some of the topics to be discussed are curve and surface sketching, 2D and 3D transformations, perspective drawing and hidden line removal. Since personal computers will be available for demonstrations and in-class implementations, programming experience is necessary.

Minicourse #4: *COMAP microcomputer software in mathematics instruction* is being organized by DAVID A. SMITH of Duke University, and is being

held from 7:30 p.m. to 9:30 p.m. on Monday, August 8, and Tuesday, August 9. It is a Minicourse intended for college teachers. Uses of **existing** microcomputer software to enhance instruction in full courses in the undergraduate curriculum will be demonstrated. Included will be software for use in single- and multi-variable calculus, differential equations, and topics at the lower division college level. Presentations will be given by mathematicians who have developed the software **and** have had extensive experience with its use in their courses. It is planned for participants to have the opportunity to work with the software themselves on microcomputers.

Minicourse #5: *Commercial microcomputer software in mathematics instruction*. This Minicourse is also being organized by DAVID A. SMITH, and will be held from 8:30 a.m. to 10:30 a.m. and 2:00 p.m. to 4:00 p.m. on Tuesday, August 9 and will be identical to Minicourse #4 with the exception that only materials produced by individuals and organizations other than CONDUIT will be demonstrated.

Minicourse #6: *Coloring problems*. This Minicourse is being organized by DAVID M. BERMAN of the University of New Orleans, and has been scheduled for 8:30 a.m. to 10:30 a.m. on Monday, August 8, and Wednesday, August 10. The famous four-color problem has given rise to the study of coloring of graphs in general. This area is rich in results of interest to both pure and applied mathematicians. In this minicourse—which assumes no knowledge of graph theory—the four-color problem, more general coloring problems, some variations on the theme of graph coloring, and some surprising applications will be discussed.

The Minicourses are open only to persons who have registered for the Joint Mathematics Meetings and paid the Joint Meetings registration fee.

The Minicourses have separate registration fees of \$20 each, and are limited to thirty participants each, except for Minicourse #1, which is limited to fifty. Payment of the fee(s) must be made at the meeting registration desk in Albany two hours prior to the beginning of the Minicourse or the reservation will be relinquished to someone on the waiting list. When making payment, the participant should present the confirmation to the cashier. "Standby" reservation confirmations will be issued to participants whose preregistration was received after the Minicourse was filled. These individuals should check with the meeting cashier one hour prior to the Minicourse to see if any openings have occurred.

Contributed Papers

Papers are being accepted on three topics in collegiate mathematics for presentation in contributed paper sessions at the MAA Summer Meeting in Albany. The topics are:

- The undergraduate mathematics curriculum
- The use of computers in undergraduate mathematics instruction
- Classroom notes

Presentations are normally limited to ten minutes, although selected contributors may be given up to twenty minutes.

Individuals wishing to submit papers for any of these sessions at Albany should have sent the following information to the MAA Washington office (1529 Eighteenth Street, NW, Washington, DC 20036) **before May 16.**

1. Title
2. Intended session
3. A one-paragraph abstract (for distribution at the meeting)
4. A one-page outline of the presentation
5. A list of special equipment required for the presentation (e.g., computer, film projector, videotape player).

Late papers will not be accepted.

This information will be sent to session leaders who will arrange for refereeing. Selection of papers will have been announced by July 1.

Banquet For 25-Year Members

The MAA is planning a banquet for individuals who have been members of the Association for twenty-five years or more. The banquet will take place Wednesday evening, August 10. A cash bar will be operated from 6:00 p.m. to 6:45 p.m. in the Patroon Lounge in the Campus Center. Dinner will be served at 7:00 p.m. in the Patroon Room, one flight up. The menu for the dinner is as follows:

Chilled wedge of Saratoga melon, iced relishes, roast prime rib of beef au jus, rosette potatoes, fresh native green beans with mushrooms, romaine salad with vinaigrette dressing, brioche and crescent rolls with butter, minted chocolate mousse with Chantilly cream, ladyfingers, wine, coffee, and tea

Please note that all tickets for this banquet should have been purchased through preregistration, since a guarantee had to be given to the caterer much earlier than usual.

Activities of Other Organizations

Pi Mu Epsilon (IME) will hold its annual meeting on Wednesday and Thursday, August 10 and 11. The J. Sutherland Frame Lecture will be given by HENRY L. ALDER of the University of California, Davis, at 8:30 p.m. on Wednesday, August 10. The title of his talk is *How to discover and prove theorems: A demonstration with partitions.*

The **Association for Women in Mathematics (AWM)** will hold a panel discussion on *Grants: Getting them and keeping them*, at 9:10 a.m. on Wednesday, August 10. The AWM membership meeting will follow the panel discussion at 10:10 a.m. on the same day. At 8:30 p.m. on Tuesday, August 9, the AWM will sponsor a party at the Ramada Inn, where desserts and after-dinner drinks will be served.

Other Events of Interest

Book Sales

Books published by the AMS and the MAA will be sold for cash prices somewhat below the usual prices when these same books are sold by mail. **These discounts will be available only to registered participants wearing the official meeting badge.** VISA and MASTERCARD credit cards will be accepted for book sale purchases at the meeting. The book sales are open the same days and hours as the Joint Mathematics Meetings registration desk, and are located in the meeting registration area.

Exhibits

The book and educational media exhibits will be located in the Lecture Center Vestibule and are open from 1:00 p.m. to 5:00 p.m. on Monday, August 8, and from 8:30 a.m. to 4:30 p.m. on Tuesday and Wednesday, August 9–10. All participants are encouraged to visit the exhibits during the meeting.

MATHFILE

MATHFILE, the computerized version of *Mathematical Reviews*, will be demonstrated in the exhibit area during regular exhibit hours. Sample searches will be performed on two terminals connected to computers of the vendors who offer MATHFILE: BRS (800-833-4707, in New York 518-783-1161) and DIALOG (800-227-1960, in California 800-982-3810).

MATHFILE is also available during evening hours at greatly reduced rates on "BRS After Dark". This system uses a simplified command language and is especially designed for the end-user with a home computer or a terminal.

Summer List of Applicants

At the direction of the AMS-MAA-SIAM Committee on Employment Opportunities, which is charged with operation of the Employment Register and with the publication *Employment Information in the Mathematical Sciences*, the Society will publish a Summer List of mathematical scientists seeking employment for distribution at the Albany meeting.

Copies of the 1983 summer list will be available at the Transparencies section of the registration desk for \$2. Following the meeting, they may be purchased from the AMS office in Providence for \$3. This list should prove useful to employers who have last-minute openings in the latter part of the summer or in the fall.

The deadline for receipt of applicant forms to appear in this summer list was July 1, 1983.

Instead of an Employment Register at the Summer Meeting in Albany, there will be an opportunity for posting of both applicant résumé forms and employers' announcements of open positions in or near the main meeting registration area. There will be no special room set aside for interviews. No provisions will be made by the Society for interviews: arrangements will be the responsibility of each employer and applicant. Messages may be left in the message box located in the registration area.

Special applicant and employer forms will be available at the Transparencies section of the registration desk both for applicants to post résumés and for employers to post forms announcing positions.

Applicants who submit an applicant form, but do not plan to attend the meeting will appear on the printed list only. There is no provision made for posting résumés for participants who do not attend the meeting.

Petition Table

At the request of the AMS Committee on Human Rights of Mathematicians, a table will be made available in the meeting registration area at which petitions on behalf of named individual mathematicians suffering from human rights violations may be displayed and signed by meeting participants acting in their individual capacities.

Signs of moderate size may be displayed at the table, but must not represent the case of the individual in question is backed by the Committee on Human Rights unless it has, in fact, so voted. Volunteers may be present at the table to provide information on individual cases, but notice must be sent at least five (5) days in advance of the meeting, or by August 3, to the Meetings Department in Providence (telephone 401-272-9500). Since space is limited, it may also be necessary to limit the number of volunteers present at the table at any one time. The Committee on Human Rights may delegate a person to be present at the table at any or all times, taking precedence over other volunteers.

Any material which is not a petition (e.g. advertisements, résumés) will be removed by the staff. **When registration closes, any material on the table will be discarded, so individuals placing petitions on the table should be sure to remove them prior to 4:30 p.m. on Wednesday, August 10.**

Accommodations

Information which appears below in the sections on **University Housing** and **Food Services** was furnished by SUNYA. Although firm information was requested, because of the uncertainty of the State of New York budget, many of the statements in these two sections may be subject to change between now and the time of the meetings.

University Housing

Participants requesting housing on campus during the meeting will be assigned to Indian Quadrangle, (located in the southeast corner of the campus). Colonial Quadrangle will be used as an overflow dormitory, if necessary. The check-in desk for Indian Quad is located in the lobby of Mohawk Tower, which can be identified by a weather station on its roof. The check-in desk for Colonial Quad is located in the lobby of Livingston Tower (located

diagonally across the campus from Mohawk Tower on the northwest side). Those participants who are arriving via Western Avenue (NY Route 20) will enter the campus from the south entrance and follow signs leading them to Indian Quad. Those arriving on Washington Avenue, bear left after entering one of the north entrances and proceed along the perimeter of the campus to Indian Quad. The entrance to the lobby faces the inside of the quadrangle. The check-in desk will be in operation daily from 9 a.m. until 11 p.m. with the exception of August 7 and 8, when the hours are 9 a.m. until 3 a.m. the following morning. Temporary parking will be allowed during check-in. (See section on **Parking**.)

Participants desiring confirmed reservations for on-campus housing **should have preregistered and sent required payment(s) to the Mathematics Meetings Housing Bureau prior to the July 1, 1983 deadline.** (Please refer to sections below titled Room Rates Including Meal Plans and Meal Plans Only.)

Dormitories at SUNYA are not air-conditioned. Each quad consists of a high-rise tower and eight low-rise units. In addition to the usual dormitory room setup with communal bathrooms, there are a number of suites available containing one single and either one or two double-bedded rooms and bath. **There are no cots available in the dormitories.**

Children aged ten and over will be charged the same rates as adults. Children nine and under will be charged a reduced rate for room and board (meal Plan C or D).

Parents will be allowed to bring portacribs or small cribs for infants and toddlers. These children may stay in the same room with parents at no charge. It is not a requirement that food plans be purchased for children four years of age and under. For additional information regarding families, please write to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, Rhode Island 02940, or call 401-272-9500, extension 239.

Beds will be made up in advance for preregistered participants. In addition to bed linen, two towels are provided. A small bar of soap and a plastic glass will be provided upon request. Since this may prove to be inadequate, it is advised that participants bring an additional bar of soap as well as a face cloth, if necessary. Each room is equipped with floor lamp, desk and dresser. No clothes hangers are provided, and it is suggested that participants bring their own supply. Bathrooms will be cleaned periodically.

There will be a limited number of rooms available for those without confirmed reservations; however, beds in these rooms will not be made up in advance. Participants arriving without prior reservations will be given a set of bed linens, pillow, and blanket in order to make up their own beds as well as two towels, and upon request a plastic glass and soap. Again, it is recommended that additional soap, a face cloth and clothes hangers be brought by the individual.

Keys will be issued to each participant staying in the residence halls. These keys open the outside

State University of New York, Center at Albany



● CAMPUS GUIDE

Lecture Center

- 1 Social Science
- 2 Humanities
- 3 Education
- 4 Campus Center
- 5 Physics
- 6 Chemistry
- 7 Biology
- 8 Library
- 9 Theatre-Music
- 10 Earth Science
- 11 Fine Arts
- 12 Administration
- 13 Business

⊕ POST OFFICE

Colonial Quadrangle

T Livingston Tower

Indian Quadrangle

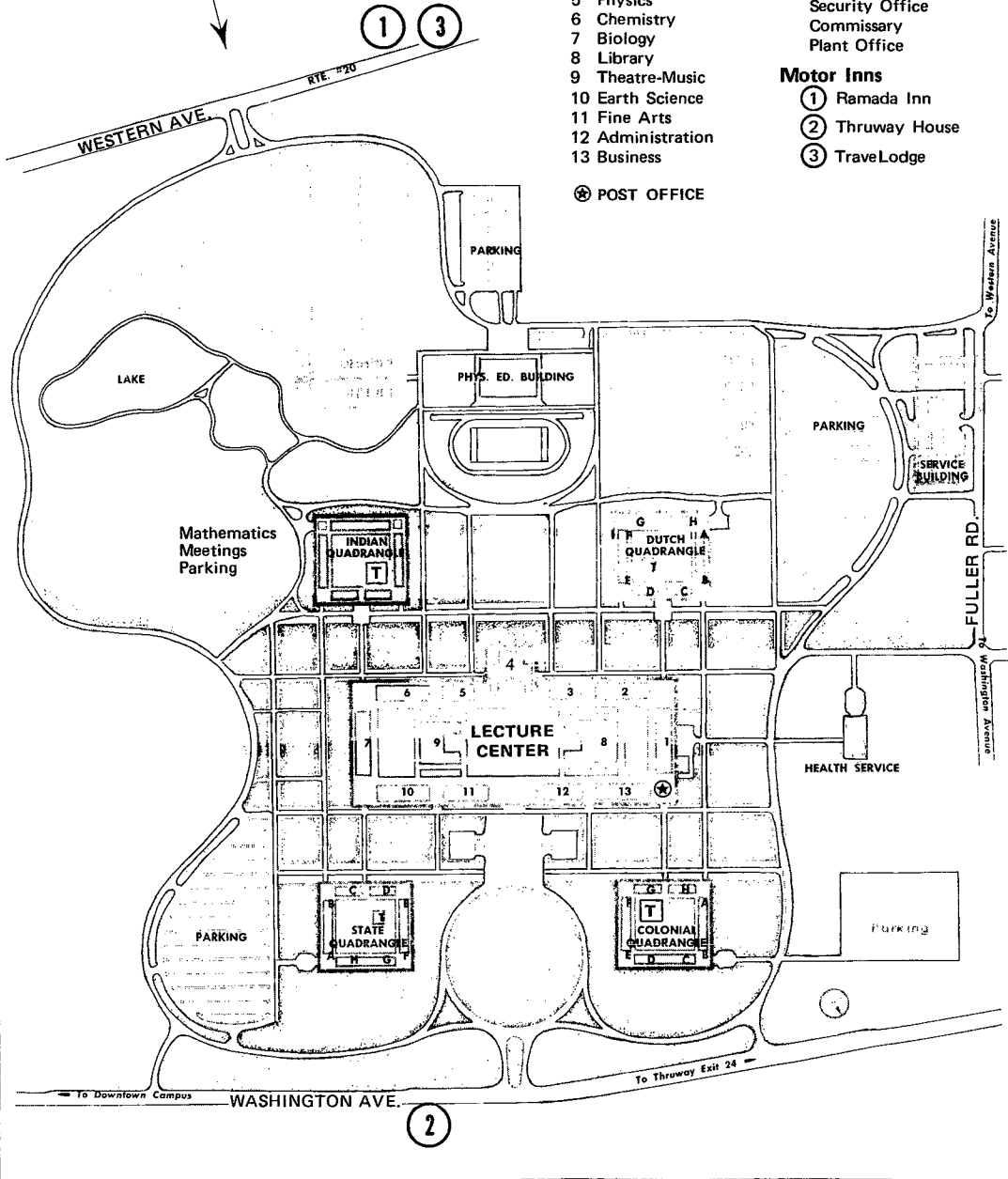
T Mohawk Tower

Service Buildings

Motor Pool
Security Office
Commissary
Plant Office

Motor Inns

- ① Ramada Inn
- ② Thruway House
- ③ TraveLodge



TIMETABLE

LC = Lecture Center

(Eastern Daylight Saving Time)

The final version of the Timetable and Program, including room assignments, will be distributed at the meeting.

AMERICAN MATHEMATICAL SOCIETY SHORT COURSE SERIES

SATURDAY, August 6	POPULATION BIOLOGY
11:00 a.m. - 4:00 p.m.	REGISTRATION (Short Course Only) Lecture Center Vestibule (Outside LC 1)
2:00 p.m. - 2:20 p.m.	Introduction to mathematical population biology Simon A. Levin
2:20 p.m. - 3:20 p.m.	Population dynamics and demography James Frauenthal
3:30 p.m. - 4:30 p.m.	Epidemiology James Yorke
4:40 p.m. - 5:00 p.m.	Summary Simon A. Levin
SUNDAY, August 7	
8:00 a.m. - 2:00 p.m.	REGISTRATION (Short Course Only) Lecture Center Vestibule (Outside LC 1)
9:00 a.m. - 10:00 a.m.	Mathematical population genetics Thomas Nagylaki
10:10 a.m. - 11:10 a.m.	Evolution, game theory, and economics Ethan Akin
11:20 a.m. - 11:45 a.m.	Coevolution Simon A. Levin
1:30 p.m. - 2:30 p.m.	Optimal control theory in population biology Wayne Getz
2:40 p.m. - 3:40 p.m.	Graph theory and food webs George Sugihara
3:50 p.m. - 4:00 p.m.	Summary Simon A. Levin
4:00 p.m. - 4:45 p.m.	General discussion

JOINT MATHEMATICS MEETINGS

SUNDAY, August 7	American Mathematical Society	Mathematical Association of America
9:00 a.m. - 4:00 p.m.		BOARD OF GOVERNORS MEETING Squire Room, Ramada Inn
4:00 p.m. - 8:00 p.m.	REGISTRATION Lecture Center Vestibule	
4:00 p.m. - 8:00 p.m.	AMS BOOK SALE LC Vestibule	MAA BOOK SALE LC Vestibule
4:45 p.m.		LAKE GEORGE CRUISE
5:00 p.m. - 10:00 p.m.	COUNCIL MEETING Squire Room, Ramada Inn	
MONDAY, August 8	AMS	MAA
8:00 a.m. - 4:30 p.m.	REGISTRATION Lecture Center Vestibule	
8:00 a.m. - 4:30 p.m.	AMS BOOK SALE LC Vestibule	MAA BOOK SALE LC Vestibule
8:15 a.m. - 8:25 a.m.		WELCOME ADDRESS
8:30 a.m. - 9:30 a.m.	INVITED ADDRESS Harmonic maps of Riemann surfaces James Fells, LC 7	
8:30 a.m. - 10:30 a.m.		MINICOURSE #2 Problems from industry for use in the undergraduate classroom Jeanne L. Agnew Marvin S. Keener

door of the residence hall, the door to the suite (if applicable), and the door to the individual room. There is no deposit requirement for keys; however, **there will be a penalty of \$20 payable to the SUNYA Key Account by the individual participant should keys be lost, to cover cost of replacement of both locks and keys.**

There are heat detectors in hallways and lounges. There are smoke detectors in individual bedrooms. There are three elevators in the dormitories, one of which stops at every floor. All will be appropriately marked. Stairways are unlocked.

There is one kitchen unit in the basement of Mohawk Tower as well as in most of the low-rise buildings on Indian Quad containing a small refrigerator, range-top and oven. No utensils are provided. It is suggested that participants who wish to avail themselves of this convenience bring their own kitchen articles.

There are coin-operated laundry facilities in the tower basement as well as one in the basement of each low-rise building. There is a 35 cent charge for the use of washers; dryers are free. Participants are requested to bring their own laundry materials.

Vending machines dispensing soft drinks, candy, etc., are located in the tower.

No pets are allowed in the residence halls. Alcoholic beverages are not prohibited; however, residents are required to exercise moderation.

There is no telephone service in any of the residence hall rooms. Public telephones are located in the lobby of the towers.

Check-in Locations and Times

The check-in desk will be in operation in the lobby of Mohawk Tower, Indian Quad, daily from 9 a.m. to 11 p.m. with the exception of the nights of August 7 and 8 when the desk will remain open to accommodate late comers until 3 a.m. As indicated in the text above, there is a possibility that Livingston Tower (Colonial Quad) may be used as an overflow dormitory. This tower is situated on the northwest corner of the campus diagonally across the quadrangle from Mohawk Tower.

Room Rates Including Meal Plans

Note: The State University of New York central administration has now approved the rates listed below.

Note: Rooms on campus are not available without a meal plan.

The following adult package plans offered by SUNYA include 7 percent state and local sales tax.

Plan A: Single room with breakfast and lunch \$27.60 per day

Plan A: Double room with breakfast and lunch \$22.60 per day per person

Plan B: Single room with breakfast, lunch and dinner \$34.40 per day

Plan B: Double room with breakfast, lunch and dinner \$29.40 per day per person

Children 10 years of age or older must occupy a bed and pay adult rates for lodging and food.

Plans C and D below apply for children up to and including the age of 9.

Plan C: Breakfast and lunch \$14.90

Plan D: Breakfast, lunch, and dinner \$20.25

The above options were available by prepayment only.

Meal Plans Only

For preregistered participants not staying in residence halls, commuters, or those staying in hotels, there is a modified plan whereby meals only could have been purchased. **Meal tickets must be purchased through preregistration**, and the daily rate per person is given below:

Adults and Children 10 years of age and over:

Plan E: Breakfast and lunch \$ 6.60

Plan F: Breakfast, lunch, and dinner \$13.40

Children 9 years of age and under:

Plan G: Breakfast and lunch \$ 3.90

Plan H: Breakfast, lunch, and dinner \$ 9.25

Note: Meals on a cash-as-you-go basis are not available in the cafeterias; however, the Campus Center Snack Bar offers a limited menu for cash between the hours of 7:30 a.m. and 1:00 p.m.

Lake George Cruise

A cruise on Lake George aboard the Ticonderoga has been arranged for Sunday, August 7. Buses will depart from the Indian Quadrangle at 4:45 p.m. and return to Indian Quadrangle at 10:15 p.m. The buses will be marked "Lake George Cruise." This cruise sails the beautiful island-dotted narrows of Lake George, with live music on board. The cost is \$15 per person for those not on any meal plan, or those on either meal Plans A, C, E, or G. For those on meal Plan B or F, the ticket price is \$8.20. For children up to and including 9 years of age on meal Plan D or H, tickets are \$9.65. (Since children under 10 are offered meals at a reduced rate, the cost of their tickets for the cruise is higher.) This box dinner replaces the regularly scheduled meal for that night for those taking the cruise. Individuals who do not wish to participate in the cruise may still obtain their evening meal in the cafeteria. Since the Lake George Steamboat Company has set a deadline for reservations, this cruise was offered **through preregistration only**. If a sufficient number of preregistrations was not received by July 1, interested participants were notified of cancellation and appropriate refunds made.

The above prices include the cost of the bus, the cruise, all taxes and gratuities, and a boxed dinner consisting of fried chicken, potato salad, fruit, brownie, soft drink, and relishes.

Picnic

At 6:15 p.m. on Monday, August 8, there will be a picnic at the Indian Quad South Outdoor Area. This meal replaces the regularly scheduled dinner for that night for all participants on meal Plans B, D, F,

TIMETABLE

LC = Lecture Center

MONDAY, August 8	American Mathematical Society	Mathematical Association of America
8:30 a.m. - 10:30 a.m.		MINICOURSE #3 An introduction to the mathematical techniques and applications of computer graphics Joan Wyzkoski
8:30 a.m. - 10:30 a.m.		MINICOURSE #6 Coloring problems David M. Berman
8:40 a.m. - noon		CONTRIBUTED PAPER SESSION The use of computers in undergraduate mathematics instruction
8:40 a.m. - noon		CONTRIBUTED PAPER SESSION Classroom notes
11:00 a.m. - noon	INVITED ADDRESS Fourier transforms and representations of general linear groups Wen-Ch'ing Winnie Li	
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE I On the Coxeter element and the structure of the exceptional Lie groups Bertram Kostant	
1:00 p.m. - 5:00 p.m.		EXHIBITS LC Vestibule
	SPECIAL SESSIONS	
2:15 p.m. - 4:15 p.m.	Automorphic functions and automorphic representations I	
2:15 p.m. - 6:00 p.m.	Ergodic theory concerning point transformations with finite invariant measure I	
2:15 p.m. - 4:35 p.m.	Differential analysis in infinite dimensional spaces I	
2:15 p.m. - 4:35 p.m.	Tensor products and p-summing operators in harmonic analysis I	
	SESSIONS FOR CONTRIBUTED PAPERS	
2:15 p.m. - 3:40 p.m.	Algebra	
2:15 p.m. - 3:55 p.m.	Analysis	
5:00 p.m. - 6:00 p.m.	INVITED ADDRESS Riemann surfaces and their associated Wirtinger varieties Robert C. Gunning	
6:15 p.m.		PICNIC
7:30 p.m. - 9:30 p.m.		MINICOURSE #1 Pascal for mathematicians Harley Flanders
7:30 p.m. - 9:30 p.m.		MINICOURSE #4 COMAP microcomputer software in mathematics instruction David A. Smith
TUESDAY, August 9	AMS	MAA
	SPECIAL SESSIONS	
8:00 a.m. - 10:25 a.m.	Automorphic functions and automorphic representations II	
8:20 a.m. - 10:40 a.m.	Topological methods in combinatorial group theory I	
	SESSION FOR CONTRIBUTED PAPERS	
8:20 a.m. - 10:45 a.m.	General Session I	
8:30 a.m. - 4:30 p.m.		REGISTRATION LC Vestibule
8:30 a.m. - 4:30 p.m.	AMS BOOK SALE LC Vestibule	MAA BOOK SALE LC Vestibule
8:30 a.m. - 4:30 p.m.		EXHIBITS LC Vestibule

Albany Meetings Travel SuperPhone 800-556-6882

INSTANT... PERSONALIZED... IMMEDIATE CONFIRMATION OF
TRAVEL AND HOTEL RESERVATIONS FOR THE JOINT MATHEMATICS MEETINGS IN
ALBANY, NEW YORK

One free call does it all! No forms to mail and no waiting when you use your major credit card (VISA, MASTERCARD, American Express or air travel card.)

TRAVEL SUPERSERVICE:

- Fly to Albany with **USAIR** the official carrier for the Joint Mathematics Meetings and get 30 percent or more off! No restrictions on reservations purchased at least 14 days in advance. This special offer is available **ONLY** through Mathematics SuperPhone! Call SuperPhone toll-free today at 800-556-6882 and **SAVE!**

- Unbiased advice on the most direct, economical air routes.
- Fast, computerized reservation, ticketing, invoicing, itinerary.
- Guaranteed lowest possible air fares for your city.
- Automatic "Fare Check" at regular intervals before your departure to assure the most economical rate. If lower fares develop, your ticket will be automatically rewritten at savings to you.

HOTEL CONFIRMATION:

Along with your travel arrangements, ask for immediate confirmation of your hotel accommodations. All hotels for this meeting must be confirmed through this number.

N.B.: University accommodations must be obtained through the Mathematics Meetings Housing Bureau.

CALL NOW: 800-556-6882 (In Rhode Island and outside the Continental U.S. call 401-884-9500.)

Hours of Operation: 9:00 a.m. to 7:00 p.m. EST, Monday through Thursday, Fridays until 6:00 p.m.

and H. There is no additional charge for participants on either of these plans for the picnic. For those not on any meal plan as well as those on meal Plans A, C, E, or G, the cost of the picnic ticket is \$7. Because the guarantee had to be given to the caterer in advance of the meeting, the picnic was offered **through preregistration only**. The menu will feature barbecued chicken, hot dogs, hamburgers, assorted salads, corn, baked beans, watermelon, brownies, soda, coffee, tea, and milk. In case of rain, this event will be moved to the cafeteria.

Beer Party

A beer party will be held at 7:00 p.m. on Tuesday, August 9 at the Indian Quad Outdoor Area. Tickets are \$5.35 per person and **should have been purchased through preregistration**. In addition to beer, white and red wines, soft drinks, potato chips, pretzels and peanuts will be served. In case of rain, this event will be moved to the cafeteria.

MAA Banquet

For those individuals not on any meal plan, as well as those on meal Plan A and E, the cost of the ticket for the MAA 25-year banquet on Wednesday is \$16.05. There is an additional charge of \$9.25 for participants on Plan B and F who plan to attend the banquet.

N.B.: As stated elsewhere in the meeting announcement, tickets for the MAA banquet, picnic, beer party, and cruise were available only through preregistration due to deadlines set by SUNYA.

Food Services

Food service in the Indian Quad cafeteria will begin with breakfast on Saturday, August 6, and

will end with lunch on Thursday, August 11. No food service will be available after lunch on Thursday.

Only prepaid meals will be served in the cafeteria in the basement of Indian Quad. Cafeteria hours of operation are:

Breakfast	7:00 a.m. to 8:30 a.m.
Lunch	11:30 a.m. to 1:00 p.m.
Dinner	5:00 p.m. to 6:30 p.m.

A sample breakfast served in the dining room would be various fruits and juices, eggs (two styles), sausages, pancakes with syrup, sweet rolls, and assorted jams and jellies. A typical lunch would be soup, hamburger steak with creole sauce, french fried potatoes, salad variations, assorted breads, whipped fruited jello and hot dogs, hamburgers and grilled cheese sandwiches. Dinner menus include cream of mushroom soup, browned roast chicken with peach half or ham and roast beef cold platter, baked potato, buttered peas, rye bread, ice cream, lemon cake and fresh apples. Second helpings will be allowed for all meals.

Hotels

Blocks of rooms have been set aside for use by participants at the hotels listed below. Participants should make their own reservations early with the Albany Meetings Travel SuperPhone. (See box above.) Reservations at these hotels will not be available by calling the hotel directly. The rates listed below are subject to change, and to an 8 percent sales tax.

In all cases, a one night's deposit including the 8 percent tax is required to guarantee a room. This can be charged to a credit card when booking through

TIMETABLE

LC = Lecture Center

TUESDAY, August 9	American Mathematical Society	MAA and Other Organizations
8:30 a.m. - 10:30 a.m.		MAA - MINICOURSE #5 Commercial microcomputer software in mathematics instruction David A. Smith
8:40 a.m. - 9:30 a.m.		MAA - INVITED ADDRESS Understanding and teaching problem- solving skills Alan Schoenfeld
	SESSION FOR CONTRIBUTED PAPERS	
8:45 a.m. - 10:40 a.m.	Topology	
	SPECIAL SESSION	
9:00 a.m. - 10:20 a.m.	Ergodic theory concerning point transformations with finite invariant measure II	
	SESSIONS FOR CONTRIBUTED PAPERS	
9:00 a.m. - 10:25 a.m.	Functional analysis	
9:00 a.m. - 9:55 a.m.	Geometry	
	SPECIAL SESSION	
9:15 a.m. - 10:35 a.m.	Tensor products and p-summing operators in harmonic analysis II	
9:50 a.m. - 10:40 a.m.		MAA - INVITED ADDRESS Have you ever met a polyhedron you did not like? Branko Grünbaum
11:00 a.m. - noon		MAA - THE EARLE RAYMOND HEDRICK LECTURES: Lecture I Some ideas in the development of Fourier analysis Elias M. Stein
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE II On the Coxeter element and the structure of the exceptional Lie groups Bertram Kostant	
2:00 p.m. - 4:00 p.m.		MAA - MINICOURSE #5 Commercial microcomputer software in mathematics instruction David A. Smith
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS On the residual spectrum of the linear group Hervé Jacquet	
2:15 p.m. - 3:05 p.m.		MAA - INVITED ADDRESS Analysis of complex genetic systems Richard Lewontin
	SPECIAL SESSIONS	
2:15 p.m. - 4:35 p.m.	Several complex variables I	
2:15 p.m. - 5:30 p.m.	Differential analysis in infinite dimensional spaces II	
2:15 p.m. - 5:05 p.m.	Solutions of operator equations and fixed points I	
2:15 p.m. - 4:35 p.m.	Topological methods in combinatorial group theory II	
	SESSION FOR CONTRIBUTED PAPERS	
2:15 p.m. - 3:10 p.m.	Number theory	
2:30 p.m. - 4:30 p.m.		MAA - SECTION OFFICERS MEETING Squire Room, Ramada Inn
4:30 p.m. - 5:30 p.m.		MAA - BUSINESS MEETING
7:00 p.m. - 10:00 p.m.		Pi Mu Epsilon - RECEPTION
7:00 p.m.		BEER PARTY

the Albany Meetings Travel SuperPhone. If an emergency occurs and you find you must cancel your reservation, this must be done prior to 6:00 p.m. on the day of your arrival, or you will be charged for that day. The cut-off date for reservations at all hotels is July 25, 1983. After this date none of the hotels are obligated to provide a room at these special rates.

The estimated walking distance from the hotel to the meetings is given in parentheses following the telephone number. The number after the name of the hotel is the number it carries on the map.

The following codes apply: AC = Air Conditioned; CL = Cocktail Lounge; FP = Free Parking; GR = Game Room; RT = Restaurant; SP = Swimming Pool; SU = Sauna; TV = Television.

In all cases, children 17 years of age and under can stay in a parent's room at no charge. The rates for cots are noted below for each hotel, as they vary. In all cases "Single" refers to one person in one bed; "Double" refers to two persons in one bed; "Twin" refers to two persons in two beds. A rollaway cot for an extra person can be added to double or twin rooms only.

Ramada Inn (#1 on the campus map)

1228 Western Avenue
Albany, New York 12203

Telephone: 518-489-2981 (10 minutes)

Single: \$34 Double: \$39
Twin \$46 Rollaway cot \$5

Extra person in room: No charge
Code: AC, CL, FP, GR, RT, SP, SU, TV,

Free transportation is provided to and from the airport, bus station, and AMTRAK station. Upon arrival, contact the hotel and request transportation.

Thruway House (#2 on campus map)

1375 Washington Avenue
Albany, New York 12206

Telephone: 518-459-3100 (10 minutes)

Single: \$34 Double: \$40
Twin \$40 Rollaway cot \$6

Extra person in room: \$6 (18 and over)
Code: AC, CL, FP, RT, SP, TV

Free van service is provided. Contact the hotel upon arrival at the airport.

Travelodge (#3 on campus map)

1230 Western Avenue
Albany, New York 12203

Telephone: 518-489-4423 (10 minutes)

Single: \$29 Double \$35
Twin \$38 Rollaway cot \$4

Extra person in room: No charge
Code: AC, FP, SP, TV

Registration Desk

Registration at the Meetings

Meeting preregistration and registration fees only partially cover expenses of holding meetings. All mathematicians who wish to attend sessions are

expected to register, and should be prepared to show their meeting badge, if so requested. The fees for registration at the meetings, which are 30 percent more than the preregistration fees, are listed below.

AMS Short Course

Student/Unemployed	\$10
All Other Participants	\$30
One-day Fee (Second Day Only)	\$15

Joint Mathematics Meetings

Member of AMS, MAA, IIME	\$49
Emeritus Member of AMS, MAA	\$12
Nonmember	\$75
Student/Unemployed	\$12

MAA Minicourses #1 through #6

All Participants	\$20 each
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Registration fees may be paid at the meetings in cash, by personal or travelers' checks, or by VISA or MASTERCARD credit cards. Canadian checks must be marked for payment in U.S. funds.

There will be no extra charge for members of the families of registered participants, except that all professional mathematicians who wish to attend sessions must register independently.

All full-time students currently working toward a degree or diploma qualify for the student registration fees, regardless of income.

The unemployed status refers to any person currently unemployed, actively seeking employment, and who is not a student. It is not intended to include any person who has voluntarily resigned or retired from his or her latest position.

Persons who qualify for emeritus membership in either the Society or the Association may register at the emeritus member rate. The emeritus status refers to any person who has been a member of the AMS or MAA for twenty years or more, and is retired on account of age from his or her latest position.

Nonmembers who register at the meetings and pay the \$75 nonmember registration fee are entitled to a discount of the difference between the member registration fee of \$49 and the nonmember registration fee of \$75 as a \$26 credit against dues in either the AMS or MAA, or both, provided they apply for membership before September 11, 1983.

Nonmember students who register at the meetings and pay the \$12 registration fee are entitled to a discount of the difference between the student preregistration fee of \$9 and the registration fee of \$12 as a \$3 credit against dues in either the AMS or MAA or both, provided they apply for membership before September 11, 1983.

Nonmembers and nonmember students who thus qualify may apply for membership at the meetings, or by mail afterwards up to the deadline.

Registration Dates and Times

AMS Short Course

Lecture Center Vestibule (Outside Lecture Center 1)

Saturday, August 6	11:00 a.m. to 4:00 p.m.
Sunday, August 7	8:00 a.m. to 2:00 p.m.

TIMETABLE

TUESDAY, August 9	American Mathematical Society	MAA and Other Organizations
7:30 p.m. - 9:30 p.m.		MAA - MINICOURSE #1 Pascal for mathematicians Harley Flanders
7:30 p.m. - 9:30 p.m.		MAA - MINICOURSE #4 COMAP microcomputer software in mathematics instruction David A. Smith
8:00 p.m. - 9:00 p.m.		MAA - EVENING SESSION The MAA newsletters: A dialogue among editors Marcia P. Sward
8:30 p.m. - 10:30 p.m.		Association for Women in Mathematics PARTY
WEDNESDAY, August 10	AMS	MAA and Other Organizations
8:30 a.m. - 9:30 a.m.	INVITED ADDRESS Reverse mathematics Leo A. Harrington	
8:30 a.m. - 4:30 p.m.		REGISTRATION LC Vestibule
8:30 a.m. - 4:30 p.m.	AMS BOOK SALE LC Vestibule	MAA BOOK SALE LC Vestibule
8:30 a.m. - 4:30 p.m.		EXHIBITS LC Vestibule
8:30 a.m. - 10:30 a.m.		MAA - MINICOURSE #2 Problems from industry for use in the undergraduate classroom Jeanne L. Agnew Marvin S. Keener
8:30 a.m. - 10:30 a.m.		MAA - MINICOURSE #3 An introduction to the mathematical tech- niques and applications of computer graphics Joan Wyzkoski
8:30 a.m. - 10:30 a.m.		MAA - MINICOURSE #6 Coloring problems David M. Berman
8:40 a.m. - 10:50 a.m.		MAA - CONTRIBUTED PAPER SESSION The undergraduate mathematics curriculum
9:00 a.m. - 11:00 a.m.		IIME - CONTRIBUTED PAPER SESSION
9:10 a.m. - 10:10 a.m.		AWM - PANEL DISCUSSION Grants: Getting them and keeping them Rhonda Hughes Linda Rothschild (moderator) Cora Sadosky Alice Schafer Judith Sunley
9:45 a.m. - 10:45 a.m.	INVITED ADDRESS The Schrödinger equation Ira W. Herbst	
10:10 a.m. - 10:40 a.m.		AWM - MEMBERSHIP MEETING
11:00 a.m. - noon		MAA - THE EARLE RAYMOND HEDRICK LECTURES: Lecture II Some ideas in the development of Fourier analysis Elias M. Stein
noon - 1:00 p.m.		IIME - COUNCIL LUNCHEON

Joint Mathematics Meetings

[and MAA Minicourses (until filled)]

Lecture Center Vestibule

Sunday, August 7 4:00 p.m. to 8:00 p.m.

Monday, August 8 8:00 a.m. to 4:30 p.m.

Tuesday, August 9,
and 8:30 a.m. to 4:30 p.m.

Wednesday, August 10

Assistance and Information Desk

Lecture Center Vestibule (Outside Lecture Center 7)

Thursday, August 11 8:30 a.m. to 1:30 p.m.

Please note that the Joint Mathematics Meetings registration desk **will not be open on Thursday, August 11**, and that the telephone message center will not be in operation that day. Other services provided during the meeting at the registration desk will also no longer be available (see section below on **Registration Desk Services**). There will, however, be a small desk set up in the Lecture Center Vestibule, where local information will be available and where a staff member will provide limited assistance to participants. No registration or cash transactions will be possible at this desk.

Registration Desk Services

AMS/MAA Information: Information on the publications and activities of both organizations may be obtained at this section of the registration desk.

Assistance, Comments and Complaints: A log for registering participants' comments or complaints about the meetings is kept at the Transparencies section of the registration desk. All participants are encouraged to use this method of helping to improve future meetings. Comments on all phases of the meetings are welcome. If a written reply is desired, participants should furnish their name and address.

Participants with problems of an immediate nature requiring action at the meeting should see the director of meetings, who will try to assist them.

Audio-Visual Equipment: Rooms where special sessions and contributed paper sessions will be held will be equipped with an overhead projector, screen, and blackboard.

Presenters of ten- or twenty-minute papers are strongly urged to use the overhead projector rather than the blackboard for their presentation in order to obtain maximum visibility by all members of the audience of the material being presented.

Members of the AMS/MAA staff will be available to advise or consult with speakers on their audio-visual requirements.

Baggage and Coat Check: Provision will be made for participants checking out of the residence halls early to leave baggage in the registration area until leaving the campus.

Check Cashing: The meeting cashier will cash personal or travelers' checks up to \$50, **upon presentation of the official meeting registration badge**, provided there is enough cash on hand. Canadian checks must be marked for payment in U.S. funds.

Dues: Members of the AMS or MAA may pay their dues at the meeting. MAA members must make dues payments to the MAA representative at the Transparencies Section of the registration desk. AMS members may also make dues payments at the Transparencies Section but may also pay their dues to the meeting cashier or at the AMS Book Sale.

Local Information: This section of the desk will be staffed by members of the Local Arrangements Committee and other volunteers from the Albany mathematical community.

Lost and Found: See the meeting cashier.

Mail: All mail and telegrams for persons attending the meetings should be addressed to the participant, c/o Joint Mathematics Meetings, Department of Mathematics, SUNY, Center at Albany, Albany, New York 12222, Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. First class mail not picked up will be forwarded after the meeting to the mailing address given on the participant's registration record.

Personal Messages: Participants wishing to exchange messages during the meetings should use the mailbox mentioned above. Message pads and pencils are provided. It is regretted that such messages left in the box cannot be forwarded to participants after the meeting is over.

Telephone Messages: A telephone message center will be located in the registration area to receive incoming calls for participants. The center will be open from August 7-10 only, during the same hours as the Joint Mathematics Meetings registration desk. Messages will be taken and the name of any individual for whom a message has been received will be posted until the message has been picked up at the message center. The telephone number of the message center will be announced later.

Transparencies: Speakers wishing to prepare transparencies in advance of their talk will find the necessary materials and copying machines at this section of the registration desk. A member of the staff will assist and advise speakers on the best procedures and methods for preparation of their material. There is a modest charge for these materials. **Please note that this service will not be available on Thursday, August 11.**

Visual Index: An alphabetical list of registered participants, including local addresses, arrival and departure dates, is maintained in the registration area.

Miscellaneous Information

Athletic Facilities

At this time, it is not known whether the gym will be open during the meetings. If it is, participants may use the swimming pool and squash courts free of charge. Tennis courts are free to participants upon presentation of the meeting badge; they remain lit until approximately 11:30 p.m. There is an off-road

TIMETABLE

LC = Lecture Center

WEDNESDAY, August 10	American Mathematical Society	MAA and Other Organizations
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE III On the Coxeter element and the structure of the exceptional Lie groups Bertram Kostant	
1:00 p.m. - 1:50 p.m.		MAA - INVITED ADDRESS Theoretical and experimental contributions to the development of a science of vehicular traffic Robert Hermann
	SPECIAL SESSIONS	
1:00 p.m. - 4:35 p.m.	Several complex variables II	
1:00 p.m. - 4:20 p.m.	Dynamical systems I	
2:00 p.m. - 4:15 p.m.	The calculus of variations in the large and its applications I	
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS The topology of real algebraic sets Selman Akbulut	
	SPECIAL SESSIONS	
2:15 p.m. - 4:35 p.m.	Solutions of operator equations and fixed points II	
2:15 p.m. - 4:30 p.m.	Differential analysis in infinite dimensional spaces III	
	SESSION FOR CONTRIBUTED PAPERS	
2:15 p.m. - 3:40 p.m.	General Session II	
2:30 p.m. - 4:30 p.m.		IIME - CONTRIBUTED PAPER SESSION
	SPECIAL SESSION	
3:00 p.m. - 4:20 p.m.	Applications of algebraic topology I	
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS Functional equations over a group, and the mean value property J. H. B. Kemperman	
4:45 p.m. - 6:15 p.m.	STEELE PRIZE SESSION AND BUSINESS MEETING	
6:00 p.m. - 8:30 p.m.		MAA - BANQUET FOR 25-YEAR MEMBERS
6:30 p.m. - 8:15 p.m.		IIME - BANQUET
7:00 p.m. - 9:33 p.m.		MAA - FILM PROGRAM
7:00 p.m.		Points of view: Perspective and projection
7:28 p.m.		Dragon fold...and other ways to fill space
7:39 p.m.		Caroms
7:52 p.m.		Linear programming
8:04 p.m.		Turning a sphere inside out
8:27 p.m.		Hypothesis testing, inferential statistics Part II
8:55 p.m.		Journey to the center of a triangle
9:07 p.m.		Symmetry and tessellations
8:30 p.m. - 9:30 p.m.		IIME - J. SUTHERLAND FRAME LECTURE How to discover and prove theorems: A demonstration with partitions Henry L. Alder

running course around the perimeter of the university which is approximately three miles long.

Book Store

The University Book Store is open Monday through Friday from 9:00 a.m. to 4:00 p.m.

Camping

There are no camping sites within 15 miles of the university. The closest camping sites are:

Thompson's Lake State Park (20 miles)

Moreau Lake State Park (45 miles)

Child Care

The Local Arrangements Committee will have a list of babysitters available at the Local Information section of the registration desk during the meeting.

Crib Rental

The supply of rental cribs available is very limited. Portacribs are available for \$10 a week and full-size cribs for \$15 (not including delivery). Interested participants are advised to contact the following as soon as possible:

Richard Goldstein, SUNYA, Mathematics Department, 1400 Washington Avenue, Albany, New York 12203; (518-457-3943).

Handicapped

There is a ramp located at the rear of Mohawk Tower, Indian Quad, at lobby level which will facilitate entry into the building. The elevators provide easy access to all floors. Bathrooms, however, are not equipped for handicapped persons.

Libraries

At present, the campus library plans to be open from 8:00 a.m. to 6:00 p.m. Monday through Friday. Participants may use the library facilities at no charge.

Local Information

Albany, the state capitol of New York, is steeped in upper Hudson Valley lore, surrounded by fields and farmlands. The city was originally settled by the Dutch in 1609, as the trading post of Fort Orange.

Some of the attractions in the area are Fort Crailo, a Dutch home and fort built about 1704, and where the song *Yankee Doodle* was composed; Schuyler Mansion, built in 1761–1762, and housing a beautiful collection of 18th and early 19th century furnishings; Historic Cherry Hill, built in 1787, and now a museum; and Ten Broeck Mansion, built in 1797–1798. Also within driving distance is the Saratoga racetrack, and a visit to the Empire State Plaza in downtown Albany is recommended.

Medical Services

The University Health Service is open for emergency care and doctor referrals from 8:00 a.m. to midnight, Monday through Friday. The on-campus ambulance can be summoned by calling 457-8633.

Nearby hospitals providing emergency medical care are:

St. Peters Hospital, New Scotland Avenue & Manning Boulevard, 454-1318

Albany Medical Center Hospital, New Scotland Avenue (Near South Lake Avenue), 445-3131

The emergency number on campus which should be used to report medical emergencies is 457-7616.

Parking

There is adequate parking for all participants in the lot east of Indian Quad. Temporary parking at the front entrance will be permitted for 10–15 minutes for check-in purposes. There are no parking fees or sticker requirements.

Social Events

See the section on Meal Plans Only which appears earlier in this announcement for full details on the Lake George cruise, picnic, and beer party.

Travel

USAIR, the official carrier for the Albany meetings, has agreed to offer a 30 percent minimum discount to any participant purchasing tickets on its airline at least 14 days in advance through the Albany Meetings Travel SuperPhone. Other fares will, of course, still be available after the 14-day limitation. All participants are urged to consider this organization for their airline and hotel reservations. This service (which has an 800 number) is described in a box contained elsewhere in this announcement.

In August, Albany is on Eastern Daylight Saving Time.

There is regular airline service to Albany County Airport by several major airline carriers. The airport in Albany is approximately five miles from campus. The Ramada Inn provides free transportation to and from the airport, bus station and AMTRAK station. Call the hotel upon arrival.

Pine Hills Yellow Cab Company, whose airport number is 869-2258, provides both taxis and limousines in its service to the city of Albany and Albany County Airport. The one-way rate from the airport to the campus is \$9.90 for a single passenger, and \$6.40 per person for two or more persons in a taxi. Preregistrants were asked to supply airline flight arrival dates and times on the preregistration and housing form. If indications are that arrivals will be heavy on a particular flight, Pine Hills Yellow Cab Company will provide limousines at a \$4.90 per person rate. It is approximately a fifteen-minute ride by taxi from the airport to Indian Quad at SUNYA.

All participants using public transportation to reach the campus should instruct the driver to drop them off at the Indian Quad.

Albany is one-half mile from the intersection of I-90 (New York Thruway–Mass Pike) and I-87 (New York Thruway and Adirondack Northway). Follow I-90 East and take Exit 2 marked "Washington Avenue, SUNY."

TIMETABLE

LC = Lecture Center

THURSDAY, August 11	American Mathematical Society	MAA and Other Organizations
8:00 a.m. - 9:00 a.m.		IIME - DUTCH TREAT BREAKFAST
	SPECIAL SESSIONS	
8:00 a.m. - 10:50 a.m.	Several complex variables III	
8:00 a.m. - 10:20 a.m.	Dynamical systems II	
8:30 a.m. - 10:45 a.m.	The calculus of variations in the large and its applications II	
8:30 a.m. - 9:50 a.m.	Applications of algebraic topology II	
	SESSION FOR CONTRIBUTED PAPERS	
8:30 a.m. - 9:55 a.m.	Differential equations	
8:30 a.m. - 1:30 p.m.		ASSISTANCE & INFORMATION DESK LC Vestibule (Outside LC 7)
8:40 a.m. - 9:30 a.m.		MAA - INVITED ADDRESS Some connections between algebra and set theory Barbara L. Osofsky
8:40 a.m. - 9:30 a.m.		MAA - INVITED ADDRESS Progress report of the Commission on Precollege Education in Mathematics, Science, and Technology Katherine P. Layton
	SPECIAL SESSION	
9:00 a.m. - 10:50 a.m.	Summability methods I	
9:00 a.m. - noon		IIME - CONTRIBUTED PAPER SESSION
9:40 a.m. - 10:30 a.m.		MAA - INVITED ADDRESS Convexity ideas in geometric function theory Thomas H. MacGregor
11:00 a.m. - noon		MAA - THE EARLE RAYMOND HEDRICK LECTURES: Lecture III Some ideas in the development of Fourier analysis Elias M. Stein
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE IV On the Coxeter element and the structure of the exceptional Lie groups Bertram Kostant	
	SPECIAL SESSIONS	
1:00 p.m. - 3:05 p.m.	The calculus of variations in the large and its applications III	
1:00 p.m. - 4:50 p.m.	Summability methods II	
1:00 p.m. - 4:50 p.m.	Dynamical systems III	
1:00 p.m. - 3:20 p.m.	Solutions of operator equations and fixed points III	
1:00 p.m. - 3:20 p.m.	Several complex variables IV	
1:00 p.m. - 1:50 p.m.		MAA - INVITED ADDRESS Primality testing Carl Pomerance
2:00 p.m. - 2:50 p.m.		MAA - INVITED ADDRESS Galois' version of Galois theory Harold M. Edwards
3:30 p.m. - 5:00 p.m.		IIME - CONTRIBUTED PAPER SESSION

AMTRAK has a station in Rensselaer, 6 miles from campus. There are connections to Boston, New York City, Montreal, Buffalo, and Chicago. The cost of a cab from the AMTRAK station to the university is \$8 plus \$1 per person extra.

Greyhound and Trailways provide bus service from Boston, New York City, and Buffalo. The cost of the cab from the bus station to the university is \$7 plus 50 cents per person extra.

August Weather

Normal high	81°F
Normal low	59°F
Record high	99°F
Record low	37°F
Average August rain	2-8 inches
Probability of rain	35%
Average humidity	73%

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.

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*Special session speaker

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Program of the Sessions

The time limit for each contributed paper in the AMS general 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.

Abstracts of papers presented in AMS sessions at this meeting will be found in the August 1983 issue of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings below.

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

Monday, August 8, 1983, 8:30 a.m.

Invited Address

- 8:30– 9:30 (1) *Harmonic maps of Riemann surfaces*. JAMES EELLS, University of Warwick, United Kingdom (805-58-96)

Monday, August 8, 1983, 11:00 a.m.

Invited Address

- 11:00–12:00 (2) *Fourier transforms and representations of general linear groups*. WEN-CH'ING WINNIE LI, Pennsylvania State University, University Park (805-10-137)

Monday, August 8, 1983, 1:00 p.m.

Colloquium Lectures: Lecture I

- 1:00– 2:00 (3) *On the Coxeter element and the structure of the exceptional Lie groups*. BERTRAM KOSTANT, Massachusetts Institute of Technology

Monday, August 8, 1983, 2:15 p.m.

Special Session on Automorphic Functions and Automorphic Representations, I

- 2:15– 2:35 (4) *Differential operators on the hyperbolic upper half space and the Doi-Naganuma lifting*. SOLOMON FRIEDBERG, Harvard University (805-10-17)
- 2:40– 3:00 (5) *Representations of metaplectic groups over $GL(2)$ of local fields*. PAUL GERARDIN, Université Paris VII, France (805-22-45)
- 3:05– 3:25 (6) *Applications of the oscillator representation*. Preliminary report. STEVE RALLIS, Ohio State University, Columbus (805-10-51) (Introduced by Wen-Ch'ing Winnie Li)
- 3:30– 3:50 (7) *Langlands lifting from $GSp(4)$ to $GL(4)$* . I. PIATETSKI-SHAPIRO* and D. SOUDRY, Yale University and Tel Aviv University, Israel (805-20-30) (Introduced by Wen-Ch'ing Winnie Li)
- 3:55– 4:15 (8) *The multiplicity one theorem for $GL(n)$* . CARLOS JULIO MORENO, University of Illinois, Urbana-Champaign (805-10-67)

Monday, August 8, 1983, 2:15 p.m.

Special Session on Ergodic Theory Concerning Point Transformations With Finite Invariant Measure, I

- 2:15– 2:35 (9) *Law of the iterated logarithm for semiflows over maps of the interval*. SHERMAN WONG, Bernard M. Baruch College, City University of New York (805-60-77)
- 2:45– 3:05 (10) *More on "bad universal" sequences in ergodic theory*. ALEXANDRA BELLOW, Northwestern University (805-28-171)
- 3:15– 3:35 (11) *New proofs for the maximal ergodic theorem and the Hardy-Littlewood maximal theorem*. ROGER L. JONES, DePaul University (805-28-76)
- 3:45– 4:05 (12) *Sofic systems and data transmission*. Preliminary report. BRIAN MARCUS, KARL PETERSEN* and SUSAN WILLIAMS, University of North Carolina, Chapel Hill (805-28-48)
- 4:15– 4:35 (13) *Type III_1 transformations and their cocycle extensions*. V. S. PRASAD*, Université de Sherbrooke, J. CHOKSI, McGill University, and J. HAWKINS, State University of New York, Stony Brook (805-28-28)
- 4:45– 5:05 (14) *An example of a measure-preserving flow with minimal self-joinings*. KYEWON PARK* and ANDREW DEL JUNCO, Ohio State University, Columbus (805-28-49)
- 5:15– 5:35 (15) *Approximately transitive ergodic transformations*. Preliminary report. JANE M. HAWKINS, State University of New York, Stony Brook (805-28-170)

- 5:40– 6:00 (16) *On the nonexistence of contractive projections*. Preliminary report. ROBERT SINE, University of Rhode Island (805-46-181)

Monday, August 8, 1983, 2:15 p.m.

Special Session on Differential Analysis in Infinite Dimensional Spaces, I

- 2:15– 2:55 (17) *Spectral duality for smooth maps*. Preliminary report. LOUIS D. NEL, Carleton University (805-58-54)
- 3:00– 3:40 (18) *Approximation of differentiable functions on a Hilbert space*. M. P. HEBLE, University of Toronto (805-58-53)
- 3:50– 4:35 (19) *Polar subsets of locally convex spaces*. SEAN DINEEN, University College Dublin, Ireland (805-58-116)

Monday, August 8, 1983, 2:15 p.m.

Special Session on Tensor Products and p -summing Operators in Harmonic Analysis, I

- 2:15– 2:35 (20) *Harmonic analysis and duality*. MARTIN WALTER, University of Colorado, Boulder (805-43-16)
- 2:45– 3:05 (21) *A version of Chevet's theorem for stable variables*. Preliminary report. EVARIST GINÉ, MICHAEL B. MARCUS* and JOEL ZINN, Texas A&M University (805-60-44)
- 3:15– 3:35 (22) *Fourier pointwise convergence under dyadic rearrangements*. BRENT SMITH, California Institute of Technology (805-42-22)
- 3:45– 4:05 (23) *Liftings of generalized invariant Hilbertian forms in $l_+^1 \times l_-^1$* . Preliminary report. MISCHA COTLAR, Universidad Central de Venezuela, and CORA SADOSKY*, Howard University (805-43-174)
- 4:15– 4:35 (24) *Bimeasure algebras on locally compact groups*. JOHN E. GILBERT, University of Texas, Austin, TAKASHI ITO, Musashi Institute of Technology, Japan, and BERTRAM M. SCHREIBER*, Wayne State University (805-43-111)

Monday, August 8, 1983, 2:15 p.m.

Session on Algebra

- 2:15– 2:25 (25) *On a linear diophantine problem of Frobenius*. Preliminary report. BHARTI TEMKIN, Berkeley Heights, New Jersey (805-10-83) (Introduced by A. Odlyzko)
- 2:30– 2:40 (26) *Examples of non-isomorphic arithmetically equivalent fields*. FAWZI A. AL-DUKAIR, King Saud University, Saudi Arabia (805-12-02) (Introduced by Hugo Rossi)
- 2:45– 2:55 (27) *Spec(R), ideals and the Strong de Morgan's Law*. S. B. NIEFIELD and K. I. ROSENTHAL*, Union College, New York (805-13-123)
- 3:00– 3:10 (28) *Cross-symmetric matrices which are orthogonally similar to block diagonal matrices*. Preliminary report. JAMES R. WEAVER, University of West Florida (805-15-47)
- 3:15– 3:25 (29) *Commutative rings with no superdecomposable modules: A description*. PAUL E. JAMBOR, University of North Carolina, Wilmington (805-16-154)
- 3:30– 3:40 (31) *On subgroups of planar discontinuous groups*. R. N. KALIA*, Southwest State University, and G. ROSENBERGER, University of Dortmund, Federal Republic of Germany (805-20-149)

Monday, August 8, 1983, 2:15 p.m.

Session on Analysis

- 2:15– 2:25 (32) *Baire* 1 functions in general settings*. DARWIN E. PEEK, Trinity University (805-26-93)
- 2:30– 2:40 (33) *Rearrangements of functions*. JOHN A. CROWE, PAUL C. ROSENBLOOM and JOHN A. ZWEIBEL*, Columbia University (805-28-46)
- 2:45– 2:55 (34) *On rounding corners*. ROGER W. BARNARD and KENT PEARCE*, Texas Tech University (805-30-106)
- 3:00– 3:10 (35) *On support points and exposed points of some classes of analytic functions*. SHELTON PERERA, State University of New York, Albany (805-30-156)
- 3:15– 3:25 (36) *On possible Almansi expansions on the complement of a ball*. Preliminary report. THOMAS M. CREESE, University of Kansas (805-32-135)
- 3:30– 3:40 (37) *An integral formula in P_n for Riemann's zeta function*. THOMAS BENGTON, Miami University, Oxford (805-33-119)
- 3:45– 3:55 (38) *Series expansion of an elliptic integral near its singularity*. B. C. CARLSON, Ames Laboratory-DOE, Iowa State University (805-33-136)

Monday, August 8, 1983, 5:00 p.m.

Invited Address

- 5:00– 6:00 (39) *Riemann surfaces and their associated Wirtinger varieties*. ROBERT C. GUNNING, Princeton University (805-14-127)

Tuesday, August 9, 1983, 8:00 a.m.

Special Session on Automorphic Functions and Automorphic Representations, II

- 8:00– 8:20 (40) *Special values of modular functions*. Preliminary report. MARTIN L. KAREL, Rutgers University, Camden (805-10-33)
- 8:25– 8:45 (41) *Aut(C/Q) action on zeta-integrals and local constants of 1-dimensional representations*. STEPHEN V. ULLOM, University of Illinois, Urbana-Champaign (805-12-19)
- 8:50– 9:10 (42) *C_q operators and Brandt matrices*. Preliminary report. ARNOLD K. PIZER, University of Rochester (805-10-52)
- 9:15– 9:35 (43) *Diagonalizing modular forms*. WEN-CH'ING WINNIE LI, Pennsylvania State University, University Park (805-10-25)
- 9:40–10:00 (44) *Fourier coefficients of modular forms of halfintegral weight*. Preliminary report. A. O. L. ATKIN, University of Illinois, Chicago (805-10-63)
- 10:05–10:25 (45) *On the local Langlands conjecture*. Preliminary report. GUY HENNIART, Université Paris-Sud, France (805-12-66) (Introduced by Wen-Ch'ing Winnie Li)

Tuesday, August 9, 1983, 8:20 a.m.

Special Session on Topological Methods in Combinatorial Group Theory, I

- 8:20– 8:40 (46) *Covering space proofs in combinatorial group theory*. Preliminary report. MARVIN TRETAKOFF*, Institute for Advanced Study, and CAROL TRETAKOFF, Brooklyn College, City University of New York (805-20-172)
- 8:50– 9:10 (47) *A rewriting process for some subgroups of mapping class groups*. DARRYL MCCULLOUGH* and ANDY MILLER, University of Oklahoma (805-20-130)
- 9:20– 9:40 (48) *A combinatorial interpretation of the third integral homology of a group*. ALLAN J. SIERADSKI, University of Oregon (805-20-14) (Introduced by Edward C. Turner)
- 9:50–10:10 (49) *Imbeddings of Cayley graphs in the torus and the Klein bottle*. THOMAS W. TUCKER, Colgate University (805-57-173)
- 10:20–10:40 (50) *Automorphisms of freegroups in graph theory and topology*. JOHN R. STALLINGS, University of California, Berkeley (805-20-183)

Tuesday, August 9, 1983, 8:20 a.m.

General Session for Contributed Papers, I

- 8:20– 8:30 (51) *Associativity problems (AP) and the four-color problem (4CP). Further algebraic equivalents and historical acknowledgments*. Preliminary report. DOV TAMARI, New York, New York (805-05-62)
- 8:35– 8:45 (52) *Quadratic neofield extensions of finite fields*. TATIANA DERETSKY, University of California, Santa Barbara (805-05-29)
- 8:50– 9:00 (53) *Investigating connections among quantum logics*. Preliminary report. PATRICIA FRAZER LOCK, St. Lawrence University (805-06-139)
- 9:05– 9:15 (54) *An algorithm for raising a polynomial to an integral power*. DONALD R. SNOW, Brigham Young University (805-05-180)
- 9:20– 9:30 (55) *Interpolation for the generalized sampling sum of approximation theory*. ABDUL J. JERRI, Clarkson College of Technology (805-41-198)
- 9:35– 9:45 (56) *On trigonometric n-widths of Sobolev classes*. YULY MAKOVUZ, Oklahoma State University, Stillwater (805-41-129) (Introduced by John Wolfe)
- 9:50–10:00 (57) *Some new spaces of distributions with atomic decomposition*. GERALD COHEN, Florida International University (805-42-102)
- 10:05–10:15 (58) *Direct spiral tilings with an odd number of arms*. ANNE FONTAINE*, College of Saint Rose, and GEORGE E. MARTIN, State University of New York, Albany (805-51-121)
- 10:20–10:30 (59) *Optimal replacement when damage is either a Wiener process or the integral of a Markov chain*. FARAG A. ATTIA, Kuwait University (805-60-03)
- 10:35–10:45 (60) *On limit distributions of sums of renewal-reward processes*. JOSHUA LEVY, State University of New York, Albany (805-60-94)

Tuesday, August 9, 1983, 8:45 a.m.

Session on Topology

- 8:45– 8:55 (61) *(Local) mixers and (L)EC-spaces*. Preliminary report. CARLOS R. BORGES, University of California, Davis (805-54-09)
- 9:00– 9:10 (62) *Paracompact countable products*. Preliminary report. SCOTT W. WILLIAMS, State University of New York, Buffalo (805-54-160)
- 9:15– 9:25 (63) *Residues and outgrowths*. Preliminary report. JOHN E. MACK, University of Kentucky, and MARLON C. RAYBURN*, University of Manitoba (805-54-161)
- 9:30– 9:40 (64) *Some strong embeddings*. C. E. AULL, Virginia Polytechnic Institute and State University (805-54-155)
- 9:45– 9:55 (65) *Generalized continua and Newman's property*. L. F. MCAULEY*, State University of New York, Binghamton, and E. E. ROBINSON, Ithaca College (805-55-152)
- 10:00–10:10 (66) *Discrete open and closed mappings on generalized continua with Newman's property*. L. F. MCAULEY, State University of New York, Binghamton, and E. E. ROBINSON*, Ithaca College (805-54-153)
- 10:15–10:25 (67) *Cell-like mappings and noncompact spaces*. LEONARD R. RUBIN, University of Oklahoma (805-54-120)
- 10:30–10:40 (68) *Extra countably compact spaces*. VICTOR SAKS, Daemen College (805-54-103)

Tuesday, August 9, 1983, 9:00 a.m.

Special Session on Ergodic Theory Concerning Point Transformations with Finite Invariant Measure, II

- 9:00– 9:20 (69) *Expansive maps and hyperbolic canonical coordinates*. WILLIAM L. REDDY, Wesleyan University (805-54-133)
- 9:30– 9:50 (70) *Graphic minimal sets with disjoint powers*. NELSON G. MARKLEY, University of Maryland, College Park (805-54-50)
- 10:00–10:20 (71) *Classification of some finite Blaschke products as metric endomorphisms*. N. F. G. MARTIN, University of Virginia (805-28-38)
- 10:30–10:50 Discussion

Tuesday, August 9, 1983, 9:00 a.m.

Session on Functional Analysis

- 9:00– 9:10 (72) *Support points of the unit ball of H^p ($1 \leq p \leq \infty$)*. YUSUF ABU-MUHANNA, University of Petroleum and Minerals, Saudi Arabia (805-30-07) (Introduced by Hugo Rossi)
- 9:15– 9:25 (73) *Best L_∞ -approximation of measurable, vector-valued functions*. ABDALLAH M. AL-RASHED*, King Saud University, Saudi Arabia, and RICHARD B. DARST, Colorado State University (805-41-01)
- 9:30– 9:40 (74) *Norms of linear functionals on the space of bounded analytic functions on an annulus*. MICHAEL J. HOFFMAN, California State University, Los Angeles (805-46-200)
- 9:45– 9:55 (75) *Roots of invertibly weighted shifts with finite defect*. GERARD E. KEOUGH, Boston College (805-47-124)
- 10:00–10:10 (76) *Best simultaneous approximation in L_p norm and L_p quasi-norm*. Preliminary report. SALEM A. SAHAB* and S. M. KHALEELULLA, King Abdulaziz University, Saudi Arabia (805-46-13)
- 10:15–10:25 (77) *Compactness of the operator $A(x, D) - A(x, D)$ in the space $\mathcal{F}^{-1}(L^1(\mathbf{R}^n))$* . SAMUEL ZAIDMAN, Université de Montréal (805-47-61) (Introduced by Hugo Rossi)

Tuesday, August 9, 1983, 9:00 a.m.

Session on Geometry

- 9:00– 9:10 (78) *Classification of real semisimple graded Lie algebras*. WILLIAM A. HUBER, Columbia University (805-53-189)
- 9:15– 9:25 (79) *The signature theorem, briefly*. HOWARD OSBORN, University of Illinois, Urbana-Champaign (805-57-04)
- 9:30– 9:40 (80) *Almost Grassmannizable and almost algebraizable webs and webs of maximum 2-rank*. Preliminary report. VLADISLAV V. GOLDBERG, New Jersey Institute of Technology (805-53-84)
- 9:45– 9:55 (81) *The meaning of the "divergence" of a bivalent tensor*. PHILIP MANN and DOMINA EBERLE SPENCER*, University of Connecticut, Storrs (805-78-193)

Tuesday, August 9, 1983, 9:15 a.m.

Special Session on Tensor Products and p -summing Operators in Harmonic Analysis, II

- 9:15– 9:35 (82) *A question on interpolation sets for bimeasures.* Preliminary report. COLIN C. GRAHAM*, Northwestern University, and BERTRAM M. SCHREIBER, Wayne State University (805-43-112)
- 9:45–10:05 (83) *Construction techniques for some thin sets in duals of compact abelian groups.* D. HAJELA, Ohio State University, Columbus (805-43-110)
- 10:15–10:35 (84) *Uniformizable $\Lambda(2)$ sets, uniform integrability, and 2-associatedness.* JOHN J. F. FOURNIER, University of British Columbia (805-43-86)

Tuesday, August 9, 1983, 1:00 p.m.

Colloquium Lectures: Lecture II

- 1:00– 2:00 (85) *On the Coxeter element and the structure of the exceptional Lie groups.* BERTRAM KOSTANT, Massachusetts Institute of Technology

Tuesday, August 9, 1983, 2:15 p.m.

Invited Address

- 2:15– 3:15 (86) *On the residual spectrum of the linear group.* HERVÉ JACQUET, Columbia University (805-10-68)

Tuesday, August 9, 1983, 2:15 p.m.

Special Session on Several Complex Variables, I

- 2:15– 2:35 (87) *The complex Monge-Ampère equation.* J. J. KOHN, Princeton University (805-32-196)
- 2:45– 3:05 (88) *An intrinsic construction of the Fefferman metric.* Preliminary report. FRANK FARRIS, Brown University (805-32-56)
- 3:15– 3:35 (89) *The Yamabe problem on CR-manifolds.* Preliminary report. JOHN M. LEE*, Harvard University, and DAVID JERISON, Massachusetts Institute of Technology (805-32-69)
- 3:45– 4:05 (90) *The complex Monge-Ampère equation and scalar boundary invariants of strictly pseudoconvex domains.* Preliminary report. C. ROBIN GRAHAM, Courant Institute of Mathematical Sciences, New York University (805-32-184)
- 4:15– 4:35 (91) *Multiplicities for weakly pseudoconvex boundary points.* Preliminary report. JOHN P. D'ANGELO, University of Illinois, Urbana-Champaign (805-32-88)

Tuesday, August 9, 1983, 2:15 p.m.

Special Session on Differential Analysis in Infinite Dimensional Spaces, II

- 2:15– 2:55 (92) *Fourier transformation of smooth functions on l^p .* Preliminary report. BORIS MITYAGIN, Ohio State University, Columbus (805-46-199)
- 3:05– 3:50 (93) *Slices for actions of infinite dimensional groups.* Preliminary report. T. N. SUBRAMANIAM, Brandeis University (805-58-146)
- 4:00– 4:40 (94) *Minimax inequalities and applications.* KOK-KEONG TAN, Dalhousie University (805-58-85)
- 4:50– 5:30 (95) *Variational derivatives and p -gradients of functionals on spaces of continuously differentiable functions.* E. P. HAMILTON*, Washington College, and M. Z. NASHED, University of Delaware (805-58-205)

Tuesday, August 9, 1983, 2:15 p.m.

Special Session on Solutions of Operator Equations and Fixed Points, I

- 2:15– 2:35 (96) *Contractor directions with nonlinear majorant functions and iterative methods of contractor directions.* M. ALTMAN, Louisiana State University, Baton Rouge (805-47-15)
- 2:45– 3:05 (97) *A degree theory for quasilinear maps.* Preliminary report. PATRICK M. FITZPATRICK*, University of Maryland, College Park, and I. MASSABÓ and J. PEJSACHOWICZ, University of Calabria, Italy (805-46-105)
- 3:15– 3:35 (98) *A class of multivalued maps.* Preliminary report. GILLES FOURNIER* and DONALD VIOLETTE, Université de Sherbrooke (805-55-177)
- 3:45– 4:05 (99) *Remarks on the Browder-Göhde demiclosedness principle.* Preliminary report. W. A. KIRK, University of Iowa (805-47-113)
- 4:15– 4:35 (100) *Semigroup of nonexpansive mappings on a Hilbert space.* ANTHONY TO-MING LAU, University of Alberta (805-47-134)

4:45– 5:05 (101) *Fixed points and coincidence points*. DAVID G. BOURGIN, University of Houston, Houston (805-55-206)

Tuesday, August 9, 1983, 2:15 p.m.

Special Session on Topological Methods in Combinatorial Group Theory, II

- 2:15– 2:35 (102) *The word problem versus the isomorphism problem*. A. M. W. GLASS* and J. J. MADDEN, Wesleyan University (805-20-43)
- 2:45– 3:05 (103) *Matrix representations of Artin groups*. CRAIG SQUIER, University of California, Santa Barbara (805-20-182) (Introduced by Edward C. Turner)
- 3:15– 3:35 (104) *Presentation of a group of homeomorphisms*. R. KRAMER, University of British Columbia (805-20-87)
- 3:45– 4:05 (105) *Embeddings of acyclic 2-complexes in S^4 with simply-connected complement*. GUENTHER HUCK, Cornell University (805-57-157) (Introduced by Marshall M. Cohen)
- 4:15– 4:35 (106) *Group presentation, p -adic analytic groups and lattices in $SL_2(\mathbb{C})$* . ALEXANDER LUBOTZKY, Hebrew University of Jerusalem, Israel (805-20-197) (Introduced by Edward C. Turner)

Tuesday, August 9, 1983, 2:15 p.m.

Session on Number Theory

- 2:15– 2:25 (107) *A closed expression for the zeta function of odd integer argument*. C. MUSÈS, Centre de Recherches en Mathématiques, France (805-10-41) (Introduced by K. Demys)
- 2:30– 2:40 (108) *Taylor-Dirichlet series that satisfy an algebraic differential-difference equation*. Preliminary report. FRANK R. WADLEIGH, University of Bahrain (805-10-148)
- 2:45– 2:55 (109) *Researches on partitions revisited*. JOSEPH ARKIN, Spring Valley, New York (805-10-159)
- 3:00– 3:10 (110) *On the poles of a local zeta function for curves*. DIANE MEUSER, Boston University (805-12-138)

Wednesday, August 10, 1983, 8:30 a.m.

Invited Address

- 8:30– 9:30 (111) *Reverse mathematics*. LEO A. HARRINGTON, University of California, Berkeley (805-99-204)

Wednesday, August 10, 1983, 9:45 a.m.

Invited Address

- 9:45–10:45 (112) *The Schrödinger equation*. IRA W. HERBST, University of Virginia (805-81-118)

Wednesday, August 10, 1983, 1:00 p.m.

Colloquium Lectures: Lecture III

- 1:00– 2:00 (113) *On the Coxeter element and the structure of the exceptional Lie groups*. BERTRAM KOSTANT, Massachusetts Institute of Technology

Wednesday, August 10, 1983, 1:00 p.m.

Special Session on Several Complex Variables, II

- 1:00– 1:20 (114) *An exact fundamental solution for the heat equation for $\bar{\partial}$ on strictly pseudo-convex domains*. DAVID S. TARTAKOFF, University of Illinois, Chicago (805-32-164)
- 1:30– 1:50 (115) *Proper holomorphic correspondences and the Bergman projection*. STEVE BELL, Princeton University (805-32-125)
- 2:00– 2:20 (116) *Two results on the boundary behaviour of biholomorphic transformations*. B. L. FRIDMAN, Wichita State University (805-32-20)
- 2:25– 2:45 (117) *Vanishing theorem for semipositive line bundles over non-Kähler manifolds*. YUM-TONG SIU, Harvard University (805-32-126)
- 2:50– 3:10 (118) *Application of an extension theorem of closed positive currents to Kähler geometry*. NGAIMING MOK, Princeton University (805-32-192) (Introduced by R. Michael Range)
- 3:15– 3:35 (119) *Approximation of totally flat CR-manifolds*. Preliminary report. HUGO ROSSI, University of Utah (805-32-104)
- 3:45– 4:05 (120) *The hull of holomorphy of an n -manifold in \mathbb{C}^n* . Preliminary report. SIDNEY M. WEBSTER* and CARLOS E. KENIG, University of Minnesota, Minneapolis (805-32-142)
- 4:15– 4:35 (121) *C - R flat hypersurfaces*. JIRI DADOK, Indiana University, Bloomington, and PAUL YANG*, University of Southern California (805-32-186)

Wednesday, August 10, 1983, 1:00 p.m.

Special Session on Dynamical Systems, I

- 1:00– 1:20 (122) *A partial ordering of permutations induced by continuous maps of the real line.* Preliminary report. CHRIS BERNHARDT, Lafayette College (805-58-92)
- 1:30– 1:50 (123) *Bifurcations of circle maps: Arnol'd tongues, bistability and rotation intervals.* Preliminary report. PHILIP BOYLAND, University of Iowa (805-58-40)
- 2:00– 2:20 (124) *A generalization of L. Block's results on simple periodic orbits.* CHUNG-WU HO, Southern Illinois University, Edwardsville (805-58-166)
- 2:30– 2:50 (125) *Stratification of the space of interval maps.* LOUIS BLOCK and DAVID HART*, University of Florida (805-58-167)
- 3:00– 3:20 (126) *A very small remark on smooth Denjoy counterexamples.* GLEN R. HALL, Mathematics Research Center, Madison (805-58-108)
- 3:30– 3:50 (127) *Spectral decomposition of a Markov operator.* TIEN-YIEN LI, Michigan State University (805-60-140) (Introduced by Louis Block)
- 4:00– 4:20 (128) *Cellular automata as dynamical systems.* Preliminary report. JOHN MILNOR, Institute for Advanced Study (805-68-109)

Wednesday, August 10, 1983, 2:00 p.m.

Special Session on The Calculus of Variations in the Large and its Applications, I

- 2:00– 2:30 (129) *The calculus of variations approach to Einstein metrics on compact Kähler manifolds.* MEL S. BERGER, University of Massachusetts, Amherst (805-58-71)
- 2:35– 3:05 (130) *On a generalized Lane-Emden equation.* Preliminary report. WEI-MING NI, University of Minnesota, Minneapolis (805-35-10)
- 3:10– 3:40 (131) *Applications of multiple valued functions.* F. ALMGREN, Princeton University (805-49-89)
- 3:45– 4:15 (132) *A modulus of asymmetry and lower bounds for capacity.* Preliminary report. L. E. FRAENKEL, University of Sussex, England (805-49-98) (Introduced by Melvyn S. Berger)

Wednesday, August 10, 1983, 2:15 p.m.

Invited Address

- 2:15– 3:15 (133) *The topology of real algebraic sets.* Preliminary report. SELMAN AKBULUT, Michigan State University and Max-Planck-Institut für Plasmaphysik Library, Federal Republic of Germany (805-57-117)

Wednesday, August 10, 1983, 2:15 p.m.

Special Session on Solutions of Operator Equations and Fixed Points, II

- 2:15– 2:35 (134) *On fixed point stability for set valued contractions and nonexpansive set valued mappings.* TECK-CHEONG LIM, George Mason University (805-46-82)
- 2:45– 3:05 (135) *Spurious numerical solutions of initial and boundary value problems.* Preliminary report. A. M. ALBANO and MARIO MARTELLI*, Bryn Mawr College (805-34-145)
- 3:15– 3:35 (136) *Fixed points for mappings and families of mappings in locally convex spaces.* Preliminary report. S. A. NAIMPALLY, Lakehead University, K. L. SINGH*, University of Minnesota, Duluth, and J. H. M. WHITFIELD, Lakehead University (805-47-178)
- 3:45– 4:05 (137) *Operator equations involving multi-valued and/or nondensely defined linear operators.* SUNG J. LEE, University of South Florida, Tampa, and M. ZUHAIR NASHED*, University of Delaware (805-47-190)
- 4:15– 4:35 (138) *Solvability of periodic BV problems for nonlinear ODE's via the A-proper mapping theory.* W. V. PETRYSHYN, Rutgers University, New Brunswick (805-34-176)

Wednesday, August 10, 1983, 2:15 p.m.

Special Session on Differential Analysis in Infinite Dimensional Spaces, III

- 2:15– 2:55 (139) *Differential analysis and geometry of Banach spaces— isomorphism theory.* K. SUNDARESAN*, Cleveland State University, and S. SWAMINATHAN, Dalhousie University (805-58-58)
- 3:00– 3:40 (140) *The impact of gauge theory on infinite dimensional nonlinear analysis.* MEL S. BERGER, University of Massachusetts, Amherst (805-58-72)
- 3:45– 4:30 (141) *Group analysis of some partial differential equations arising in applications.* Preliminary report. C. C. A. SASTRI, Dalhousie University (805-58-27)

Wednesday, August 10, 1983, 2:15 p.m.

General Session for Contributed Papers, II

- 2:15– 2:25 (142) *The complexity of computing the covering radius of a code.* AILEEN M. MCLOUGHLIN, Trinity College, Ireland (805-68-201) (Introduced by Rodney W. Johnson)
- 2:30– 2:40 (143) *Algorithms for the decomposition of convex polygons.* Preliminary report. RUTH SILVERMAN, Fairfield University, and ALAN H. STEIN*, University of Connecticut, Waterbury (805-68-150)
- 2:45– 2:55 (144) *Age structure and the paradox of enrichment.* Preliminary report. DAVID J. WOLLKIND* and JAMES SMITH, Washington State University (805-92-162) (Introduced by H. Clare Wiser)
- 3:00– 3:10 (145) *Evaluation of flowgraphs: A generalization.* Preliminary report. MARIALUISA N. MCALLISTER, Moravian College (805-94-158) (Introduced by Everett Pitcher)
- 3:15– 3:25 (146) *A determinant form for non-linear divided differences, with applications.* HERBERT E. SALZER, Brooklyn, New York (805-65-12)
- 3:30– 3:40 (147) *An adaptive competing species model with strange attractors.* V. W. NOONBURG, University of Hartford (805-92-95)

Wednesday, August 10, 1983, 3:00 p.m.

Special Session on Applications of Algebraic Topology, I

- 3:00– 3:20 (148) *Thom modules.* Preliminary report. DAVID HANDEL, Wayne State University (805-55-35)
- 3:30– 3:50 (149) *A local formula for the total surgery obstruction.* NORMAN LEVITT*, Rutgers University, New Brunswick, and ANDREW RANICKI, University of Edinburgh, Scotland (805-57-57)
- 4:00– 4:20 Discussion

Wednesday, August 10, 1983, 3:30 p.m.

Invited Address

- 3:30– 4:30 (150) *Functional equations over a group and the mean value property.* J. H. B. KEMPERMAN, University of Rochester (805-39-202)

Wednesday, August 10, 1983, 4:45 p.m.

AMS Prize Session and Business Meeting

Thursday, August 11, 1983, 8:00 a.m.

Special Session on Several Complex Variables, III

- 8:00– 8:20 (151) *Special exhaustions on affine manifolds.* Preliminary report. DANIEL M. BURNS, JR., University of Michigan, Ann Arbor (805-32-144)
- 8:30– 8:50 (152) *C^k estimates for the Cauchy-Riemann equations on some weakly pseudoconvex domains.* JERZY RYCZAJ, Technical University, Poland (805-32-90)
- 9:00– 9:20 (153) *Eigenfunctions of the invariant Laplacian in B .* WALTER RUDIN, University of Wisconsin, Madison (805-32-18)
- 9:30– 9:50 (154) *Interpolation, and inner maps that preserve measure.* BOGUSLAW THOMASZEWSKI, University of Wisconsin, Madison (805-46-74)
- 10:00–10:20 (155) *Further defect relations for meromorphic functions on C^n .* BERNARD SHIFFMAN, Johns Hopkins University (805-32-165)
- 10:30–10:50 (156) *Positive-definiteness and its application to interpolation problems for holomorphic functions.* FRANK BEATROUS* and JACOB BURBEA, University of Pittsburgh, Pittsburgh (805-32-128)

Thursday, August 11, 1983, 8:00 a.m.

Special Session on Dynamical Systems, II

- 8:00– 8:20 (157) *Consequences of topological stability.* MIKE HURLEY, Case Western Reserve University (805-58-132)
- 8:30– 8:50 (158) *Verifying the existence of periodic solutions by discrete determination of the Poincaré index.* RUSSELL B. WALKER, Montana State University (805-58-39)
- 9:00– 9:20 (159) *A computer assisted study of the transition from super- to subcritical Hopf bifurcation for parameterized families of maps of the plane.* Preliminary report. D. ARONSON, J. JOHNSON and R. MCGHEE*, University of Minnesota, Minneapolis (805-34-168)
- 9:30– 9:50 (160) *Tori in resonance.* Preliminary report. KENNETH MEYER, University of Cincinnati, Cincinnati (805-34-05)

10:00–10:20 (161) *Cascade of sinks*. Preliminary report. CLARK ROBINSON, Northwestern University (805-58-141)

Thursday, August 11, 1983, 8:30 a.m.

Special Session on The Calculus of Variations in the Large and its Applications, II

- 8:30– 9:00 (162) *Stability analysis of ground states of nonlinear Schrödinger equations*. MICHAEL I. WEINSTEIN, Stanford University (805-35-70)
- 9:05– 9:35 (163) *An extension of the Mountain Pass lemma*. KUNG-CHING CHANG, Peking University, People's Republic of China (805-49-21) (Introduced by Melvyn S. Berger)
- 9:40–10:10 (164) *Equilibrium shapes of crystals under gravity and solutions to other crystalline variational problems*. Preliminary report. JEAN E. TAYLOR, Rutgers University, New Brunswick (805-49-91)
- 10:15–10:45 (165) *A selection principle for a nonlinear eigenvalue problem*. GEORGE H. KNIGHTLY*, University of Massachusetts, Amherst, and D. SATHER, University of Colorado, Boulder (805-35-32)

Thursday, August 11, 1983, 8:30 a.m.

Special Session on Applications of Algebraic Topology, II

- 8:30– 8:50 (166) *Geometric applications of lower algebraic K-theory*. Preliminary report. DOUGLAS R. ANDERSON, Syracuse University (805-57-73)
- 9:00– 9:20 (167) *Geometric K theory for Lie groups and foliations*. PAUL BAUM*, Brown University, and ALAIN CONNES, I.H.E.S., France (805-58-78)
- 9:30– 9:50 Discussion

Thursday, August 11, 1983, 8:30 a.m.

Session on Differential Equations

- 8:30– 8:40 (168) *Multi-frequency excitations in Duffing's oscillator*. D. P. GUPTA, Bright Star University of Technology, Libya (805-34-122)
- 8:45– 8:55 (169) *Lipschitz stability of nonlinear systems*. Preliminary report. SABER ELAYDI* and FOZI DANNAN, Kuwait University (805-34-08)
- 9:00– 9:10 (170) *Further-generalized solutions of algebraic differential equations*. LEE A. RUBEL, University of Illinois, Urbana-Champaign (805-34-195)
- 9:15– 9:25 (171) *Representing a partial differential equation in terms of an infinite variety of integrable and nonintegrable systems of ordinary differential equations*. Preliminary report. MIKE MIKALAJUNAS, Montréal, Quebec (805-35-06)
- 9:30– 9:40 (172) *Quasi-analyticity for hypoelliptic operators*. Preliminary report. RAM S. PATHAK, King Saud University, Saudi Arabia (805-35-34) (Introduced by Ali H. Azzam)
- 9:45– 9:55 (174) *Modelling crime via simple differential equations*. Preliminary report. ALAN HOENIG, John Jay College of Criminal Justice, City University of New York (805-90-194)

Thursday, August 11, 1983, 9:00 a.m.

Special Session on Summability Methods, I

- 9:00– 9:20 (175) *Toeplitz-type theorems for paths in lozenges*. BRUCE L. R. SHAWYER, University of Western Ontario (805-40-80) (Introduced by Billy E. Rhoades)
- 9:30– 9:50 (176) *The position of little Nörlund means in Δ* . J. DEFranza*, Youngstown State University, and D. J. FLEMING, St. Lawrence University (805-40-42)
- 10:00–10:20 (177) *Generalized Hausdorff matrices as bounded operators on l^p* . DAVID BORWEIN, University of Western Ontario (805-40-26)
- 10:30–10:50 (178) *Matrix summability of Fourier series based on inclusion theorems*. BILLY E. RHOADES, Indiana University, Bloomington (805-42-79)

Thursday, August 11, 1983, 1:00 p.m.

Colloquium Lectures: Lecture IV

- 1:00– 2:00 (179) *On the Cozeter element and the structure of the exceptional Lie groups*. BERTRAM KOSTANT, Massachusetts Institute of Technology

Thursday, August 11, 1983, 1:00 p.m.

Special Session on The Calculus of Variations in the Large and its Applications, III

- 1:00– 1:30 (180) *Variational problems for unbounded functionals*. Preliminary report. MARTIN SCHECHTER, Courant Institute of Mathematical Sciences, New York University, and Yeshiva University (805-35-99)

- 1:35– 2:05 (181) *Degree theoretic versus variational methods for certain partial differential equations*. Preliminary report. CHARLES J. AMICK, University of Chicago (805-35-97) (Introduced by Melvyn S. Berger)
- 2:10– 2:40 (182) *Globally convergent procedures for solving nonlinear variational problems*. Preliminary report. ALEXANDER EYDELAND, University of Massachusetts, Amherst (805-49-31)
- 2:45– 3:05 Survey of Open Problems

Thursday, August 11, 1983, 1:00 p.m.

Special Session on Summability Methods, II

- 1:00– 1:20 (183) *Strong summability in BK-spaces and L^p multipliers*. MARTIN G. BUNTINAS, Loyola University of Chicago (805-42-37)
- 1:30– 1:50 (184) *Summability; sectional boundedness and μ* . ALBERT WILANSKY, Lehigh University (805-40-115)
- 2:00– 2:20 (185) *On summability invariants*. Preliminary report. WOLFGANG BEEKMANN, Fernuniversität, Federal Republic of Germany, and SHAO-CHIEN CHANG*, Brock University (805-40-24)
- 2:30– 2:50 (186) *Associativity and invariance properties in summability fields*. Preliminary report. WOLFGANG BEEKMANN*, Fernuniversität, Federal Republic of Germany, and SHAO-CHIEN CHANG, Brock University (805-40-60)
- 3:00– 3:20 (187) *The inclusion classification problem for conull spaces*. Preliminary report. A. K. SNYDER, Lehigh University (805-40-36)
- 3:30– 3:50 (188) *Summability and substructures of $2^{\mathbb{N}}$* . R. T. SAMARATUNGA, Simon Fraser University, and J. J. SEMBER*, Simon Fraser University (805-40-23)
- 4:00– 4:20 (189) *Lacunary sets and sequence spaces*. ALLEN R. FREEDMAN, Simon Fraser University (805-40-101)
- 4:30– 4:50 (190) *The strong ϕ topology on symmetric sequence spaces*. Preliminary report. WILLIAM H. RUCKLE, Clemson University (805-40-59)

Thursday, August 11, 1983, 1:00 p.m.

Special Session on Dynamical Systems, III

- 1:00– 1:20 (191) *A class of vectorfields on S^2 that have polynomial models*. STEPHEN SCHECTER* and MICHAEL F. SINGER, North Carolina State University (805-58-131)
- 1:30– 1:50 (192) *Global asymptotic volume estimates for some endomorphisms*. HELENA S. WISNIEWSKI, Rochester Institute of Technology (805-58-188)
- 2:00– 2:20 (193) *Orientation preserving Morse-Smale diffeomorphisms on compact surfaces*. Preliminary report. STEVE BATTERSON, Emory University, Atlanta (805-58-187)
- 2:30– 2:50 (194) *Essentially expanding basic sets*. Preliminary report. DENNIS PIXTON, State University of New York, Binghamton (805-58-185)
- 3:00– 3:20 (195) *Dynamical behavior of a two-species, eco-genetic model*. Preliminary report. JAMES SELGRADE* and GENE NAMKOONG, North Carolina State University (805-34-100)
- 3:30– 3:50 (196) *Integral homology of Smale diffeomorphisms*. MICHAEL MALLER* and MICHAEL SHUB, Queens College, City University of New York (805-58-107)
- 4:00– 4:20 (197) *Vector fields and transverse foliations*. Preliminary report. SUE GOODMAN, University of North Carolina, Chapel Hill (805-58-169)
- 4:30– 4:50 (198) *Entropy and knots*. JOHN FRANKS and R. F. WILLIAMS*, Northwestern University (805-58-203)

Thursday, August 11, 1983, 1:00 p.m.

Special Session on Solutions of Operator Equations and Fixed Points, III

- 1:00– 1:20 (199) *Interval methods for fixed-point problems*. L. B. RALL, Mathematics Research Center, Madison (805-65-65)
- 1:30– 1:50 (200) *Fixed points of holomorphic functions*. SIMEON REICH, University of Southern California (805-47-11)
- 2:00– 2:20 (201) *A random fixed point theorem*. V. M. SEHGAL, University of Wyoming, and S. P. SINGH*, Memorial University of Newfoundland (805-47-64)
- 2:30– 2:50 (202) *A variant of a theorem of Browder-Fan and Reich*. V. M. SEHGAL, University of Wyoming (805-47-175)
- 3:00– 3:20 (203) *Geometric constructions and the fixed point property*. S. THOMEIER, Memorial University of Newfoundland (805-55-179)

Thursday, August 11, 1983, 1:00 p.m.

Special Session on Several Complex Variables, IV

- 1:00– 1:20 (204) *Approximation of singularity sets by analytic varieties*. Preliminary report. JOHN WERMER, Brown University (805-32-147)
- 1:30– 1:50 (205) *Subharmonicity and function algebras*. Preliminary report. H. ALEXANDER, University of Illinois, Chicago (805-32-143)
- 2:00– 2:20 (206) *Composition operations on $H^2(B)$* . Preliminary report. JOSEPH CIMA*, CHARLES STANTON, and WARREN WOGEN, University of North Carolina, Chapel Hill (805-32-75)
- 2:30– 2:50 (207) *A new class of entire functions with asymptotic expansions at infinity*. Preliminary report. DARYL GELLER, State University of New York, Stony Brook (805-32-55)
- 3:00– 3:20 (208) *Automorphism groups of strongly pseudoconvex domains*. Preliminary report. WILLIAM R. ZAME, State University of New York, Buffalo (805-32-191)

Salt Lake City, Utah

Hugo Rossi
Associate Secretary

**CONFERENCE PROCEEDINGS OF THE
CANADIAN MATHEMATICAL SOCIETY**

**Current Trends
in Algebraic Topology**

**Richard M. Kane, Stanley O. Kochman,
Paul S. Selick, and Victor P. Snaith, Editors**

Current trends in algebraic topology is the proceedings of a conference by the same name held at the University of Western Ontario, London, Ontario from June 29 to July 10, 1981. It contains papers which were presented at the conference and some related papers.

The book contains research papers in topology and so potential readers should be at least at the level of graduate students in topology. Since the book is a collection of research papers from different areas, papers of interest to any individual will vary according to his or her research interests. Anyone doing research in topology is likely to find some papers of interest.

Contents of Part 1

ALGEBRAIC K-THEORY, with papers by R. Charney, M. Karoubi, E. Lluis-Puebla and V. Snaith, V. Snaith (two papers), C. Soulé, J. Stienstra, R. Thomason, and F. Waldhausen

GENERALIZED HOMOLOGY AND COHOMOLOGY, with papers by J. Boardman, P. Landweber and Z. Yosimura, H. Miller and V. Snaith, D. Ravenel, and R. Seymour

HOMOTOPY THEORY, with papers by R. Bruner, F. Cohen, D. Davis and M. Mahowald, J. Neisendorfer and P. Selick, and P. Selick

H-SPACES, with papers by J. Harper and R. Kane

ORDINARY HOMOLOGY AND COHOMOLOGY, with papers by A. Bahri, A. Baker, S. Kochman, D. Kraines and T. Lada, J. McCleary, S. Papastavridis, and D. Pengelley

Contents of Part 2

ALGEBRAIC VARIETIES, with papers by P. Baum, W. Browder and N. Katz, and J. Harper and R. Mandelbaum

GROUP ACTIONS, with papers by A. Assadi, H. Dovermann, I. Hambleton and I. Madsen, S. Illman, S. Kahn, L. G. Lewis, J. P. May and J. E. McClure, T.-Y. Lin, A. Liulevicius, J. P. May and J. E. McClure, T. Petrie, R. Schultz, J. Tornehave, M. Wang, and A. Zabrodsky

MANIFOLDS AND STRUCTURES ON MANIFOLDS, with papers by M. Frame, J.-C. Hausmann, W.-C. Hsiang and B. Jahren, N. Levitt, and S. Weinberger

TRANSFER, with papers by H. Miller, H. Munkholm and E. Pedersen, and H. Munkholm and A. Ranicki

1980 *Mathematics Subject Classifications*: 55-06; 18F25, 55N20, 55N22, 55P35 & others.

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Fairfield, October 28–29, 1983, Fairfield University

Second announcement of the 806th meeting

The eight hundred and sixth meeting of the American Mathematical Society will be held at Fairfield University in Fairfield, Connecticut, on Friday and Saturday, October 28 and 29, 1983.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there will be three invited one-hour addresses. The speakers, their affiliations, and the titles of their talks, are as follows:

JOHN L. HARER, Columbia University and the University of Maryland, *Homology of the moduli space of curves*.

JOHN HUBBARD, Cornell University and Harvard University, *Dynamics of rational maps*.

DANIEL J. KLEITMAN, Massachusetts Institute of Technology, *Dependent intervals*.

Special Sessions

By invitation of the same committee, there will be five special sessions of selected twenty-minute papers. The topics of these special sessions, the names and affiliations of the mathematicians arranging them, and tentative lists of speakers are:

Theory of infinite groups, BEN FINE, Fairfield University. The speakers include Seymour Bachmuth, Tony Gaglione, Richard Goldstein, Roger Lyndon, John Ratcliffe, Carol Tretkoff, Marvin Tretkoff, Peter Waterman, and Ken Weston.

Surfaces and three-manifolds, WILLIAM GOLDMAN, Massachusetts Institute of Technology and the University of Maryland, and JOHN L. HARER. The speakers include William Abikoff, Ruth Charney, Matthew Grayson, Steve Kerckhoff, Larry Lok, Howard Masur, John McCarthy, Edward Miller, Lee Mosher, Steven Polnick, Patricia Snipe, and Scott Wolpert.

Combinatorics, DANIEL J. KLEITMAN. The speakers include Michael D. Albertson, Kenneth P. Baclawski, Kenneth Berman, Fan Chung, Paul Edelman, Ira M. Gessel, Ronald L. Graham, Curtis Greene, Joan P. Hutchinson, Jeffrey Kahn, Jeffrey C. Lagarias, David R. Richman, Gian-Carlo Rota, Michael Saks, Richard P. Stanley, and Herbert S. Wilf.

Approximation theory and numerical analysis, JOHN A. ROULIER, University of Connecticut. The speakers include Myron Henry, J. Lewis, H. W. McLaughlin, C. Micchelli, D. Pence, T. J. Rivlin, O. Shisha, and D. Zwick.

Topics in complex analysis, DOROTHY B. SHAFFER, Fairfield University. The speakers include Milne Anderson, Roger Barnard, Bettye Anne Case, David Hamilton, Walter Hengartner, Y. J. Leung, Richard Libera, Albert Livingston, Tom MacGregor,

Peter McCoy, Ed Merkes, Sanford S. Miller, David Minda, George Piranian, Jack Quine, Maxwell Reade, Burton Rodin, Glen Schober, Herb Silverman, Ted J. Suffridge, Evelyn Sylvia, and Anna Tsao.

Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form, and submit it by **August 2**, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics. Abstracts should be sent to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the deadline of **August 23**. Members are reminded that a charge of \$12 is imposed for retyping abstracts that are not in camera-ready form.

It appears unlikely that late papers can be accommodated.

Registration

The meeting registration desk will be located in the Lobby of Gonzaga Hall, and will be open from 12:30 p.m. to 5:30 p.m. on Friday, and from 8:30 a.m. to 1:30 p.m. on Saturday. The registration fees are \$10 for members, \$16 for nonmembers, and \$5 for students or unemployed mathematicians.

Accommodations

Rooms have been blocked at the Fairfield Motor Inn. Individuals should make their own reservations, and identify themselves as participants in the American Mathematical Society's meeting at Fairfield University. The cut-off date for reservations is August 15, after which rooms will be assigned on a space-available basis. The rates listed below are subject to possible change and do not include applicable taxes.

Fairfield Motor Inn (1.6 miles)

417 Post Road, Fairfield 06430

Telephone: 203-255-0491

Single \$50.50

Double \$60.50

Although rooms have not been blocked at the following motels, they are included here for information purposes.

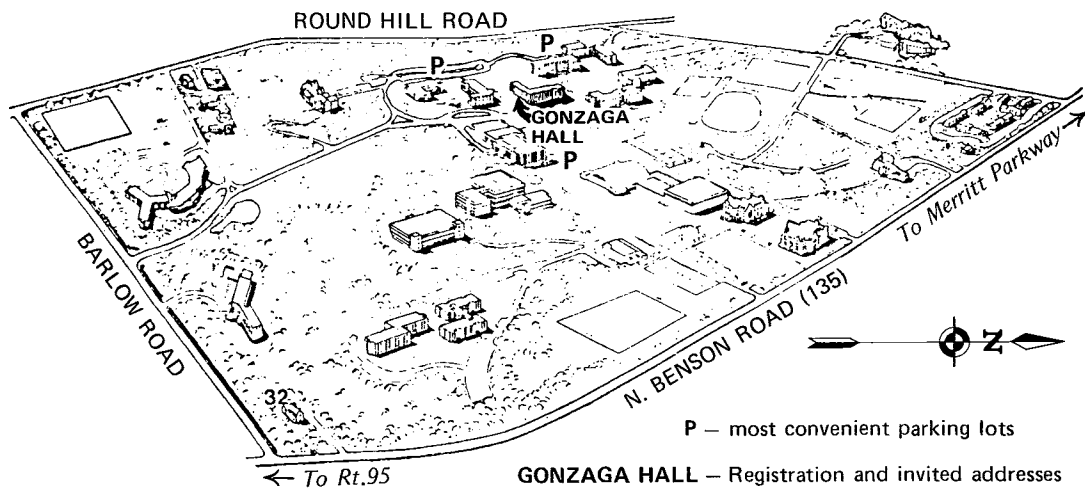
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Black Rock Turnpike, Fairfield 06430

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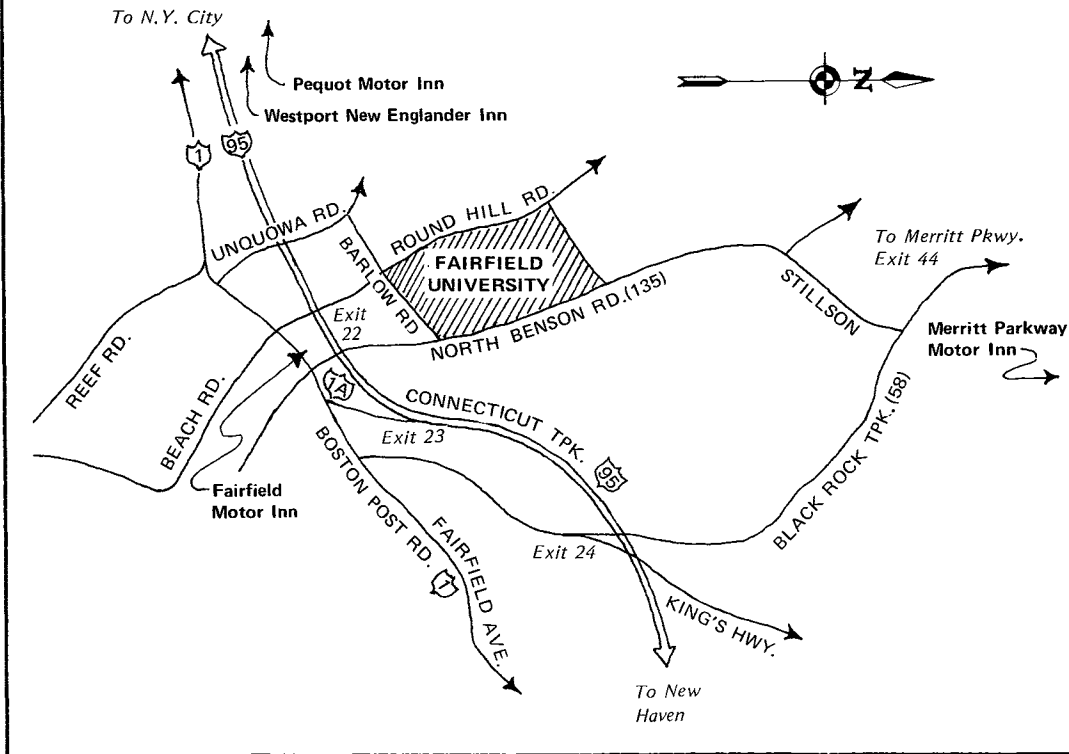
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Pequot Motor Inn (4.5 miles)
3471 Post Road, Fairfield 06430
Telephone: 203-259-7885

Single or Double \$48
(The Pequot Motor Inn has a few family suites at \$65 per night, which can accommodate groups of four.)

Westport New Englander Inn (5 miles)
1595 Post Road East, Westport 06880
Telephone: 203-259-5236

Single or Double \$75

Parking

Ample free parking will be available at several lots scattered about the campus.

Travel

The Metropolitan Transit Authority provides frequent commuter service between Grand Central Station in New York City and New Haven, Connecticut, with Fairfield as an intermediate stop. The train station in Fairfield is approximately 1.5 miles from campus, and economical taxi service is available. Many trains on Amtrak's Northeast corridor service (operating between Boston and Washington) stop at Bridgeport, which is about five miles from the

Fairfield University campus. Taxi service is available from the station. Amtrak tickets to Bridgeport are sold only from locations south of New York or east of New Haven.

For those driving to the meeting, Fairfield University is very close to Exit 22 of the Connecticut Turnpike, and is about 10 minutes from Exit 44 of the Merritt Parkway.

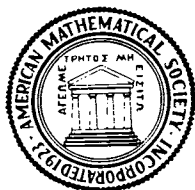
Since there is no scheduled airline service to Fairfield, participants are advised to obtain flights into LaGuardia or Kennedy Airports in New York. From there, the Connecticut Limousine service is a reliable company whose cars and buses depart from both these airports at intervals not exceeding one hour. The ride to Fairfield takes approximately 90 minutes. The cost is \$18 one way or \$35 round trip. Upon request, passengers are delivered to the Fairfield Motor Inn or to the Westport New Englander Inn.

Social Event

A beer party is scheduled to be held at 8:30 p.m. on Friday. Details will be announced in the October issue of the *Notices*.

W. Wistar Comfort
Associate Secretary

Middletown, Connecticut



Mathematical Surveys and Monographs

APPROXIMATION BY POLYNOMIALS WITH INTEGRAL COEFFICIENTS

by *Le Baron O. Ferguson*

Results in the approximation of functions by polynomials with coefficients which are integers have been appearing since that of Pál in 1914. The body of results has grown to an extent which seems to justify the present book. The intention here is to make these results as accessible as possible.

The book addresses essentially two questions. The first is the question of what functions can be approximated by polynomials whose coefficients are integers and the second question is how well are they approximated (Jackson type theorems). For example, a continuous function f on the interval $-1, 1$ can be uniformly approximated by polynomials with integral coefficients if and only if it takes on integral values at $-1, 0$ and $+1$ and the quantity $f(1) + f(0)$ is divisible by 2. The results regarding the second question are very similar to the corresponding results regarding approximation by polynomials with arbitrary coefficients. In particular, nonuniform estimates in terms of the modules of continuity of the approximated function are obtained.

Aside from the intrinsic interest to the pure mathematician, there is the likelihood of important

applications to other areas of mathematics; for example, in the simulation of transcendental functions on computers. In most computers, fixed point arithmetic is faster than floating point arithmetic and it may be possible to take advantage of this fact in the evaluation of integral polynomials to create more efficient simulations. Another promising area for applications of this research is in the design of digital filters. A central step in the design procedure is the approximation of a desired system function by a polynomial or rational function. Since only finitely many binary digits of accuracy actually can be realized for the coefficients of these functions in any real filter the problem amounts (to within a scale factor) to approximation by polynomials or rational functions with integral coefficients.

This book should make the task of finding out what is known in this field significantly easier as it presents an introduction to most of the known results in the area of approximation by polynomials with integral (integer) coefficients and pointers to the literature for the rest. It is accessible to students at the graduate level and above.

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San Luis Obispo, November 11–12, 1983, California Polytechnic State University

Second announcement of the 807th meeting

The eight hundred and seventh meeting of the American Mathematical Society will be held at California Polytechnic State University in San Luis Obispo, California, on Friday and Saturday, November 11 and 12, 1983. This meeting will be held in conjunction with a meeting of the Mathematical Association of America (MAA).

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there will be two invited one-hour addresses. The speakers, their affiliations, and the titles of their talks, are as follows:

PETER B. GILKEY, University of Oregon, *Applications of analysis to topology*.

T. Y. LAM, University of California, Berkeley, *The arithmetic of fields*.

Special Sessions

By invitation of the same committee, there will be six special sessions of selected twenty-minute papers. The topics of these special sessions and the names and affiliations of the mathematicians arranging them, are:

Geometric methods for partial differential equations, IAN M. ANDERSON, Utah State University. The speakers will include J. Arms, D. Bao, D. M. DeTurck, T. Duchamp, D. J. Eck, D. G. B. Edelen, M. Gotay, J. Isenberg, J. P. S. Kung, B. A. Kuperschmidt, J. Marsden, R. Montgomery, P. Olver, H. Rund, W. F. Shadwick, C. Shakiban, J. Sniatycki, S. L. Steinberg, and P. B. Yasskin.

Singular perturbations, E. COUTSIAS, University of New Mexico and J. MUELLER, California Polytechnic State University. The speakers will include E. Coutsias, P. Hagan, W. Kath, C. Lange, and J. Neu.

The lower division curriculum in mathematics, including calculus, MARTIN FLASHMAN, Humboldt State University. The list of speakers will include R. Borell, P. Curtiss, M. Flashman, and S. Stein.

Numerical partial differential equations, WLODEK PROSKUROWSKI, University of Southern California. The speakers will include Randy Bank, Ray Chin, Paul Concus, Jerry Hedstrom, Mark Kac, Randy LeVeque, Stan Osher, J. Sethian, Roland Sweet, and Helen Yee.

Automorphic forms, AUDREY A. TERRAS, University of California, San Diego. The speakers will include D. W. Andreoli, J. Buhler, F. Bump, J. Hafner, J. Hoffstein, C. Moreno, P. Sarnak, and J. Wolf.

Partial differential equations, theory and applications, AHMED I. ZAYED, California Polytechnic State University. The speakers will include Freddy Brackx, Avner Friedman, Deborah Haimo, Guy Johnson, Ralph Kleinman, Peter McCoy, Zuhair Nashed, Louise Raphael, Walter Schempp, Gilbert Walter, Joseph Wiener, Ahmed Zayed, and Armen Zemanian.

Most of the papers to be presented at these special sessions will be by invitation. However, anyone submitting an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract form and submit it by **August 4**, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics. Abstracts should be sent to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the abstract deadline of **August 25**. Members are reminded that a charge of \$12 is imposed for retyping abstracts that are not in camera-ready form.

MAA Program

The MAA program will include two invited speakers. IVAN NIVEN of the University of Oregon will deliver a one-hour address entitled, *Some peculiarities of rational and irrational numbers*. JUDITH V. GRABINER of California State University, Dominguez Hills, will deliver an address entitled, *The Newton-Liebniz controversy*.

A panel discussion, moderated by C. COLEMAN of Harvey Mudd College, will take place on Friday afternoon. The tentative title is, *Should there be an undergraduate specialization in applied mathematics?*

Registration

The meeting registration desk will be located at the Cal Poly Theatre, and will be open from 8:00 a.m. until 3:00 p.m. on Friday, and from 8:00 a.m. until 10:30 a.m. on Saturday. The registration fees are \$6 for members of the AMS or MAA, \$8 for nonmembers, and \$2 for students or unemployed mathematicians. Coffee and doughnuts will be provided adjacent to the registration area.

Accommodations

San Luis Obispo has a large number of motels within a two-kilometer radius of campus. In view of the large tourist business, early reservations are advised and encouraged. Participants should make their own reservations directly with the motels and should identify themselves as participants at the AMS-MAA mathematics meeting. Some hotels have offered a special rate. For additional information or help with accommodations, write to H. Arthur DeKleine, Department of Mathematics, California Polytechnic State University, San Luis Obispo, CA 93407, or telephone him at 805-546-2206.

Campus Motel

404 Santa Rosa
Telephone: 805-544-0881

Single \$34 up Double \$38 up

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1800 Monterey Street
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Single \$40-45 up Double \$45-50 up
Suite \$60-80 up

Howard Johnson's

U. S. 101 South
Telephone 805-544-5300

Single \$32 up Double \$37 up

Lamplighter Motel

1604 Monterey Street
Telephone 805-543-3709

Single \$32 up Double \$36 up

Madonna Inn (Mrs. Billie Long)

100 Madonna Road
Telephone: 805-543-3000

Single \$60 up Double \$65 up

Motel 6

1433 Calle Joaquin
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Single \$15.95 Double \$19.95
Triple or Quad \$22.95

Peach Tree

2001 Monterey Street
Telephone: 805-543-3170

Single \$30 up Double \$32 up

Royal Oak

214 Madonna Road
Telephone: 805-544-4410

Single \$42 up Double \$50-56 up

Social Events

Lunch on Friday can be purchased at the Vista Grande Restaurant on the campus. A banquet will be held at 7:00 p.m. on Friday in the Garden Room at the Madonna Inn; the cost will be \$13 per person. Preceding the banquet, there will also be a no-host cash bar at the Madonna Inn. The featured speaker at the banquet will be announced in the October *Notices*. There will be a luncheon in the Faculty Dining Hall at 12:15 p.m. on Saturday. Tickets for the Friday banquet and Saturday luncheon will be available at the registration desk. Since the number of tickets will be limited, advance reservations are requested. They may be obtained by calling Euel Kennedy of California Polytechnic State University at 805-546-2245.

Travel and Local Information

San Luis Obispo is approximately half-way between Los Angeles and San Francisco on the coast (about 375 km south of San Francisco, and 300 km north of Los Angeles). The area is served daily by Greyhound Bus, Amtrak, and Wings West Airline from either San Francisco or Los Angeles. The train ride along the coast is very scenic and popular, and early reservations are advised for both Amtrak and Wings West Airline. Local bus service is excellent and buses operate between the campus and the Greyhound and Amtrak terminals. Taxis operate between the airport and the campus.

Persons driving south to San Luis Obispo via Highway 101 should take the Monterey exit to Grande Avenue, then turn right on Grande Avenue and continue to the campus. Persons driving north to San Luis Obispo via Highway 101 should take the Grande Avenue exit, then turn left on Grande Avenue and continue to the campus. In order to proceed to Monterey Street (where several motels are located), turn right on Grande Avenue, instead of left.

The central coast of California frequently has moderate weather during early November, with a daily temperature range of 5°C to 30°C. Rainfall is infrequent, but is possible.

Several attractions of scenic or historical importance exist in the local area and include Mission San Luis Obispo de Tolosa, Hearst San Simeon State Historical Monument (65 kilometers) and Montana de Oro State Park.

Hugo Rossi

Salt Lake City, Utah

Associate Secretary

Evanston, November 11–12, 1983, Northwestern University

Second Announcement of the 808th Meeting

The eight hundred and eighth meeting of the American Mathematical Society will be held at Northwestern University, Evanston, Illinois, on Friday and Saturday, November 11 and 12, 1983. The sessions on Friday will be held in the Norris University Center, while the sessions on Saturday will be held in Leverone Hall.

Invited Addresses

By invitation of the 1982 Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. The speakers, their affiliations, their titles, and the scheduled times of presentation are as follows:

EIICHI BANNAI, Ohio State University, Columbus, *Orthogonal polynomials and algebraic combinatorics*, 11:00 a.m. Friday.

BURGESS J. DAVIS, Purdue University, *Brownian motion and analytic functions*, 1:45 p.m. Friday.

EUGENE B. FABES, University of Minnesota, Minneapolis, *Harmonic analysis and properties of solutions of partial differential equations with nonsmooth coefficients*, 11:00 a.m. Saturday.

REINHARD E. SCHULTZ, Purdue University, *Nonlinear analogues of linear group actions on spheres*, 1:45 p.m. Saturday.

Special Sessions

By invitation of the same committee, there will be nine special sessions of selected twenty-minute papers. The topics of these special sessions, the names of the organizers, and partial lists of speakers are as follows:

Local fields in number theory and algebraic geometry, ALAN ADOLPHSON, Oklahoma State University. The tentative list of speakers includes Richard M. Crew, Bernard M. Dwork, William E. Lang, John M. Masely, Diane Mae Meuser, Steven I. Sperber, David S. Summitt, and Lawrence C. Washington.

Operator theory in classical function spaces, EARL R. BERKSON, University of Illinois, Urbana-Champaign. The tentative list of speakers includes Richard Askey, Hari Bercovici, Carl C. Cowen, Jr., T. Alastair Gillespie, Jerome A. Goldstein, Paul R. Halmos, William B. Johnson, Barbara D. MacCluer, Allen L. Shields, Mitchell H. Taibleson, Alberto Torchinsky, and Guido L. Weiss.

Probability and related parts of analysis, DONALD L. BURKHOLDER, University of Illinois, Urbana-Champaign. The tentative list of speakers includes Joseph L. Doob, William B. Johnson, Shizuo Kakutani, H. Jerome Keisler, Terry R. McConnell, Edwin A. Perkins, Haskell P. Rosenthal, Daniel W. Stroock, and S. R. S. Varadhan.

Approximation theory, STEPHEN D. FISHER, Northwestern University. The tentative list of

speakers includes James E. Brennan, Carl de Boor, Rong-ging Jia, Dmitry Khavinson, Paul G. Nevai, and Lloyd N. Trefethan.

Harmonic analysis and its applications to partial differential equations, CARLOS E. KENIG, University of Minnesota, Minneapolis. The tentative list of speakers includes P. Bauman, R. Michael Beals, William Beckner, Michael Christ, Björn E. J. Dahlberg, Robert A. Fefferman, Gerald B. Folland, David S. Jerison, Walter Littman, Yves Meyer, Alexander J. Nagel, Yoram Sagher, Peter A. Tomas, Stephen Wainger, Richard L. Wheeden, and Jang Mei Gloria Wu.

Volterra integral and integro-differential equations, JOHN A. NOHEL, University of Wisconsin, Madison. The tentative list of speakers includes Kenneth B. Hannsgen, Klaus Höllig, Jacob J. Levin, Stig Olof Londen, Reza Malek-Madani, R. C. McCamy, Simeon Reich, Michael Renardy, and Robert L. Wheeler

Connections between codes and designs, VERA S. PLESS, University of Illinois at Chicago. The tentative list of speakers includes Edward F. Assmas, Jr., William Bridges, Robert Calderbank, Marshall Hall, Jr., Vera S. Pless, Harold N. Ward, and Richard Wilson.

Algebraic topology, STEWART B. PRIDDY, Northwestern University. The tentative list of speakers includes A. K. Bousfield, Frederick R. Cohen, Karl Heinz Daverman, Mark F. Feshbach, Zbigniew Fiedorowicz, David C. Johnson, Arunas L. Liulevicius, Charles A. McGibbon, Stephen A. Mitchell, Joseph Neisendorfer, Paul S. Selick, Bruce Williams, and John W. Wood.

Commutative algebra, JUDITH D. SALLY, Northwestern University. The tentative list of speakers includes Luchezar L. Avramov, Paul M. Eakin, Jr., E. Graham Evans, Jr., Robert M. Fossum, Eloise A. Hamann, William J. Heinzer, Jürgen Herzog, Craig L. Huneke, Melvin Hochster, Eben Matlis, Stephen J. McAdam, T. T. Moh, Christel Rotthaus, Bernd Ulrich, and Wolmer V. Vasconcelos.

Most of the papers to be presented at these special sessions will be by invitation. However, anyone contributing an abstract for the meeting who feels that his or her paper would be particularly appropriate for one of these special sessions should indicate this clearly on the abstract, and submit it by **August 8**, three weeks before the deadline for contributed papers, in order that it may be considered for inclusion.

Contributed Papers

There will also be sessions for contributed ten-minute papers. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence, or in departments of

mathematics. Abstracts should be sent to the American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940, so as to arrive prior to the **abstract deadline of August 29**. Members are reminded that a charge of \$12 is imposed for retyping abstracts that are not in camera-ready form.

Registration

The meeting registration desk will be located in the Norris University Center on Friday and in Leverone Hall on Saturday. The hours during which the desk will be open will be announced in the October issue of the *Notices*. The registration fees are \$10 for members, \$16 for nonmembers, and \$5 for students or unemployed mathematicians.

Accommodations

The following two hotels are holding blocks of rooms until October 27.

Holiday Inn

1501 Sherman Avenue, Evanston 60201

Telephone: 312-491-6400

(7 blocks southwest of Norris Center)

Single \$46	Double/Twin \$53
Triple \$59	Quadruple \$65

Orrington Hotel

1710 Orrington Avenue, Evanston 60201

Telephone: 312-866-8700

(5 blocks southwest of Norris Center)

Single \$50	Double \$60
-------------	-------------

In order to obtain the rates listed, participants should be sure to mention the American Mathematical Society's meeting when making their reservations.

Food Service

A large cafeteria is located on the ground floor at the Norris Center; it will be open all day on Friday and Saturday.

Travel and Local Information

The Continental Air Transport Company provides bus service to Evanston from Chicago's O'Hare Airport on a periodic schedule between 8:15 a.m. and 7:35 p.m. Participants may call 312-454-7800 for information, or check at the ground transportation desk in the baggage area in the American or United Airlines terminals. The trip to the Holiday Inn or

Orrington Hotel in Evanston takes approximately one hour; the one-way fare is \$7.20 per person. Groups of three or more may prefer to call Northshore Taxi (864-7500) upon arrival at O'Hare Airport. Return bus service from Evanston to O'Hare is available; however, participants are advised to obtain a schedule for the return airport trip, since service is limited on Saturday and Sunday.

Amtrak offers direct train service from many points to Union Station in Chicago. Two blocks north of Union Station is the Chicago and Northwestern Station, from which there is direct commuter train service to Davis Street Station in Evanston. The Davis Street Station is two long blocks from the Holiday Inn and Orrington Hotel, and is about seven blocks from the Norris Center. For those coming by car, the following three options afford easy access to the campus:

(1) Follow Illinois Route 42 (Sheridan Road), a generally north-south route within a few blocks of Lake Michigan, which skirts the Northwestern campus on the west. The parking entrance to Northwestern at the south end of the campus (the point at which northbound traffic on Sheridan Road makes a sharp left turn) leads directly to the parking lot adjacent to the Norris Center.

(2) Follow the Edens Expressway (Interstate 94) and leave it at the eastbound Skokie-Evanston exit, which leads into Dempster Street. Continue east on Dempster Street (Illinois Route 58) until it intersects Sheridan Road. Turn left on Sheridan Road and proceed as in (1).

(3) Follow the Tri-State Tollway (Interstate 294) and leave it at the eastbound Dempster Street exit. Continue east on Dempster Street, turn left on Sheridan Road, and proceed as in (1).

Parking

Parking permits may be obtained at the meeting registration desk at no charge on Friday and Saturday. Participants are advised that a permit **must** be displayed, or cars will be ticketed. The most convenient place to park is in the large lot adjacent to the Norris Center.

Paul T. Bateman
Associate Secretary

Urbana, Illinois

AMS TRANSLATIONS, SERIES 2

Four Papers on Ordinary Differential Equations

M. G. Kreĭn and V. A. Jakubovič

Contents

- M. G. Kreĭn, *Foundations of the theory of λ -zones of stability of a canonical system of linear differential equations with periodic coefficients*
- M. G. Kreĭn, *On tests for stable boundedness of solutions of periodic canonical systems*

- V. A. Jakubovič, *Critical frequencies of quasicanonical systems*
- M. G. Kreĭn and V. A. Jakubovič, *Hamiltonian systems of linear differential equations with periodic coefficients*

1980 *Mathematics Subject Classifications*: 34A30, 34B25, 34C35; 15A18, 70J25

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Call For Topics For 1985 AMS Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics of the various conferences that will be sponsored by the Society in 1985. The deadline for receipt of these suggestions, and the name and address of the person to whom the information should be sent, as well as some relevant information about each of the conferences are outlined below. The accompanying form (or a facsimile thereof) is to be used when submitting suggested topic(s) for any of these conferences. Individuals willing to serve as organizers should be aware that the professional meeting staff in the Society's Providence office will provide full support and assistance, before, during, and after each of these conferences. Organizers should also note that a member of the Organizing Committee must be willing to serve as editor of the proceedings volume that will be published by the Society.

All suggestions must include (1) the names and affiliations of proposed members and chairman of the Organizing Committee; (2) a two- or three-page detailed outline of the subject(s) to be covered, including the importance and timeliness of the topic; (3) a list of the recent conferences in the same or closely related areas; (4) the names and affiliations of the proposed principal speakers; (5) a list of likely candidates who would be invited to participate and their current affiliations; and (6) any other observations which may affect the size of the conference and the amount of support required. Any suggestions as to sites and dates should be made as early as possible in order to allow adequate time for planning. By action of the AMS Board of Trustees, the Meetings Department of the Society is responsible for the final selection of the site for each conference, and for all negotiations with the host institution. Individuals submitting suggestions for the conferences listed below are requested to recommend sites or geographic areas which would assist the Meetings Department in their search for an appropriate site. In the case of Joint Summer Research Conferences in the Mathematical Sciences, a one-, two-, or three-week conference may be proposed.

1985 AMS-SIAM Symposium In Applied Mathematics

A two-day symposium in applied mathematics will henceforth take place in every odd-numbered year in conjunction with a spring Eastern Sectional Meeting. The 1983 symposium, whose topic was *Inverse problems*, was held in New York City on April 12-13. The next such symposium will be held during the two days preceding the 1985 spring meeting at a site that has not yet been selected. Some topics in recent years have been *Computational fluid dynamics* (1977); *Mathematical problems in fracture mechanics* (1978); and *Mathematical psychology and psychophysiology* (1980). Proceedings are

published by the Society as volumes in the series *SIAM-AMS Proceedings*.

Deadline For Suggestions: August 15, 1983

Submit to: Professor Alan C. Newell, Chairman, AMS-SIAM Committee on Applied Mathematics, Program in Applied Mathematics, University of Arizona, Tucson, Arizona 85721.

1985 AMS Summer Institute

Summer institutes are intended to provide an understandable presentation of the state of the art in an active field of research in pure mathematics, and usually extend over a three-week period. Dates for a summer institute must not overlap those of the Society's summer meeting (not known at this printing, but sometime in August) and, in fact, there should be a period of at least one week between them. Recent topics have been *Operator algebras and applications* (1980); *Singularities* (1981); *Recursion theory* (1982); and *Nonlinear functional analysis and its applications* (1983). Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Pure Mathematics*.

Deadline For Suggestions: August 15, 1983

Submit to: Professor Robert Osserman, Chairman, AMS Committee on Summer Institutes, Department of Mathematics, Stanford University, Stanford, California 94305.

1985 AMS-SIAM Symposium Some Mathematical Questions in Biology

This one-day symposium is held in conjunction with the Annual Meeting of the AAAS in May.

Some recent topics in these annual symposia have been *Theoretical and experimental studies in cellular, developmental and population biology* (1980), *Biomechanics and mathematical models in developmental biology* (1981), *Neurobiology, the study of the nervous systems of organisms* (1982). The 1983 Symposium was on *Muscle physiology*. Papers from the symposium are published by the Society as volumes in the series *Lectures on Mathematics in the Life Sciences*.

Deadline For Suggestions: August 15, 1983

Submit to: Dr. Robert M. Miura, Chairman, AMS-SIAM Committee on Mathematics in the Life Sciences, Department of Mathematics, University of British Columbia, 121-1984 Mathematics Road, Vancouver, B.C., Canada.

1985 AMS-SIAM Summer Seminar

The goal of the summer seminar is to provide an environment and program in applied mathematics

in which experts can exchange the latest ideas and newcomers can learn about the field. Recent topics are *Algebraic and geometric methods in linear systems theory* (1979), *Mathematical aspects of physiology* (1980), *Fluid dynamical problems in astrophysics and geophysics* (1981), *Applications of group theory in physics and mathematical physics* (1982), and *Large-scale computations in fluid mechanics* (1983). Proceedings are published by the Society as volumes in the series *Lectures in Applied Mathematics*.

Deadline For Suggestions: August 15, 1983

Submit to: Professor Alan C. Newell, Chairman, AMS-SIAM Committee on Applied Mathematics, Program in Applied Mathematics, University of Arizona, Tucson, Arizona 85721.

1985 Joint Summer Research Conferences in the Mathematical Sciences

These conferences are similar in structure to those held at Oberwolfach, and represent diverse areas of mathematical activity, with emphasis on areas currently especially active. Careful attention is paid to subjects in which there is important interdisciplinary activity at present. Topics for the second series of one-week conferences, being held in 1983, are *Combinatorics and algebra*, *Applications of algebraic K-theory to algebraic geometry and number theory*, *Axiomatic set theory*, *Group actions on manifolds*, *Ordered fields and real algebraic geometry*, *Microlocal analysis*, *Fluids and plasmas*, *geometry and dynamics*, *Probability theory*, *partial differential equations and applications*, *Geometrical analysis*

of singularities, and *Kleinian groups*. Proceedings are scheduled to be published by the Society as volumes in the series *Contemporary Mathematics*.

Deadline For Suggestions: August 15, 1983

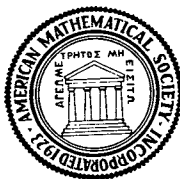
Submit to: Professor R. O. Wells, Jr., Chairman, Committee on Joint Summer Research Conferences in the Mathematical Sciences, Department of Mathematics, Rice University, Houston, Texas 77001.

1985 AMS Short Course Series

The AMS Short Courses consist of a series of lectures and discussions ordinarily extending over a period of one and one-half days immediately prior to the Joint Mathematics Meetings held in January and August each year. Each of the courses is devoted to a specific area of applied mathematics or to areas of mathematics used in the study of a specific subject or collection of problems in one of the physical, biological, or social sciences. Topics in recent years have been *Networks* (August 1981), *Tomography* (January 1982), *Statistical Data Analysis* (August 1982), *Computer Communications* (January 1983), and *Population Biology* (August 1983). Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Applied Mathematics*.

Deadline for Suggestions: July 1, 1983 for January 1985 course and December 1, 1983 for August 1985 course

Submit to: Professor Stefan A. Burr, Chairman, AMS Short Course Subcommittee, Department of Computer Sciences, CUNY, City College, New York, New York 10031.



MEMOIRS OF THE AMS

Embedding Coverings into Bundles with Applications

P. F. Duvall and L. S. Husch

The problem of when a finite regular covering of an n -dimensional closed piecewise linear manifold M can be homotoped to an embedding in an n -plane bundle over M is solved. As a corollary, a generalization of the Borsuk-Ulam Theorem is obtained. These results are then applied to the problem of embedding up to shape in $2n$ -dimensional Euclidean space continua which are the inverse limits of n -dimensional manifolds. An example of such a continuum which does not embed up to shape in $2n$ -space is given.

CONTENTS

- I. Embedding finite covers into bundles: Removing singularities of maps, Singularities of maps into bundles, Embedding covering spaces into bundles, The obstruction.
- II. Embedding manifold-like continua up to shape: Applications of Part I to embedding continua up to shape, An n -manifold-like compactum which does not embed up to shape in \mathbb{R}^{2n} , Singularities of coverings of immersions, Embedding up to shape manifold-like continua whose factors need not embed, Embedding double coverings, An example, n -manifold-like continua which do not embed up to shape in \mathbb{R}^{2n} .

1980 *Mathematics Subject Classifications*. 57R40, 57Q35, 57N35

Memoirs of the American Mathematical Society
 Memoir Number 263, iv + 55 pages (soft cover)
 List price \$8, institutional member \$6,
 individual member \$4
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Suggested Topic For 1985 Conference (check one)

- AMS-SIAM Symposium in Applied Mathematics** (Held in conjunction with an Eastern Sectional Meeting)

Submit this form before the **August 15, 1983** deadline.

- AMS Summer Institute** (In pure mathematics and usually held in July/August)

Submit this form before the **August 15, 1983** deadline.

- AMS Symposium on Some Mathematical Questions in Biology** (Held in conjunction with AAAS Annual Meeting)

Submit this form before the **August 15, 1983** deadline.

- AMS-SIAM Summer Seminar** (In applied mathematics and held in June/July)

Submit this form before the **August 15, 1983** deadline.

- Joint Summer Research Conferences in the Mathematical Sciences** (Series of six to ten week-long conferences held in June/July/August)

Submit this form before the **August 15, 1983** deadline.

- AMS Short Course Series** (Held in conjunction with Annual and Summer meetings)

Submit this form before the **July 1, 1983** and **December 1, 1983** deadlines.

Please print or type your responses. Return completed application to chairman of appropriate committee by deadline listed.

I propose organizing an AMS conference in 1985, as specified above, on the following topic:

I suggest the following members and chairman of the Organizing Committee. These individuals have / have not been requested to serve on that committee.

(Prospective committee members, chairman, and their current affiliations.)

Submitted by _____ Date _____

Address _____

N.B.: Please attach a two- or three-page detailed outline of the subject(s) to be covered, including the importance and timeliness of the topic, a list of the recent conferences in the same or closely related areas, the names and affiliations of the proposed principal speakers, and a list of appropriate candidates for invitations to participate and their current affiliations. Care and attention should be devoted to the size of the proposed conference and its relationship to limitations of funding support available. These limitations are very real at the present time, due to the general shortage of funds available for the support of research. Any extraordinary expenses should be supported by special justification.

4/83

Invited Speakers and Special Sessions

Invited Speakers at AMS Meetings

The individuals listed below have accepted invitations to address the Society at the times and places indicated. For some meetings, the list of speakers is incomplete.

Fairfield, October 1983

John L. Harer Daniel J. Kleitman
John Hubbard

San Luis Obispo, November 1983

Peter B. Gilkey T. Y. Lam

Evanston, November 1983

Eiichi Bannai Eugene B. Fabes
Burgess J. Davis Reinhard E. Schultz

Louisville, January 1984

Gunnar Carlsson M. Susan Montgomery
Persi Diaconis Herbert A. Simon
Simon Donaldson (Gibbs Lecturer)
Robert D. MacPherson Leon Simon
Andrew Majda Robert E. Tarjan

Notre Dame, April 1984

Nigel J. Kalton Karel L. Prikry
Paul G. Nevai William Schelter

Organizers and Topics of Special Sessions

The list below contains all the information about Special Sessions at meetings of the Society available at the time this issue of the *Notices* went to the printer.

The section below entitled **Information for Organizers** describes the timetable for announcing the existence of Special Sessions.

October 1983 Meeting in Fairfield

Eastern Section

Deadline for organizers: Expired

Deadline for consideration: August 2, 1983

Ben Fine, *Theory of infinite groups*
William Goldman and John L. Harer, *Surfaces and three-manifolds*
Daniel J. Kleitman, *Combinatorics*
John A. Roulier, *Approximation theory and numerical analysis*
Dorothy B. Shaffer, *Topics in complex analysis*

November 1983 Meeting in San Luis Obispo

Far Western Section

Deadline for organizers: Expired

Deadline for consideration: August 4, 1983

Ian M. Anderson, *Geometric methods for partial differential equations*
E. Coutsias and J. Mueller, *Singular perturbations*
Martin Flashman, *The lower division curriculum in mathematics, including calculus*

Wlodek Proskurowski, *Numerical partial differential equations*

Audrey A. Terras, *Automorphic forms*

Ahmed I. Zayed, *Partial differential equations, theory and applications*

November 1983 Meeting in Evanston

Central Section

Deadline for organizers: Expired

Deadline for consideration: August 8, 1983

Alan Adolphson, *Local fields in number theory and algebraic geometry*
Earl R. Berkson, *Operator theory in classical function spaces*
Donald L. Burkholder, *Probability and related parts of analysis*
Stephen D. Fisher, *Approximation theory*
Carlos E. Kenig, *Harmonic analysis and its applications to partial differential equations*
John A. Nohel, *Volterra integral and integro-differential equations*
Vera S. Pless, *Connections between codes and designs*
Stewart B. Priddy, *Algebraic topology*
Judith D. Sally, *Commutative algebra*

January 1984 Meeting in Louisville

Associate Secretary: W. Wistar Comfort

Deadline for organizers: Expired

Deadline for consideration: October 12, 1983

Donald W. Anderson and Gunnar Carlsson, *Homotopy theory*
J. Thomas Beale, *Incompressible fluid flow*
John B. Conway, *Function theoretic operator theory*
Persi Diaconis, *Random walks on finite groups*
Andrew M. W. Glass, *Ordered algebraic structures*
Henry Hermes and Hector Sussman, *Vector field systems and control*
Mark A. Kon, *Partial differential operators*
Suzanne M. Lenhart, *Partial differential equations and optimal control problems*
M. Susan Montgomery and Lance Small, *Ring theory*
Ira J. Papick, *Commutative algebra*
William L. Perry, *Ill-posed problems*
W. Wiley Williams *Semigroup theory*

April 1984 Meeting in Notre Dame

Central Section

Deadline for organizers: July 15, 1983

Deadline for consideration: To be announced

Spring 1984 Meeting

Far Western Section

Deadline for organizers: July 15, 1983

Deadline for consideration: To be announced

Spring 1984 Meeting

Eastern Section

Deadline for organizers: July 15, 1983

Deadline for consideration: To be announced

Spring 1984 Meeting

Southeastern Section

Deadline for organizers: July 15, 1983

Deadline for consideration: To be announced

August 1984 Meeting

Associate Secretary: Frank T. Birtel

Deadline for organizers: November 15, 1983

Deadline for consideration: To be announced

Information for Organizers

Special Sessions at Annual and Summer meetings are held under the general supervision of the Program Committee. They are administered by the Associate Secretary in charge of the meeting with staff assistance from the Society office in Providence.

Some Special Sessions arise from an invitation to a proposed organizer issued through the Associate Secretary. Others are spontaneously proposed by interested organizers or participants. Such proposals are welcomed by the Associate Secretaries.

The number of Special Sessions at a Summer or Annual Meeting is limited to twelve. Proposals, invited or offered, which are received at least nine months prior to the meeting are screened for suitability of the topic and of the proposed list of speakers, and for possible overlap or conflict with other proposals (specific deadlines for requesting approval for Special Sessions at national meetings are given above). If necessary, the numerical limitation is enforced.

Proposals for Special Sessions should be submitted directly to the Associate Secretary in charge of the meeting (at the address given in the accompanying box). If such proposals are sent to the Providence office, addressed to the *Notices*, or directed to anyone other than the Associate Secretary, they will have to be forwarded and may not be received before the quota is filled.

In accordance with an action of the Executive Committee of the Council, no Special Session may be arranged so late that it may not be announced in the *Notices* early enough to allow any member of the Society, who wishes to do so, to submit an abstract for consideration for presentation in the Special Session before the deadline for such consideration.

Special Sessions are effective at sectional meetings and can usually be accommodated. They are arranged by the Associate Secretary under the supervision of the Committee to Select Hour Speakers for the section. The limitation on the number of sessions depends on the space and time available. The same restriction as for national meetings applies to the deadline for announcing Special Sessions at sectional meetings: no Special Session may be approved too late for its announcement to appear in time to allow a reasonable interval for members to prepare and submit their abstracts prior to the special early deadline set for consideration of papers for Special Sessions.

Send Proposals for Special Sessions to the Associate Secretaries

The programs of sectional meetings are arranged by the Associate Secretary for the section in question:

Far Western Section (Pacific and Mountain)

Hugo Rossi, Associate Secretary
Department of Mathematics
University of Utah
Salt Lake City, UT 84112
(Telephone 801-581-8159)

Central Section

Paul T. Bateman, Associate Secretary
Department of Mathematics
University of Illinois
Urbana, IL 61801
(Telephone 217-333-4996)

Eastern Section

W. Wistar Comfort, Associate Secretary
Department of Mathematics
Wesleyan University
Middletown, CT 06457
(Telephone 203-347-9411)

Southeastern Section

Frank T. Birtel, Associate Secretary
Department of Mathematics
Tulane University
New Orleans, LA 70118
(Telephone 504-865-5646)

As a general rule, members who anticipate organizing Special Sessions at AMS meetings are advised to seek approval at least nine months prior to the scheduled date of the meeting. No Special Sessions can be approved too late to provide adequate advance notice to members who wish to participate.

Information for Speakers

A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is received in Providence prior to the special early deadline announced above and in the announcements of the meeting at which the Special Session has been scheduled.

Abstracts of papers submitted for consideration for presentation at a Special Session must be received by the Providence office (Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, RI 02940) by the special deadline for Special Sessions, which is usually three weeks earlier than the deadline for contributed papers for the same meeting. The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

MATHFILE

Mathematical Reviews Online

MATHFILE is the online version of **MATHEMATICAL REVIEWS**, the authoritative record of published mathematical literature throughout the world. **MR**, a publication of the American Mathematical Society, provides essentially complete worldwide coverage of pure mathematics as well as those works in applied mathematics, physics, engineering, computer science, biology, operations research and other fields containing new and interesting mathematics. It contains reviews of 35,000 to 40,000 items each year which have been published in over 1,500 journals, books and book series.

All this material is available online with BRS and Dialog. The database, called **MATHFILE**, includes all bibliographic and subject information on articles and books reviewed in *Mathematical Reviews* since 1973. The file will be updated monthly with the addition of approximately 3,000 new items.

In addition to the bibliographic information, **MATHFILE** contains all the primary and secondary subject classifications attached to those items. Furthermore, starting with the material from mid-1979 issues of *Mathematical Reviews*, the text of each review is in the file.

Additional information may be obtained from

J. L. Selfridge, Executive Editor, (313) 764-7228

Mathematical Reviews, 611 Church Street, P.O. Box 8604, Ann Arbor, Michigan 48107

Taissa T. Kusma, Database Specialist, (401) 272-9500

American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940

MATHFILE User's Guide

A user's guide has been prepared by the Society to make searching **MATHFILE** easier, more effective and faster. The Guide includes:

Instructions. How to get started on the vendor's system, an explanation of the file and suggestions on search techniques.

List of Journals. Journal name abbreviations used by *Mathematical Reviews*, and the full titles as defined by the Library of Congress and those used by *Mathematical Reviews*; the ISSN, Coden, and useful publishing information.

Subject Classification Systems. A correlated display of the two (1970 and 1980) slightly different MR systems, and the Library of Congress system.

Index of terms occurring in the subject classification. Alphabetic listing of subject words from the MR classification system with the corresponding class numbers given for each. This list will be very helpful to searchers unfamiliar with the MR Subject Classification.

Title words of entries reviewed from 1973 to 1979, arranged alphabetically with class numbers under which the entries occurred and frequency of occurrence of each word in each section.

Inversion of the title word list, arranged by classification number, showing which title words occurred in each section and with what frequency. This will be useful in finding the right words to search a specific subject.

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*Offprints of separate chapters

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Special Meetings

THIS SECTION contains announcements of meetings of interest to some segment of the mathematical public, including *ad hoc*, local, or regional meetings, and meetings or symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. (Information on meetings of the Society, and on meetings sponsored by the Society, will be found inside the front cover.)

AN ANNOUNCEMENT will be published in the *Notices* if it contains a call for papers, and specifies the place, date, subject (when applicable), and the speakers; a second full announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in each issue until it has been held and a reference will be given in parentheses to the month, year and page of the issue in which the complete information appeared.

IN GENERAL, announcements of meetings held in North America carry only date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. All communications on special meetings should be sent to the Editor of the *Notices*, care of the American Mathematical Society in Providence.

DEADLINES for entries in this section are listed on the inside front cover of each issue. In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence SIX MONTHS prior to the scheduled date of the meeting.

July 1, 1982–September 1, 1983. **Special Year in Mathematics Related to Energy**, University of Wyoming, Laramie, Wyoming. (October 1982, p. 588)

September 1, 1982–August 31, 1983. **Statistical and Continuum Approaches to Phase Transition**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota. (January 1982, p. 74)

October 31, 1982–October 1, 1983. **Mathematisches Forschungsinstitut Oberwolfach** (Weekly Conferences), Federal Republic of Germany. (November 1982, p. 698)

1983–1984. **Academic Year Devoted to Problems on Iteration in Classical Real and Complex Analysis**, The Mittag-Leffler Institute, Djursholm, Sweden. (February 1983, p. 205)

1983. **Special Year in Commutative Algebra and Algebraic Geometry**, University of Illinois, Urbana, Illinois. (November 1982, p. 699)

JULY 1983

10–16. **International Conference on Quasigroups and their Applications**, Università Cattolica del Sacro Cuore, Milano, Italy. (February 1983, p. 208)

10–16. **Journées Arithmétiques 1983**, Noordwijkerhout, The Netherlands. (November 1982, p. 700)

11–15. **T_EX Users Group Meeting and Introductory T_EX82 Users Course**, Stanford University, Palo Alto, California. (February 1983, p. 208)

11–15. **Twelfth Conference on Stochastic Processes and their Applications**, Cornell University, Ithaca, New York. (February 1983, p. 208)

11–15. **Symposium on Large Scale Systems Theory and Applications**, Warsaw, Poland. (January 1983, p. 79)

11–15. **Twelfth Conference on Stochastic Processes and their Applications**, Cornell University, Ithaca, New York. (November 1982, p. 700)

11–15. **Ninth British Combinatorial Conference**, University of Southampton, England. (October 1982, p. 590)

11–16. **Seventh International Congress of Logic, Methodology and Philosophy of Science**, Salzburg, Austria. (October 1982, p. 590; February 1983, p. 208)

11–22. **Quadratic Forms and Hermitian K-theory**, McMaster University, Hamilton, Canada. (January 1983, p. 79)

11–22. **L.M.S./S.E.R.C. Durham Symposium in Potential Theory**, University of Durham and Grey College, Durham, United Kingdom. (October 1982, p. 590)

12–14. **Third Scandinavian Conference on Image Analysis**, København, Denmark. (June 1983, p. 436)

12–15. **International Conference on the Teaching of Mathematical Modelling**, Exeter University, Exeter, England. (October 1982, p. 590)

18–20. **ORSA/TIMS Special Interest Meeting on Applied Probability in Biology & Engineering**, University of Kentucky, Lexington, Kentucky. (June 1983, p. 436)

18–22. **Tenth International Colloquium on Automata Languages and Programming**, Barcelona, Spain. (April 1983, p. 362)

18–22. **International Conference on Mathematics in Biology and Medicine**, Bari, Italy. (October 1982, p. 590)

18–23. **Logic Colloquium '83**, Technische Hochschule Aachen, Aachen, Federal Republic of Germany. (February 1983, p. 208)

18–29. **École d'Été d'Informatique**, Clamart, France. (April 1983, p. 362)

18–August 12. **Workshop on Latin Squares: Their Construction and Application**, Simon Fraser University, British Columbia, Canada. (February 1983, p. 208)

19–22. **Sixth European Congress on Operational Research (EURO VI)**, Vienna, Austria. (February 1983, p. 208)

24–August 3. **Durham Symposium on Universal Enveloping Algebras of Lie-Algebras**, Leeds, United Kingdom.

Information: A. W. Goldie or J. C. McConnell, Department of Pure Mathematics, Leeds University, Leeds LS2 9JT, United Kingdom.

25–29. **NSF-CBMS Regional Conference in Mathematics on Iterated Rational Mappings**, University of Minnesota, Duluth, Minnesota. (June 1983, p. 436)

25–29. **Sixth International Symposium on Multivariate Analysis**, University of Pittsburgh, Pittsburgh, Pennsylvania. (October 1982, p. 590; February 1983, p. 208)

25–29. **Eleventh Conference on System Modelling & Optimization**, København, Denmark. (June 1983, p. 436)

25–August 2. **Seminar on the History of Mathematics**, University of Toronto, Toronto, Canada. (February 1983, p. 208; June 1983, p. 436)

31–August 6. **Seventh International Conference on Near-Rings and Near-Fields**, James Madison University, Harrisonburg, Virginia. (January 1983, p. 80)

1-5. **International Conference in Categorical Topology**, University of Toledo, Toledo, Ohio.

Program: Contributed papers are invited. Speakers will include B. Banaschewski (McMaster University); G. G. L. Brümmer (University of Cape Town); H. Herrlich (Universität Bremen); F. E. J. Linton (Wesleyan University); S. Morris (La Trobe University).

Information: H. L. Bentley, Mathematics Department, University of Toledo, Toledo, Ohio 43606.

1-5. **NSF-CBMS Regional Conference on Quasitriangularity and Analyticity in Operator Algebras**, Texas Tech University, Lubbock, Texas. (April 1983, p. 363)

1-5. **CBMS Regional Conference on Yang-Mills Theory and the Topology of Four-Manifolds**, University of California, Santa Barbara, Santa Barbara, California. (April 1983, p. 363)

1-10. **Seventh International Congress on Mathematical Physics**, University of Colorado, Boulder, Colorado. (February 1983, p. 209)

1-12. **NATO Advanced Study Institute on Methods in Ring Theory**, Antwerp, Belgium. (April 1983, p. 363)

1-12. **Workshop and Conference in Algebraic Topology**, Memorial University, Saint John's, Newfoundland. (November 1982, p. 701; June 1983, p. 436)

3-13. **Conference on Algebra, Algebraic Topology and their Interactions**, Stockholm, Sweden.

Information: Jan-Erik Roos, Matematiska Institutionen, Stockholm Universitet, Box 6701, S-113 85 Stockholm, Sweden.

8-11. **International Conference on Numerical Methods in Laminar and Turbulent Flow**, Seattle, Washington. (April 1983, p. 363)

8-12. **NSF-CBMS Regional Conference on Representation Theory and Harmonic Analysis on Reductive Groups over p-adic Fields**, University of Chicago, Chicago, Illinois.

Principal Lecturer: Roger Howe.

Information: Department of Mathematics, University of Chicago, Chicago, Illinois 60637.

8-12. **International Joint Conference on Artificial Intelligence**, Karlsruhe, Federal Republic of Germany. (April 1983, p. 363)

8-13. **NSF-CBMS Regional Conference on Quasitriangularity and Analyticity in Operator Algebras**, Texas Tech University, Lubbock, Texas. (April 1983, p. 363)

9-13. **Colloquium on Topology**, Eger, Hungary. (February 1983, p. 209; April 1983, p. 363)

11-14. **Eighth International Time Series Meeting**, Toronto, Canada. (April 1983, p. 363)

15-17. **Symposium on Numerical Analysis and Computational Complex Analysis**, Swiss Federal Institute of Technology (ETH), Zürich, Switzerland. (April 1983, p. 363)

15-17. **Fourth International Conference on Mathematical Modelling**, Zürich, Switzerland. (October 1982, p. 591)

16-24. **International Congress of Mathematicians**, Warsaw, Poland. (February 1983, pp. 150, 209)

16-September 9. **École d'Été d'Informatique et Mathématiques en Sciences Sociales**, Grenoble, France.

Information: Bernard Bouhet, Banques Données Socio-Polit., (GRECO 42), B. P. 45, 38402 Saint Martin d'Hères Cedex, France.

21-24. **"CRYPTO 83"**, University of California, Santa Barbara, California. (June 1983, p. 437)

21-27. **International Conference on Foundations of Computation Theory**, Linköping, Sweden. (February 1983, p. 209; June 1983, p. 437)

22-25. **Eighth Symposium on Operations Research**, Karlsruhe, Federal Republic of Germany.

Information: D. Pallashke, Inst. für Stat. und Math. Wirtschaftstheorie, Postfach 6380, Kollegium am Schloss Ban III, D-7500 Karlsruhe, Federal Republic of Germany.

22-26. **Third European Young Statisticians Meeting**, Louvain, Belgium.

Information: P. Embrechts, Department of Mathematics, Katholieke Univ. Leuven, 200-B Celestijnenlaan, B-3030 Heverlee, Belgium.

22-26. **Numerical Problems for Bifurcation Problems**, Dortmund, Federal Republic of Germany.

Organizers: T. Küpper (Dortmund), H. D. Mittelmann (Dortmund), H. Weber (Mainz).

Information: T. Küpper, Abteilung Mathematik, Postfach 50 05 00, D-4600 Dortmund 50, Federal Republic of Germany.

22-26. **Seventh International Conference on Structural Mechanics in Reactor Technology**, Marriott Hotel, Chicago, Illinois. (October 1982, p. 591)

22-26. **Universal Algebra**, József Attila University, Szeged, Hungary. (October 1982, p. 591)

22-27. **Tenth International Congress on Cybernetics**, Namur, Belgium. (October 1982, p. 591)

22-September 2. **NATO Advanced Study Institute on Approximation Theory (Spline Functions) and Applications**, Memorial University of Newfoundland, St. John's, Newfoundland, Canada.

Topics: Multivariate approximation, nonlinear approximation, multidimensional approximation, Walsh function, spline functions and applications.

Speakers: E. W. Cheney, L. Collatz, J. Korevaar, G. Meinardus, J. Meinguet, C. Micchelli, G. Phillips, L. Schumaker, A. Sharma, John Todd, R. S. Varga, H. Werner, Z. Ziegler.

Information: S. P. Singh, NATO-ASI, Department of Mathematics, Memorial University, St. John's, Newfoundland, Canada A1B 3X7, 709-737-8795.

26-29. **Polish Symposium on Interval and Fuzzy Mathematics**, Poznań, Poland. (February 1983, p. 209)

26-30. **Colloquium on Universal Algebra**, Szeged, Hungary. (June 1983, p. 437)

26-31. **Conference on Combinatorial Groups**, Busan National University, Busan, Korea. (November 1982, p. 701)

29-31. **Conference to Honor the Sixtieth Birthday of J. B. Keller**, Northwestern University, Evanston, Illinois. (February 1983, p. 209)

29-September 2. **Third Prague Symposium on Asymptotic Statistics**, Kutna Hora, Czechoslovakia.

Information: D. Vorlickova, Faculty of Mathematics and Statistics, Charles University, 83 Sokolovska, CS-18600 Praha, Czechoslovakia.

29-September 3. **Journées de Théorie des Nombres**, Marseille-Luminy, France.

Organizer: P. Satgé.

Information: Maryse Cohen-Solal, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.

29-September 3. **Third International Conference on Recent Progress in Many Body Theories**, Altenberg, Germany.

Information: H. Kümmel, Institut für Theor. Phys., Ruhr Univ. Postfach 102148, D-4630 Bochum 1, Federal Republic of Germany.

29-September 6. **Conference on Operator Algebras, Connections with Topology and Ergodic Theory**, Busteni, Romania. (June 1983, p. 437)

29-September 10. **Progress in Gauge Field Theory**, Cargèse, France. (June 1983, p. 437)

30-September 2. **The First International Tampere Seminar on Linear Statistical Models and their Applications**, Department of Mathematical Sciences, Statistics, University of Tampere, Tampere, Finland. (June 1983, p. 437)

30-September 2. **Second International Conference on Databases**, Cambridge, Great Britain. (June 1983, p. 437)

30-September 8. **International Conference on Singularities & Dynamical Systems**, Crete, Greece. (April 1983, p. 363)

30-October 8. **École d'Automne du CIMPA: "Théorie des Nombres"**, Nice, France.

Chairmen: J. Coates (Paris); W. Schmidt (Boulder, Colorado); D. A. Hejhal (Minneapolis, Minnesota).

Information: Centre Intern. Math. Pures et Appl., 1 av. Edith Cavell, F-06000 Nice, France.

31-September 14. **Statistical Extremes and Applications**, Vimeiro, Portugal. (June 1983, p. 437)

SEPTEMBER 1983

4-9. **Fourth Pannonische Symposium über Mathematische Statistik**, Bad Patzmannsdorf, Austria.

Information: W. Wertz, Institut für Statistik - TU, Argentinierstrasse 8/7, A-1040 Wien, Austria.

4-10. **XVI Biennial Fluid Dynamics Symposium**, Warsaw, Poland. (June 1983, p. 437)

5-10. **Twelfth International Colloquium on Group Theoretical Methods in Physics**, Miramare-Trieste, Italy. (June 1983, p. 437)

5-16. **NATO Advanced Study Institute on "Quarks, Leptons and Beyond"**, Munich, Federal Republic of Germany.

Information: Mme. W. Huber, Max Planck Institut für Phys. and Astrophys., 6 Föhringer Ring, D-8000 München 40, Federal Republic of Germany.

6-10. **Conference on Viscoplasticity and Applications**, Bucharest, Romania.

Information: N. Cristescu, Fac. Math., 14 Str. Academie, R-70109 Bucharest, Romania.

6-10. **Second International Meeting on Bayesian Statistical Methods**, Valencia, Spain. (June 1983, p. 437)

12-16. **First European Simulation Congress**, Aachen, Federal Republic of Germany.

Information: Lehrstuhl für Allgemeine Elektrotechnik und Datenverarbeitungssysteme, RWTH Aachen, Schinkelstrasse 2, D-5100 Aachen, Federal Republic of Germany.

12-22. **Forty-fourth Biennial Session of the International Statistical Institute**, Madrid, Spain.

Information: ISI Permanent Office, 428 Prinses Beatrixlaan, NL-2270 AZ Voorburg, The Netherlands.

13-16. **Undergraduate Mathematics Teaching Conference**, Nottingham, Great Britain.

Information: Secretary, Shell Centre for Mathematics Education, The University, Nottingham, Great Britain.

13-17. **Colloque sur le Comportement Dynamique des Réseaux d'Automates et leurs Applications**, Marseille-Luminy, France.

Organizers: J. Demongeot, E. Goles, M. Tchuente (Grenoble).

Information: Maryse Cohen-Solal, CIRM, Luminy, Case 916, F-13288 Marseille Cedex 9, France.

21-23. **George D. Aiken Lecture Series: Technical Symposium on Acid Rain Transport and Transformation Phenomenon**, University of Vermont, Burlington, Vermont. (February 1983, p. 209)

23-24. **Eleventh Annual Mathematics and Statistics Conference**, Miami University, Oxford, Ohio. (April 1983, p. 363)

23-24. **Ohio Delta Chapter of Pi Mu Epsilon Annual Student Conference**, Miami University, Oxford, Ohio. (April 1983, p. 363)

24. **Memorial Meeting for Errett A. Bishop**, LaJolla, California.

Sponsor: Mathematics Department, University of California, San Diego.

Invited Speakers: Irving Glicksberg (University of Washington); John Kelley (University of California, Berkeley); Halsey Royden (Stanford University); Gabriel Stoltenberg (Northeastern University); John Wermer (Brown University).

Information: Secretary of the Mathematics Department, University of California, San Diego, LaJolla, California 92093.

25-October 2. **International Conference on Operator Algebras, Ideals and their Applications in Theoretical Physics**, Naturwissenschaftlich-Theoretischen Zentrum, Karl Marx University, Leipzig, German Democratic Republic. (January 1983, p. 80)

26-28. **Third International Workshop on Database Machines**, Munich, Federal Republic of Germany.

Information: M. Missikoff, IASI CNR, 12 via Buonarroti, I-00185 Rome, Italy.

26-29. **Fifth International Symposium on Finite Elements in Flow Problems**, Austin, Texas.

Information: G. F. Carey, Cockrell Hall 2, 102, University of Texas, Austin, Texas 78712.

26-30. **International Workshop on Applied Mathematics and Performance, Reliability Models of Computer, Communication Systems**, Pisa, Italy.

Information: S. Tucci, Dipart. Inform., 40 Corso Italia, I-56100 Pisa, Italy.

26-30. **Second International Meeting on Statistical Climatology**, Lisbon, Portugal. (June 1983, p. 437)

OCTOBER 1983

4-5. **The Twenty-second Annual Army Operations Research Symposium**, US Army Logistics Management Center, Ft. Lee, Virginia. (June 1983, p. 437)

5-10. **Fifth GAMM Conference on Numerical Methods in Fluid Mechanics**, Rome, Italy.

Information: R. Piva, Ist. Mecc. Apl., Fac. Ing., 18 via Eudossiana, I-00184 Rome, Italy.

5-12. **Week of Algebraic Geometry**, Barcelona, Spain.

Invited Speakers: Arbarello; Barth; Beauville; Clemens; Narshorne; Murre.

Information: G. Welters or S. Xambo, Descamps, Matemáticas Universidad de Barcelona, Plaza Universidad, Barcelona-7, Spain.

6-10. **Twentieth Anniversary Meeting of the American Society for Cybernetics**, Foothill College, Los Altos Hills, California.

Theme: The theme of the meeting will be "Societal Transformations in the Systems Age: A Platform for Change."

Program: There will be plenary sessions by small groups of invited speakers, and a keynote address will be given each evening. There will also be symposia, tutorials, workshops, and paper sessions.

Information: William J. Reckmeyer, Chair, ASC 20th Anniversary Meeting, Cybernetic Systems Program, San Jose State University, San Jose, California 95192, 408-277-3409.

8-9. **The Fourteenth Midwest Partial Differential Equations Seminar**, Purdue University, West Lafayette, Indiana.

Information: M. S. Baouendi, Department of Mathematics, Purdue University, West Lafayette, Indiana 47907, 317-494-1908.

10-14. **ICMI-JSME Regional Conference on Mathematical Education**, Tokyo, Japan. (June 1983, p. 437)

11-13. **Conference on Phase Transformations and Material Instabilities in Solids**, The Mathematics Research Center, University of Wisconsin, Madison, Wisconsin. (June 1983, p. 438)

17-21. **NSF Conference on Asymptotic Behavior of Mass and Space-Time Geometry**, Oregon State University, Corvallis, Oregon.

Purpose: The purpose of the conference is to clarify the strongest possible theorems regarding the positivity of mass in general relativity and to examine the implications of the positive mass theorem (Schoen-Yau-Witten) on the development of horizons, singularities and cosmic censorship in Einstein's theory of gravitation.

Invited Speakers: A. Ashtekar (Paris); G. Horowitz (Princeton); R. Penrose (Rice-Oxford); T. Piran (IAS-Jerusalem); J. W. York, Jr. (North Carolina); Y. Choquet-Bruhat (Paris); R. Bartnik (Courant Institute); E. T. Newman (Pittsburgh); M. Perry (Princeton); C. Taubes (University of California, Berkeley).

Organizing Committee: D. Brill (Maryland); F. Flaherty (Oregon State); J. Isenberg (Oregon); R. O. Wells, Jr. (Rice).

Information: F. J. Flaherty, Department of Mathematics, Oregon State University, Corvallis, Oregon 97331.

18-21. **Third Symposium on Microcomputer and Microprocessor Applications**, Budapest, Hungary.

Information: I. Baba, Scientific Society for Telecommunications, P. O. Box 451, H-1372 Budapest, Hungary.

21-22. **Fifth Midwest Conference on Probability**, Northwestern University, Evanston, Illinois.

Program: There will be four one-hour talks, two by Daniel Stroock (University of Colorado) and one each by Thomas Kurtz (University of Wisconsin) and Sandy Zabell (Northwestern University).

Information: Mark Pinsky, Department of Mathematics, Northwestern University, Evanston, Illinois 60201.

24-26. **1983 Annual Conference of Association for Computing Machinery**, Sheraton Centre Hotel, New York, New York. (February 1983, p. 210)

24-27. **Seventh Symposium on Computer Applications in Medical Care**, Baltimore, Maryland. (June 1983, p. 438)

24-29. **International Conference on Mathematical Methods in Operations Research**, Sofia, Bulgaria. (June 1983, p. 438)

31-November 10. **Ninth International Conference on Very Large Data Bases**, Firenze, Italy.

Information: Costantino Thanos, IEL-CNR, 46 via S. Maria, I-56100 Pisa, Italy.

NOVEMBER 1983

1-9. **Sixth International Summer School on Problems of Model Choice & Parameter Estimation in Regression Analysis**, Sellin, German Democratic Republic. (June 1983, p. 438)

4-5. **Third Southeastern-Atlantic Regional Conference on Differential Equations**, University of Tennessee, Knoxville, Tennessee.

Program: Lectures will be given by Kenneth Hannsgen (Virginia Tech), Robert Jensen (University of Kentucky) and Ian Knowles (University of Alabama, Birmingham). In addition there will be sessions for twenty-minute contributed talks.

Information: Don Hinton or Gene Klaasen, Mathematics Department, University of Tennessee, Knoxville, Tennessee 37996, 615-974-2130 or 615-974-3360.

7-9. **Twenty-fourth Annual IEEE Symposium on Foundations of Computer Science**, Tucson Marriott Hotel, Tucson, Arizona. (February 1983, p. 210)

7-11. **Society for Industrial and Applied Mathematics 1983 Fall Meeting**, Norfolk, Virginia. (April 1983, p. 364)

8-11. **Fifth International Seminar on Boundary Elements**, Hiroshima, Japan.

Information: C. A. Brebbia, Department of Mathematics, The University of Southampton, Southampton, SO9 5NH Great Britain.

10-13. **American Mathematical Association of Two-Year Colleges Annual Convention**, Court of Flags Hotel, Orlando, Florida. (February 1983, p. 210)

13-18. **Symposium on Measurements in Fluid Transients**, Boston, Massachusetts.

Information: L. D. Koffman, School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332.

16-18. **Eighth Conference on Probability & Statistics in the Atmospheric Sciences**, Hot Springs, Arkansas. (June 1983, p. 438)

24-27. **International Congress on Computational and Applied Mathematics**, University of Leuven, Belgium. (February 1983, p. 210)

DECEMBER 1983

5-7. **Everett Pitcher Lecture Series**, Lehigh University, Bethlehem, Pennsylvania.

Principal Lecturer: Jean-Pierre Serre (College de France).

Information: Department of Mathematics, Christmas-Saucon Hall 14, Lehigh University, Bethlehem, Pennsylvania 18015.

5-7. **Second Latin American Conference on Applied Mathematics**, Laboratorio de Computação Científica LCC/CNPq, Rio de Janeiro, Brazil. (April 1983, p. 364)

5-16. **Workshop on Pattern Recognition and Analysis of Seismicity**, Miramare-Trieste, Italy. (June 1983, p. 438)

6-9. **Congrès du Centenaire de la S.E.E., "Électricité, électronique et civilisation"**, Paris, France.

Information: B. Favez, Soc. Electr., Électron. et Radioélectr., 48 rue de la Procession, 75724 Paris Cedex 15, France.

JANUARY 1984

6-10. **NSF-CBMS Regional Conference on Some Global Problems Concerning Curvature of Riemannian Manifolds**, Polytechnic Institute of New York, Brooklyn, New York.

Principal Speaker: Jerry Kazdan (University of Pennsylvania).

Program: Professor Kazdan will give ten expository lectures on scalar and Ricci curvature with emphasis on the use of partial differential equations in understanding Riemannian geometry. Some particular topics will be: for scalar curvature, the Yamabi problem and the positive mass problem in general relativity; for Ricci curvature, the Calabi conjecture, and Einstein metrics and their relation to the Poincaré conjecture.

Information: L. M. Sibner or E. Y. Miller, Polytechnic Institute of New York, 333 Jay Street, Brooklyn, New York 11201.

JUNE 1984

4-8. **Fifth International Conference on the Theory and Applications of Graphs, With Special Emphasis on Computer Science Applications**, Western Michigan University, Kalamazoo, Michigan. (June 1983, p. 438)

AUGUST 1984

August 1984. **Fifth International Congress on Mathematics Education**, University of Adelaide, Australia. (June 1982, pp. 331, 376)

Reciprocity Agreements

The listings below update the report published in the June 1983 *Notices*, pages 439-444.

Asia

Calcutta Mathematical Society

Apply to: M. Dutta, Secretary, Calcutta Mathematical Society, 92, Acharya Prafulla Chandra Road, Calcutta-9, India.

Dues: \$2; admission fee \$1; payable to M. Dutta, Secretary.

Privileges: *Bulletin, News Bulletin.*

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Europe

• Gesellschaft für Angewandte Mathematik und Mechanik

Apply to: W. Velte, Sekretär der GAMM, Institut für Angewandte Mathematik und Statistik der Universität, Am Hubland, 8700 Würzburg, Federal Republic of Germany.

Dues: DM 30,-; payable to J. Zierp. [Bank: Deutsche Bank Karlsruhe, BLZ 660 700, Konto 03/65585 01, (Sonderkonto GAMM).]

Privileges: Regular publications of GAMM and participation in scientific meetings at a reduced rate.

Officers: J. Zierp (President), K. Kirchgässner (Vice President), W. Schiehlen (Treasurer), W. Velte (Secretary).

Real Sociedad Matemática Española

Apply to: J. Llovet, Secretario de la Real Sociedad Matemática Española, Serrano 123, Madrid-6, Spain.

Dues: \$15; payable to Secretario.

Privileges: *Revista Matemática Hispano-Americana, Gaceta Matemática.*

Officers: Pedro L. Garcia Perez (President), Juan Llovet (Secretary).

Latin America

Sociedad de Matemática de Chile

Apply to: Jaime Figueroa, Casilla 653, Santiago, Chile.

Dues: \$10; payable to Jaime Figueroa.

Privileges: Receive: *Gaceta de la Sociedad*; participate in meetings.

Officers: Rolando Rebolledo (President), Jorge Soto Andrade (Vice-President), Jaime Figueroa (Treasurer), Victor González (Secretary).

South Pacific

• New Zealand Mathematical Society

Apply to: J. L. Schiff, Treasurer, Department of Mathematics, University of Auckland, Private Bag, Auckland, New Zealand.

Dues: \$NZ10.50 (1983); payable to J. L. Schiff, Treasurer, New Zealand Mathematical Society, c/o Royal Society of New Zealand, Private Bag, Wellington, New Zealand.

Privileges: All those of ordinary members except the right to vote; free copy of the *Newsletter of the NZMS* (3 per year); subscription to *Mathematical Chronicle* at reduced rate.

Officers: J. H. Ansell (President), D. B. Gauld, W. Davidson (Vice Presidents), J. L. Schiff (Treasurer), K. A. Russell (Secretary).

MEMOIRS OF THE AMS

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A. R. P. van den Essen and A. H. M. Levelt

It is well known that in the case of formal power series in one variable the matrix of a differential operator (with irregular singularities) can be brought into Jordan canonical form eventually, after extracting a root of the variable in question.

In this Memoir a suitable generalization of this result to several variables is given. It is proved that in the case of formal power series in n variables the matrices of n pairwise commuting differential operators, with so called unmixed irregular singularities, can be brought into Jordan form simultaneously.

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1. Introduction
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 3. Preliminaries to the proof of Theorem 1
 4. Proof of the theorem
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- 1980 *Mathematics Subject Classifications*: 47F05, 34A25, 58A17

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Canadian Mathematical Society Société Mathématique du Canada

CONFERENCE PROCEEDINGS • Volume 1

The Canadian Mathematical Society has initiated publication of the proceedings of internationally attended conferences on pure and applied mathematics (including probability and statistics), and has arranged for them to be published by the American Mathematical Society. The Editorial Committee for this new book series consists of F. V. Atkinson, University of Toronto; B. Banaschewski, McMaster University; C. Clark, University of British Columbia; Erwin Kreyzig, University of Windsor, chairman; and J. B. Walsh, University of British Columbia. The committee will maintain the highest professional standards.

Volume 1, *1980 Seminar on Harmonic Analysis*, has been published. This volume is the proceedings of the 1980 Annual Seminar of the Canadian Mathematical Society, held at McGill University August 4-22. It was devoted to Harmonic Analysis with special emphasis on connections with Number Theory. A substantial part of the book is taken up by the notes for James Arthur's minicourse on Automorphic Representations and Number Theory. The rest consists of papers by speakers who submitted sufficiently detailed expositions of their talks to conform to the requirements of this series.

Volume 2 in the series, *Current Trends in Algebraic Topology*, edited by Stanley O. Kochman of the University of Western Ontario, will be the proceedings of a conference held at Vancouver in December 1980.

Conferences planned for 1982 are in Numerical Analysis and Approximation Theory.

Anyone interested in recent developments in the mathematical sciences and their applications should be aware of this new series. As a matter of editorial policy, good authoritative survey articles will be encouraged, particularly in areas that presently are in rapid development.

1980 SEMINAR ON HARMONIC ANALYSIS

edited by *Carl Herz* and *R. Rigelhof*

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1980 Mathematics Subject Classifications: 43-02, 22-02, 22E55, 42A50, 43A65.

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PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS

(ISSN 0082-0717)

The Mathematical Heritage of Henri Poincaré

Felix E. Browder, Editor

On April 7–10, 1980, the American Mathematical Society sponsored a Symposium on the Mathematical Heritage of Henri Poincaré, held at Indiana University, Bloomington, Indiana. This volume presents the written versions of all but three of the invited talks presented at this Symposium (those by W. Browder, A. Jaffe, and J. Mather were not written up for publication). In addition, it contains two papers by invited speakers who were not able to attend, S. S. Chern and L. Nirenberg.

If one traces the influence of Poincaré through the major mathematical figures of the early and mid-twentieth century, it is through American mathematicians as well as French that this influence flows, through G. D. Birkhoff, Solomon Lefschetz, and Marston Morse. This continuing tradition represents one of the major strands of American as well as world mathematics, and it is as a testimony to this tradition as an opening to the future creativity of mathematics that this volume is dedicated.

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L. Nirenberg, *Variational and topological methods in nonlinear problems*

Section 6. Mechanics and dynamical systems

Jean Leray, *The meaning of Maslov's asymptotic method: the need of Planck's constant in mathematics*

David Ruelle, *Differentiable dynamical systems and the problem of turbulence*

Steve Smale, *The fundamental theorem of algebra and complexity theory*

Section 7. Ergodic theory and recurrence

Harry Furstenberg, *Poincaré recurrence and number theory*

H. Furstenberg, Y. Katznelson and D. Ornstein, *The ergodic theoretical proof of Szemerédi's theorem*

Section 8. Historical material

P. S. Aleksandrov, *Poincaré and topology*

Henri Poincaré, *Résumé analytique*

Jacques Hadamard, *L'oeuvre mathématique de Poincaré*

1980 *Mathematics Subject Classifications*: 01, 14, 22, 30, 32 & others

Proceedings of Symposia in Pure Mathematics
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Singularities

Peter Orlik, Editor

This book presents the proceedings of the Summer Institute on Singularities held at Humboldt State University, Arcata, California on July 20–August 7, 1981, and was prepared with partial support from the National Science Foundation.

The Theory of Singularities is a relatively new area of research which has grown rapidly and developed into a major field of activity. It employs the tools of Algebraic Geometry, Algebraic Topology, Differential Geometry and Real and Complex Analysis. The basic aim of these volumes is to give an exposition of the area, describe recent progress and list open problems. Some of the major topics are resolution and deformation of singularities in the algebraic and analytic categories; smoothing theory and mixed Hodge structures; equisingularity, the study of polar varieties and Whitney stratifications; Milnor fibration, monodromy and intersection pairing; analytic results, including the Gauss-Manin connection and relations with differential systems; metric properties and curvature; connections with knot theory and link theory, equivariant results and automorphic forms; unfoldings, adjacency, classification of singularities and modality; stability of singularities; Newton diagrams; Morse theory and intersection homology; and applications to physics and other sciences.

The expository papers introduce the reader to the frontiers of broad areas of research activity in singularities. The research articles solve specific problems and pose related open questions. In addition, two articles are devoted entirely to open problems in the area. Background necessary for understanding the papers is two years of graduate-level mathematics with advanced courses in Algebraic Topology, Algebraic Geometry, and Analysis.

The book's most significant contribution is its breadth. It encompasses the entire spectrum of research in singularities at this time. The field is very active and this is the first attempt at such comprehensive coverage.

Following is a list of contributors:

PART 1

Shreeram S. Abhyankar *E. Akyildiz, J. B. Carrell,*
E. Akyildiz and *D. I. Lieberman and*
J. B. Carrell *A. J. Sommese*

V. I. Arnold
Gottfried Barthel
(2 papers)
Kurt Behnke
Max Benson
M. S. Berger, P. T. Church
and J. G. Timourian
Edward Bierstone and
Pierre D. Milman
Edward Bierstone and
Gerald W. Schwarz
Lawrence Brenton,
David Bindschadler,
Daniel Drucker and
Geert C. E. Prins
E. Brieskorn
S. A. Broughton
J. W. Bruce, P. J. Giblin
and C. G. Gibson
J. W. Bruce
Ernesto Buzano and
Martin Golubitsky
Antonio Campillo
Daniel S. Chess
P. T. Church
James Damon (3 papers)
A. Dimca and
C. G. Gibson
Igor V. Dolgachev
Andrew Du Plessis
Alan H. Durfee (2 papers)
Wolfgang Ebeling
David Eisenbud
Fouad Elzein
Robert Ephraim

PART 2

Henry B. Laufer
Lê Dũng Tráng and
Zoghman Mebkhout
Lê Dũng Tráng and
B. Teissier (2 papers)
Harm van der Lek
Anatoly S. Libgober and
John W. Wood
A. Libgober
Ben Lichtin (2 papers)
Joseph Lipman
Eduard Looijenga
Ignacio Luengo
Richard Mandelbaum
John N. Mather
Clint McCrory
Isao Nakai
Walter D. Neumann
(2 papers)
Matsuo Oka
Peter Orlik and
Louis Solomon
Donal B. O'Shea
Jürgen Pesselhoy
and Oswald
Riemenschneider

István Fáry (2 papers)
Jonathan Fine
Klaus Fischer
Robert Friedman and
Roy Smith
Terence Gaffney
(3 papers)
Terence Gaffney and
Leslie Wilson
A. Galligo
Yih-Nan Gau and
Joseph Lipman
Marc Giusti
Norman Goldstein
Martin Golubitsky and
David Schaeffer
Mark Goresky and
Robert MacPherson
Gert-Martin Greuel
and Joseph Steenbrink
Helmut A. Hamm
Robert M. Hardt
Herwig Hauser
J. P. G. Henry and
M. Merle
Audun Holme
Anthony Iarrobino
Franz W. Kamber and
Philippe Tondeur
Ulrich Karras
H. King
Toshitake Kohnno
Klaus Lamotke
Rémi Langevin

Jonathan M. Wahl
C. T. C. Wall
Tamaki Yano

Stephen S.-T. Yau
Yosef Yomdin (2 papers)
Steven Zucker

1980 *Mathematics Subject Classifications*: 14, 16, 32, 53, 55, 57, 58

Proceedings of Symposia in Pure Mathematics
Volume 40: Parts 1 and 2 (hard cover)
xxvi + 676 pages (Part 1); xvi + 680 pages (Part 2)

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Part 1: ISBN 0-8218-1450-8; LC 83-2529

Part 2: ISBN 0-8218-1466-4; LC 83-2529

Publication date: July 1983

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CONTEMPORARY MATHEMATICS

(ISSN 0271-4132)

Proceedings of the Northwestern Homotopy Theory Conference

Haynes R. Miller and Stewart B. Priddy, Editors

This book contains papers submitted by participants at the Conference on Homotopy Theory held March 22–26, 1982, at Northwestern University. It consists of 30 articles by 40 mathematicians from 10 countries.

Some contributions are of an elementary nature, suitable for study in a first course in algebraic topology—there are two articles on Borsuk-Ulam theories, for instance, by Dold and Liulevicius. Several articles are intended to provide a general orientation in some subject—Barratt, Jones, and Mahowald on the Kervaire invariant problem, and Thomason on the homotopy limit problem, for example. New results of outstanding importance are proved—Madsen and Rothenberg's treatment of the classification of G -spheres and Oka's proof that the sequence of dimensions of mod p stable stems is unbounded. Some articles give quick new proofs of important known results—Harper and Zabrodsky on H -spaces, Mitchell on bordism theory, and Wilkerson on Dickson invariants, for instance.

There is a list of open problems and directions for research which should prove especially useful to graduate students. It contains 72 entries contributed by 22 topologists, and is the first such compilation since the Stanford conference in 1976. Jones, Mahowald, F. Cohen, May, Ravenel, and others go out on a limb in homotopy theory; Hambleton, Madsen, Quinn, and others speculate about surgery theory; and Schultz has a list of problems in group actions.

In content, the articles in this volume range from Hsiang and Staffeld on $A(X)$ to N. J. Kuhn on resolutions by spacelike spectra; from Petrie on equivariant cell-attaching to Ray and Schwartz on embeddings of complexes; from Schulz on exotic S^1 -spheres to Kochman on H_*BO ; and so on.

1980 *Mathematics Subject Classifications*: 55–06; 55P42, 55P45, 55R45, 55T15, 18F25

Contemporary Mathematics
Volume 19, x + 454 pages (soft cover)

List price \$29, institutional member \$22,
individual member \$15

ISBN 0-8218-5020-2; LC 83-9941

Publication date: June 1983

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LECTURES IN APPLIED MATHEMATICS

(ISSN 0075-8485)

Fluid Dynamics

in Astrophysics and Geophysics

Norman R. Lebovitz, Editor

This book features two main articles on geophysical fluid dynamics and on astrophysical fluid dynamics (by Rhines and Schutz, respectively), some timely articles on currently interesting topics in these areas, and a couple of articles on mathematical methods which are finding applications in these two areas of science.

The hope is that the juxtaposition of these two fields of application of fluid dynamics will help to expose their common foundations and methods, and open up their problem areas to a wider scientific community.

Applied mathematicians interested in acquiring a background in astro- or geophysics, and who want to understand the areas common to these two disciplines, will find these papers illuminating.

Contents

I. Geophysical fluid dynamics

Peter B. Rhines, *Lectures on geophysical fluid dynamics*

Larry G. Redekopp, *Nonlinear waves in geophysics: long internal waves*

P. Huerre and L. G. Redekopp, *Nonlinear evolution equations and critical layers*

II. Astrophysical fluid dynamics

B. F. Schutz, *Problems in astrophysical fluid dynamics*

Peter Bodenheimer, *Protostar collapse*

C. Hunter, *Galactic dynamics*

III. Mathematical technique

D. H. Sattinger, *Bifurcation from spherical symmetry*

John Guckenheimer, *An introduction to chaotic motion and strange attractors*

J. L. Bona, W. G. Pritchard and L. R. Scott, *A comparison of solutions of two model equations for long waves*

1980 *Mathematics Subject Classifications*: 76, 85, 86

Lectures in Applied Mathematics

Volume 20, x + 270 pages (hard cover)

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Publication date: June 1983

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CBMS REGIONAL CONFERENCE SERIES

(Supported by the National Science Foundation)
(ISSN 0160-7642)

Structure of Factors and Automorphism Groups

Masamichi Takesaki

This book describes the recent development in the structure theory of von Neumann algebras and their automorphism groups. It gives a quick survey of the Tomita-Takesaki theory needed for the latter use, then moves on to the duality theory for crossed products and automorphism groups, which is applied to the structure theory of factors of type III. The last part is devoted to Connes' theory of injective factors. The book can be viewed as a guided tour to the state of the art.

Contents

- I. Noncommutative Integration
- II. General Theory of Crossed Products and Duality
- III. Structure of Factors of Type III
- IV. Connes' Theory of Injective Factors and Automorphisms

1980 *Mathematics Subject Classification*: 46L10

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REFERENCE WORK

Author Institution Codes and Addresses used in Current Mathematical Publications and Mathematical Reviews

Starting in 1983, some items in Current Mathematical Publications and then in MR include an author institution address code. It is not feasible to code all institutions, and the code is assigned only for articles which have an author address coinciding with one of the institutions MR has coded. This pamphlet is reprinted from the 1982 Mathematical Reviews Annual Index. A revised list is planned for the 1983 annual index.

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RECENT REPRINTS

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1982; reprinted with updates March 1983
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by *N. E. Steenrod, P. R. Halmos,
M. M. Schiffer, and J. A. Dieudonné*

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1973; reprinted with corrections 1981,
reprinted 1983 (soft cover)
List price \$9, institutional member \$7,
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by *S. Ginsburg, S. Greibach, J. Hopcroft*

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edited by *William F. Lucas*

Proceedings of Symposia in Applied Mathematics
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OPERATIONS RESEARCH MATHEMATICS AND MODELS

edited by *Saul I. Gass*

Proceedings of Symposia in Applied Mathematics
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by *Ronald L. Graham*

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Personal Items

Alejandro D. de Acosta of the University of Wisconsin, Madison, has been appointed to a professorship at Case Western Reserve University.

Kenneth F. Andersen of the University of Alberta has been appointed to a professorship at that university.

Gerald H. Cliff of the University of Alberta has been appointed to an associate professorship at that university.

James W. Daniel of the University of Texas, Austin, has taken a two-year-only leave to serve as Scientific Director (for Europe and the Middle East) of the U.S. Office of Naval Research in London, England, effective September 1983.

Jerry L. Fields of the University of Alberta has been appointed to a professorship at that university.

Steven H. Izen of the Massachusetts Institute of Technology has been appointed to an assistant professorship at Case Western Reserve University.

Judith Q. Longyear of Wayne State University has been appointed to a professorship at that institution.

Thomas D. Rogers of the University of Alberta has been appointed to a professorship at that university.

David P. Roselle, dean of research and graduate studies at Virginia Polytechnic Institute and State University, has been appointed university provost at that institution, effective July 1, 1983. He will resign as secretary of the Mathematical Association of America.

Patrick J. Ryan of Indiana University, South Bend, has been appointed to a professorship at McMaster University.

Ambikeshwar Sharma of the University of Alberta will be at Kent State University from January 1984 until June 1984.

Stanislaw J. Szarek of the University of Texas, Austin, has been appointed to an assistant professorship at Case Western Reserve University.

Nicole Tomczak-Jaegermann of Texas A&M University, College Station, has been appointed to an assistant professorship at the University of Alberta.

Stephen Willard of the University of Alberta received the Rutherford Award for teaching.

Henry Wolkowicz of the University of Alberta has been appointed to a professorship at that university.

Wo-Sang Young of the University of Alberta has been appointed to an associate professorship at that university.

Deaths

Errett A. Bishop of the University of California, San Diego, died on April 15, 1983 at the age of 54. He was a member of the Society for 28 years. See the Special Meetings section in this issue for information about a memorial meeting to be held on September 24.

Burton H. Camp, Professor Emeritus of Wesleyan University, died on March 13, 1980 at the age of 99. He was a member of the Society for 66 years.

Irving Jacob Epstein of Rutgers University, died on April 21, 1983 at the age of 63. He was a member of the Society for 33 years.

Chester G. Jaeger of Claremont McKenna College, died on April 27, 1983 at the age of 86. He was a member of the Society for 58 years.

Herbert R. Leifer of Pittsburgh, Pennsylvania, died on May 14, 1981 at the age of 74. He was a member of the Society for 39 years.

Yudell L. Luke of the University of Missouri, Kansas City, who was a visiting professor at the Moscow State University, died in Riga, Latvia, on May 7, 1983 at the age of 64. He was a member of the Society for 43 years.

J. Wallace Marshall of Lake Wales, Florida, died on December 14, 1981 at the age of 69. He was a member of the Society for 36 years.

Arthur J. McMahon of Warwick, Rhode Island, died on July 28, 1982 at the age of 69. He was a member of the Society for 19 years.

Folke Ryde of Lund, Sweden, died on March 25, 1981 at the age of 83. He was a member of the Society for 24 years.

Graciela B. Salicrup of Ciudad Universitaria, died on July 28, 1982 at the age of 47. She was a member of the Society for 10 years.

Robert Arnold Smith of the University of Toronto, died on March 30, 1983 at the age of 46. He was a member of the Society for 22 years.

James P. Williams of Indiana University, Bloomington, died on May 1, 1983 at the age of 45. He was a member of the Society for 17 years.

H. M. Yarbrough of Owensboro, Kentucky, died on December 31, 1982 at the age of 98. He was a member of the Society for 51 years.

Erratum

The final report of the Annual Meeting in Denver appears in the June 1983 *Notices*. Craig L. Huneke should have been listed (on page 461), rather than Carlos E. Kenig, as a presider at one of the invited addresses.

Visiting Mathematicians

(Supplementary List)

The following lists of visiting mathematicians include both foreign mathematicians coming to the United States and Canada, and Americans going abroad. The original lists appeared on pages 450–452 of the June 1983 *Notices*.

American Mathematicians Visiting Abroad

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field of Special Interest</u>	<u>Period of Visit</u>
Beatson, Richard (U.S.A.)	University of Canterbury, New Zealand	Numerical Analysis	1/83 - 1/84
Childress, Stephen (U.S.A.)	University of Newcastle, England	Applied Mathematics	9/83 - 10/83
Katz, Nicholas M. (U.S.A.)	I. H. E. S., France	Algebraic Geometry, Number Theory	9/83 - 8/84
Korenblum, Boris (U.S.A.)	Imperial College, England	Analysis	9/83 - 12/83
Lax, Peter (U.S.A.)	Collège de France	Partial Differential Equations	4/84 - 5/84
Millett, Kenneth C. (U.S.A.)	I. H. E. S., France	Topology	9/83 - 6/84
Moishezon, Boris (U.S.A.)	Hebrew University, Israel	Algebraic Geometry	9/83 - 6/84
Papanicolaou, George (U.S.A.)	University of Paris, France	Probability	Spring 1984
Rao, J. S. (U.S.A.)	Indian Statistical Institute	Statistics	9/83 - 6/84

Visiting Foreign Mathematicians

Altschuler, Z. (Israel)	Texas A&M University	Functional Analysis	1/84 - 6/84
Ambartzumian, R. B. (U.S.S.R.)	McGill University	Probability	1/84 - 4/84
Antosik, Piotr (Poland)	University of California, Santa Barbara	Classical Real Analysis	9/83 - 12/83
Assouyat, Mansour (France)	Princeton University	Partial Differential Equations	9/83 - 6/84
Bayer-Fluckiger, Eva (Switzerland)	Institute for Advanced Study	Quadratic and Hermitian Forms, Knot Theory	9/83 - 4/84
Bellisard, Jean V. (France)	Princeton University	Mathematical Physics	9/83 - 6/84
Benninghofen, Benjamin (West Germany)	University of Iowa	Infinitesimal Analysis	1/83 - 5/84
Bismut, Jean-Michel (France)	Institute for Advanced Study	Probability Relations with Geometry	1/84 - 4/84
Bogomolny, Alexander (Israel)	University of Iowa	Variational Inequalities, Boundary Integral Method	8/82 - 5/84
Brown, K. A. (Scotland)	University of Washington	Algebra	9/83 - 6/84
Caboz, Régis (France)	McGill University	Application of Special Functions in Hamiltonian Mechanics	1983–1984
Carayol, Henri (France)	Institute for Advanced Study	Automorphic Theory	1/84 - 4/84
Chipot, Michael M. (France)	University of Maryland, College Park	Partial Differential Equations	8/83 - 6/84
Clozel, Laurent (France)	Institute for Advanced Study	Base Change for Automorphic Forms on $GL(n)$	9/83 - 4/84
Coates, John H. (France)	Institute for Advanced Study	Automorphic Forms	1/84 - 4/84
Coleman, Edwin (Australia)	University of California, Santa Barbara	Computing Curriculum	6/83 - 11/83
Dani, Shrikrishna G. (India)	Institute for Advanced Study	Ergodic Theory	9/83 - 4/84
Darling, Richard (Great Great Britain)	University of California, Irvine	Probability and Mathematical Physics	7/83 - 6/84
Donaldson, Simon K. (England)	Institute for Advanced Study	Differential Geometry	9/83 - 4/84
Ganguly, Dilip K. (India)	University of California, Santa Barbara	Classical Real Analysis	7/83 - 7/84
Gao, Ren (People's Republic of China)	SUNY, Albany	Functional Analysis	6/83 - 6/84
Gérardin, Paul (France)	Institute for Advanced Study	Harmonic Analysis on Reductive Groups	1/84 - 4/84
Giga, Yoshikazu (Japan)	New York University, Courant	Partial Differential Equations	9/83 - 6/84
Gohberg, Israel (Israel)	University of Maryland, College Park	Operator Theory	8/83 - 1/84
Good, J. Anton (Switzerland)	Institute for Advanced Study	Analytic Number Theory	9/83 - 4/84
Grauert, Hans (West Germany)	Institute for Advanced Study	Several Complex Variables	2/84 - 4/84
Gupta, B. C. (Brazil)	McGill University	Design of Experiments, Analysis of Variance, Distribution	4/83 - 1/84

<u>Name and Home Country</u>	<u>Host Institution</u>	<u>Field of Special Interest</u>	<u>Period of Visit</u>
Harder, Günter (West Germany)	Institute for Advanced Study	Automorphic Forms, Algebraic Groups	9/83 - 12/83
Henniart, Guy (France)	Institute for Advanced Study	Automorphic Representations	1/84 - 4/84
Hooley, Christopher (England)	Institute for Advanced Study	Number Theory	9/83 - 12/83
Hsu, Sen-Lin (People's Republic of China)	Princeton University	Differential and Algebraic Topology	3/82 - 12/83
Ilori, Samuel A. (Nigeria)	Institute for Advanced Study	Algebraic Geometry	1/84 - 4/84
Jha, Vikram (Scotland)	University of Iowa	Group Theory, Geometry	8/83 - 5/84
Karzel, H. (West Germany)	Texas A&M University	Algebra	9/83 - 1/84
Labesse, Jean-Pierre (France)	Institute for Advanced Study	Automorphic Forms	9/83 - 12/83
Laczokovich, Miklos (Hungary)	University of California, Santa Barbara	Classical Real Analysis	1/84 - 7/84
Lam, Kin (Hong Kong)	University of California, Santa Barbara	Statistics	9/83 - 8/84
Lin, Wen-Hsiung (Taiwan)	Institute for Advanced Study	Algebraic Topology	9/83 - 4/84
Livne, Ron A. (Israel)	Princeton University	Algebraic Geometry	9/83 - 1/84
Loxton, John H. (Australia)	Institute for Advanced Study	Number Theory	1/84 - 4/84
Meeks, William H. III (Brazil)	Institute for Advanced Study	Geometry and Topology	9/83 - 4/84
Mez, Hans-Christian (West Germany)	University of California, Irvine	Algebra and Logic	7/83 - 6/84
Mikusinski, Jan (Poland)	University of California, Santa Barbara	Classical Real Analysis	9/83 - 12/83
Mikusinski, Piotr (Poland)	University of California, Santa Barbara	Classical Real Analysis	9/83 - 7/84
Munkholm, Hans J. (Denmark)	University of Maryland, College Park	Topology	8/83 - 6/84
Ozawa, Shin (Japan)	New York University, Courant	Functional Analysis	9/83 - 6/84
Parreau, Francois (France)	University of Hawaii	Measure Algebras, Spectral Measures	1/84 - 5/84
Patterson, S. J. (West Germany)	Institute for Advanced Study	Automorphic Forms	2/84 - 3/84
Pejsachowicz, Jacob (Italy)	University of Maryland, College Park	Partial Differential Equations	8/83 - 6/84
Petruska, Gyorgy (Hungary)	University of California Santa Barbara	Classical Real Analysis	1/84 - 7/84
Piatetski-Shapiro, Ilya (Israel)	Institute for Advanced Study	Automorphic Forms	9/83 - 4/84
Qiu, Qing-ju (People's Republic of China)	Princeton University	Pseudo-differential Operators	11/82 - 6/84
Sadosky, Cora (Argentina)	New York University, Courant	Partial Differential Equations	9/83 - 6/84
Sakane, Yusuke (Japan)	University of Notre Dame	Differential Geometry	9/83 - 5/84
Salamon, Simon M. (England)	Institute for Advanced Study	Differential Geometry	9/83 - 4/84
Serre, Jean-Pierre (France)	Institute for Advanced Study	Automorphic Forms	9/83 - 12/83
Shatah, Jalal (Lebanon)	New York University, Courant	Partial Differential Equations, Analysis	9/83 - 6/84
Shepherd, G. C. (United Kingdom)	University of Washington	Geometry	9/83 - 12/83
Simon, Leon (Australia)	Institute for Advanced Study	Differential Geometry	1/84 - 2/84
Skowronski, Janislav M. (Australia)	University of Alberta	Systems Dynamics	9/83 - 12/83
Soma, Teruhiko (Japan)	Institute for Advanced Study	Topology	9/83 - 4/84
Spatzier, Ralf (West Germany)	New York University, Courant	Ergodic Theory	9/83 - 6/84
Speh, Birgit E. M. (West Germany)	Institute for Advanced Study	Cohomology of Arithmetic Groups	1/84 - 4/84
Spigler, Renato (Italy)	New York University, Courant	Probability	9/83 - 6/84
Springer, Tonny A. (The Netherlands)	Institute for Advanced Study	Algebra	9/83 - 10/83
Tai, Hsin-sheng (People's Republic of China)	University of Notre Dame	Differential Geometry	9/83 - 5/84
Takahashi, Wataru (Japan)	University of California, Santa Barbara	Fixed Point Theory	7/83 - 1/84
Thomas, Kenneth S. (United Kingdom)	University of Iowa	Numerical Analysis	8/83 - 5/84

Name and Home Country	Host Institution	Field of Special Interest	Period of Visit
Weit, Yitzhak (Israel)	University of Hawaii	Harmonic Analysis	8/83 - 1/84
Wuermli, Hans P. (Switzerland)	Princeton University	Harmonic Analysis	9/83 - 6/84
Xia, Daoxing (People's Republic of China)	Institute for Advanced Study	Analysis	9/83 - 4/84
Xia, Jingbo (China)	University of Iowa	Functional Analysis	8/83 - 5/85
Yu, Qihuang, (People's Republic of China)	Institute for Advanced Study	Differential Geometry, Complex Manifolds	9/83 - 4/84
Zambrini, Jean-Claude (Switzerland)	Princeton University	Stochastic Mechanics	10/83 - 9/84
Zhong, Jia-Qing (People's Republic of China)	Institute for Advanced Study	Geometry, Topology	9/83 - 4/84
Zirilli, F. (Italy)	New York University, Courant	Partial Differential Equations, Analysis	9/83 - 1/84

Backlog of Mathematics Research Journals

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 the *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).

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages		Editor's Estimated Time for Paper Submitted Currently to be Published (In Months)	Observed Waiting Time in Latest Published Issue (In Months)		
			5/31/83	12/15/82		Q ₁	M	Q ₃
Acta Inform.	8	960	0	0	6-7	6	8	9
Aequationes Math.	1	320	0	128	12		NA	
Amer. J. Math.	6	1400	1800	NR	12		NA	
Ann. Probab.	4	1100	100	275	15	10	11	12
Ann. Sci. École Norm. Sup.	4	650	NR	NR	NR	9	11	12
Ann. Statist.	4	1350	20	0	12	7	8	9
Ann. of Math.	6	1200	300	600	10	15	17	18
Appl. Math. Optim.	4	384	145	NR	6	6	6	10
Applicable Anal.	8	800	NR	0	NR	6	9	9
Arch. Hist. Exact Scis.	8	800	0	0	13-14	9	10	23
Arch. Rational Mech. Anal.	12	200	0	0	17-18	9	11	12
Bull. Soc. Math. France	4	450	NR	NR	6	11	11	17
Canad. J. Math.	6	1200	100	100	17	12	13	17
Canad. Math. Bull.	4	512	256	256	16	15	17	18
Comm. Algebra	22	2640	2102	2069	13	16	17	17
Comm. Math. Phys.	20	3040	0	0	5	7	7	9
Comm. Partial Diff. Equations	15	1900	350	300	9	6	6	9
Computing	8	768	0	NR	7	8	13	19
Duke Math. J.	4	1000	200	0	9	7	9	11
Houston J. Math.	4	600	150	300	13	21	24	29
Illinois J. Math.	4	704	1222	1129	27	25	27	27
Indiana Univ. Math. J.	6	960	400	600	18	20	22	23
Internat. J. Math. Math. Sci.	4	800	50	200	10	8	9	18
Invent. Math.	12	1572	NR	NR	7	7	9	11
Israel J. Math.	12	1100	100	621	10	7	7	13
J. Amer. Statist. Assoc.	4	1000	NR	0	NR	6	7	8
J. Assoc. Comput. Mach.	4	1000	600	200	15	11	13	13

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages		Editor's Estimated Time for Paper Submitted Currently to be Published (in Months)	Observed Waiting Time in Latest Published Issue (in Months)		
			5/31/83	12/15/82		Q ₁	M	Q ₃
J. Comput. System Sci.	6	900	100	200	12	9	11	24
J. Differential Geom.	4	650	300	300	6	9	10	13
J. Math. Biol.	9	1152	NR	NR	6	5	6	7
J. Math. Phys.	12	3000	NR	300	4-5	11	16	18
J. Math. Sociol.	4	350	NR	0	NR		NA	
J. Nigerian Math. Soc.	1	100	0	0	NR		NA	
J. Operator Theory	4	800	400	400	9	13	14	16
J. Symbolic Logic	4	1300	530	500	18	26	27	29
Linear Algebra Appl.	8	2400	300	0	12	9	10	12
Linear and Multilinear Algebra	6	540	270	6	14	14	17	19
manuscripta math.	12	1440	0	0	4	4	5	9
Math. Ann.	16	2300	0	0	4-6	4	7	8
Math. Biosci.	10	1600	NR	0	6	5	6	7
Math. Comp.	4	1500	0	0	12	10	12	16
Math. Oper. Res.	4	NR	NR	NR	NR	15	16	18
Math. Programming	9	1080	400	400	10	12	13	13
Math. Systems Theory	4	396	72	NR	6	9	13	16
Math. Z.	12	1740	0	0	7-8	8	9	12
Mem. Amer. Math. Soc.	6	3000	1000	1350	14-18	16	17	27
Michigan Math. J.	3	384	70	0	8-15	9	11	12
Monatsh. Math.	8	704	50	30	10	13	13	14
Numer. Funct. Anal. Optim.	8	850	0	150	6	5	5	8
Numer. Math.	6	888	0	0	8-9	6	7	11
Oper. Res.	6	NR	NR	400	NR	20	24	27
Pacific J. Math.	12	3000	NR	NR	17	17	19	20
Proc. Amer. Math. Soc.	12	2200	100	0	8-11	8	10	12
Quart. Appl. Math.	4	128	175	0	12	10	11	12
Rocky Mountain J. Math.	4	768	200	150	18	19	22	25
SIAM J. Algebraic Discrete Methods	4	560	103	109	12	10	11	12
SIAM J. Appl. Math.	6	1350	357	451	12	13	14	15
SIAM J. Comput.	4	800	269	329	14	11	12	13
SIAM J. Control Optim.	6	975	456	346	14	12	12	14
SIAM J. Math. Anal.	6	1225	754	730	16	13	14	18
SIAM J. Numer. Anal.	6	1300	80	116	10	12	13	16
SIAM J. Sci. Statist. Comput.	4	600	436	333	15	12	14	19
SIAM Rev.	4	560	0	0	10	9	9	10
Semigroup Forum	8	800	400	NR	6	8	9	10
Stochastics	8	NR	NR	0	NR		NA	
Topology Appl.	6	660	500	150	18	9	10	11
Trans. Amer. Math. Soc.	12	5400	100	0	11-14	12	12	15
Z. Wahrsch. Verw. Gebiete	12	1680	0	0	7-8	6	7	10

NR means no response received.

NA means not available or not applicable.

CONTEMPORARY MATHEMATICS

Plane Ellipticity and Related Problems

Robert P. Gilbert, Editor

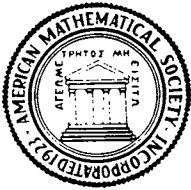
In this collection of papers concepts associated with plane-ellipticity are extended in several ways. For example, the investigations of Begehr and Gilbert, Begehr and Hsiao, Hile and Snyder treat systems of elliptic partial differential equations in the plane which resemble in some sense the Cauchy-Riemann equations. Their point of view is to seek general representation formulas and to use these in some cases to solve boundary value problems. Continuing with the theme of generalizing the Cauchy-Riemann equations, Buchanan treats the Bers-Vekua type sys-

tems in two complex variables, while Delanghe and Sommen, Brackx and Pincket, and Lounesto investigate hypercomplex function theory in \mathbb{R}^n , that is the class of homogenic functions having values in a Clifford algebra.

The remaining talks comprising this special meeting cannot be categorized as falling into a general group, but rather explore isolated, albeit important, topics associated with ellipticity.

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Allan M. Cormack, *Computed tomography: Some history and recent developments*

F. Alberto Grünbaum, *The limited angle reconstruction problem*

Sigurdur Helgason, *Ranges of Radon transforms*

Johann Radon, *Über die Bestimmung von Funktionen durch ihre Integralwerte längs gewisser Mannigfaltigkeiten* (reprinted from *Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig* 69 (1917), 262–277).

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Recent Appointments

Committee members' terms of office on standing committees expire on December 31 of the year given in parentheses following their names, unless otherwise specified.

Frank B. Cannonito (1985), Marian B. Pour-El (1985), Marina Ratner (1985), and Donald E. Sarason (1985) have been appointed by President Julia B. Robinson to the AMS-IMS-ASL *Committee on Translations from Russian and Other Foreign Languages*. Chairman of the Committee is Lawrence Zalcman. Continuing members of the AMS Subcommittee are Israel Berstein (1983), David G. Ebin (1983), Jack K. Hale (1983), Raymond L. Johnson (1984), Neal I. Koblitz (1984), Boris Mityagin (1983), Melvyn B. Nathanson (1983), Andrew M. Odlyzko (1984), and Lawrence Zalcman, chairman (1984). The IMS Subcommittee members are A. T. Bharucha-Reid, Miklós Csörgő, Eugene M. Klimko, Eugene Lukacs, chairman, and Lajos F. Takacs. The ASL Subcommittee members are Solomon Feferman (1984), James P. Jones (1984), Gregory Cherlin (1985), Vladimir Lifschitz (1984), and Gregory Minc (1984). Terms on this committee expire on September 30.

The *Committee on Summer Research Conferences* is now a joint committee. The name has been changed to the AMS-IMS-SIAM *Committee on Joint Summer Research Conferences in the Mathematical Sciences*. The members are Benedict H. Gross (1986), Kenneth Kunen (1983), Jerrold E. Marsden (1985), James McKenna (1986), Katsumi Nomizu (1986), Donald S. Ornstein (1983), Julius Shaneson (1984), and R. O. Wells, Jr., chairman (1985). Terms on this committee expire June 30.

A joint AMS-MAA *Committee on Arrangements for the Louisville Meeting* (January 25–29, 1984) has been appointed by Presidents Julia B. Robinson (AMS) and Ivan Niven (MAA). The committee members are W. Wistar Comfort (ex officio), Roger H. Geeslin, Thomas L. Holloman, William J. LeVeque (ex officio), David O'Toole, David P. Roselle (ex officio), Richard Werle, and W. Wiley Williams, chairman.

Terms have been established for the members of the AMS-MAA-SIAM *Joint Concerns Committee in Mathematics*. The members and their terms are I. Edward Block (SIAM, ex officio), Hirsh G. Cohen (SIAM, ex officio), William J. LeVeque (AMS, ex officio), Ivan Niven (MAA, ex officio), Robert E. O'Malley (SIAM, 1984), Julia B. Robinson (AMS, ex officio), David P. Roselle (MAA, 1984), Dana S. Scott (AMS, 1984), Alfred B. Willcox (MAA, ex officio).

Reports of Past Meetings

The March Meeting in Norman

The eight hundred second meeting of the American Mathematical Society was held at the University of Oklahoma, Norman, on Friday and Saturday, March 18–19, 1983. The sessions were held in the Forum Building of the Oklahoma Center for Continuing Education. There were 268 registrants, including 240 members of the Society.

Invited Addresses. By invitation of the 1982 Committee to Select Hour Speakers for Central Sectional Meetings, there were four invited one-hour addresses. The speakers, their affiliations, and the titles of their talks were as follows:

BORIS MITYAGIN, Ohio State University, *Non-linear singular equations*.

PAUL E. SCHUPP, University of Illinois, Urbana-Champaign, *Behavior at infinity: Ends, monadic logic, and automata*.

MICHAEL STARBIRD, University of Texas, Austin, *Decomposition spaces*.

JEFFREY D. VAALER, Institute for Advanced Study, *Some recent applications of Fourier analysis in number theory*.

The presiding officers at these four lectures were J. Jerry Uhl, Jr., Roger Lyndon, James W. Cannon, and Harold G. Diamond.

Special Sessions. By invitation of the same committee, there were eleven sessions of selected twenty-minute papers. The topics of these special sessions, the names of the organizers, and the lists of speakers were as follows:

Homological and combinatorial methods in group theory, ROGER C. ALPERIN, Rice University. The speakers were S. Bachmuth, Kenneth S. Brown, Marc Culler, B. Evans, Benjamin Fine, Iris Cox Hayslip, John Hempel, Verena Huber-Dyson, Bruce Ikenaga, R. Kramer, R. S. Kulkarni, Kenneth N. Moss, Joyce O'Halloran, John G. Ratcliffe, Marvin Tretkoff, Karen Vogtmann, and K. Weston.

Theory of Banach spaces, DALE E. ALSPACH, Oklahoma State University. The speakers were Dan Amir, A. D. Andrew, Steven F. Bellenot, N. L. Carothers, Peter G. Casazza, William J. Davis, G. A. Edgar, John H. Elton, Patrick Flinn, D. J. H. Garling, Peter Greim, N. J. Kalton, Edward Odell, Tenney Peck, Haskell P. Rosenthal, Elias Saab, Paulette Saab (by proxy), Nicole Tomczak-Jaegermann, and J. Jerry Uhl, Jr.

Linear algebra and matrix theory, GEORGE PHILLIP BARKER, North Carolina State University. The speakers were G. P. Barker, Biswa N. Datta, Thomas L. Markham, George D. Poole, and Donald W. Robinson.

Geometric topology, DONALD S. CORAM and BENNY D. EVANS, Oklahoma State University. The speakers were John Berge, Ethan D. Bloch, Philip L. Bowers, James W. Cannon, A. Casson, Robert J. Daverman, Jerzy Dydak, Erica Flapan, Ross Geoghegan, C. Gordon, George Kozłowski, R. Kramer, William Ortmeyer, John G. Ratcliffe, Peter Scott, Jack Segal, Peter Shalen, Thomas L. Thickstun, Bruce Trace, Vo Thanh Liem, John J. Walsh, and Wilbur Whitten.

Analytic number theory, HAROLD G. DIAMOND, University of Illinois, Urbana-Champaign. The speakers were Krishnaswami Alladi, Paul Erdős, P. X. Gallagher, S. W. Graham, John H. Hawkins, Douglas A. Hensley, Grigori Kolesnik, Helmut Maier, Kevin McCurley, Eugene K. S. Ng, G. J. Rieger, Michael D. Vose, and Eduard A. Wirsing.

Control theory and applications, KEVIN A. GRASSE and LUTHER W. WHITE, University of Oklahoma. The speakers were Calvin D. Ahlbrandt, Kevin A. Grasse, Terry L. Herdman, L. R. Hunt, Karl Kunisch, and Luther White.

Rings and modules, JOEL K. HAACK, Oklahoma State University. The speakers were Efraim P. Armendariz, William D. Blair, A. K. Boyle, Victor Camillo, John Dauns, K. R. Fuller, Alexander J. Hahn, Lawrence S. Levy, Bruno J. Mueller, Robert B. Warfield, and W. D. Weakley, and Birge Zimmerman-Huisgen.

The algebra of algorithms, automata, and languages, ROGER C. LYNDON, University of Michigan, Ann Arbor. The speakers were Thomas Drucker, Robert H. Gilman, Yuri Gurevich, Robert H. Haring-Smith, H. Jürgensen, Juhani Karhumäki, Ernest G. Manes, Robert McNaughton, David Muller, John Myhill, Howard Straubing, and Denis Therien.

Universal enveloping algebras and group algebras of infinite groups, ANDY R. MAGID and RICHARD D. RESCO, University of Oklahoma. The speakers were Randall P. Dahlberg, F. R. DeMeyer, T. J. Hodges, Susan Montgomery, J. J. Sarraillé, Martha K. Smith, and S. P. Smith.

Nonlinear functional analysis, WILLIAM O. RAY, University of Oklahoma. The speakers were M. Altman, Ronald E. Bruck, David J. Downing, W. A. Kirk, Teck-Cheong Lim, Claudio Morales, Gregory B. Passty, Simeon Reich, R. C. Sine, and Ricardo Torrejon.

Theory of semigroups, NAOKI KIMURA, BERNARD L. MADISON, and BORIS M. SCHEIN, University of Arkansas, Fayetteville. This session had one plenary meeting on Friday afternoon, but at other times was divided into three subsessions, with subjects and organizers as indicated below. The speakers in the plenary session were Karl H. Hofmann, Tôru Saitô, and Dov Tamari. The three subsessions were as follows:

1. *Semigroups and related systems*, NAOKI KIMURA. The speakers were M. E. Adams, Ernst August Behrens, Sydney Bulman-Fleming, Graham Clarke (by proxy), Arthur Gerhard, Jerzy W. Grzymala-Busse, Peter R. Jones, Jin Bai Kim,

Ulrich Knauer, John K. Luedeman, C. J. Maxson, Robert H. Oehmke, John Rodes, J. Sichler, and John Zeleznikow.

2. *Topological semigroups*, BERNARD L. MADISON. The speakers were Bridget B. Baird, Dennison R. Brown, B. Michael Castellano, Esmond E. DeVun, Gerhard Gierz, George E. Graham, John A. Hildebrandt, V. Sankrithi Krishnan, Jimmie D. Lawson, K. D. Magill, Jr., Michael Mislove, John Selden, Jr., J. W. Stepp, Albert R. Stralka, and Saraswathi Magill Subbiah.

3. *Regular semigroups*, BORIS M. SCHEIN. The speakers were Karl Byleen, Michael P. Drazin, C. C. Edwards, Andrew Foster, Simon M. Goberstein (by proxy), Howard Hamilton, Darel Hardy, Robert J. Koch, Antonio M. Lopez, Jr., Robert McFadden, William R. Nico, Mohan S. Putcha, Wiley Williams, and G. R. Wood.

Contributed Papers. There were four sessions of contributed ten-minute papers, for which Fredric D. Ancel, Michael L. Bolla, Jerry A. Johnson, and Lawrence S. Levy served as presiding officers. Of the twenty ten-minute papers listed in the program of the meeting, six were withdrawn; one late paper was added to the program, so that fifteen ten-minute papers were actually presented.

Paul T. Bateman

Urbana, Illinois

Associate Secretary

The April Meeting in New York City

The eight hundred and third meeting of the American Mathematical Society took place at the New York Statler Hotel in New York City on Thursday and Friday, April 14 and 15, 1983. There were 360 registrants, including 295 members of the Society.

A symposium on Inverse Problems, sponsored by the AMS and SIAM, took place on Tuesday and Wednesday, April 12 and 13. The National Science Foundation provided partial support for the symposium.

Invited Addresses. By invitation of the Committee to Select Hour Speakers for Eastern Sectional Meetings, there were four invited one-hour addresses. The names of the speakers, their affiliations, and the titles of their talks were as follows:

W. DALE BROWNAWELL, Pennsylvania State University, University Park, *Recent trends in transcendence theory*.

RICHARD S. HAMILTON, Cornell University, *Three-manifolds with positive Ricci curvature*.

OLIVER A. MCBRYAN, Courant Institute of Mathematical Sciences, New York University, *Computational methods for discontinuous solutions*.

WOLFGANG ZILLER, University of Pennsylvania, *On the existence of closed geodesics on Riemannian manifolds*.

The four speakers were introduced by Wolfgang Schmidt, Dennis DeTurck, James Glimm, and Karen Uhlenbeck, respectively.

Special Sessions. By invitation of the same committee, there were nine special sessions of selected twenty- and forty-minute papers. The topics of these special sessions, the names and affiliations of the organizers, and the lists of speakers were as follows:

Abelian groups, KHALID BENABDALLAH, University of Montréal. The speakers were Donna Beers, Khalid Benabdallah, Jutta Hausen, Paul Hill, John Irwin, Samir Khabbaz, George Kolettis, Charles Megibben, John D. O'Neill, K. M. Rangaswamy, J. D. Reid, Charles Vinsonhaler, Elbert Walker, and W. J. Wickless.

Transcendence theory and Diophantine problems, W. DALE BROWNAWELL. The speakers were Enrico Bombieri, Richard T. Bumby, Gregory V. Chudnovsky, Thomas W. Cusick, Howard Kleiman, J. C. Lagarias, Richard Mason, Julia Mueller, Gerald Myerson, Melvyn B. Nathanson, A. M. Odlyzko, Charles F. Osgood, Eric Reyssat, M. L. Robinson, Joseph H. Silverman, Cameron L. Stewart, Wolfgang M. Schmidt, Rob Tubbs, Jeffrey D. Vaaler, and Paul A. Voita.

Combinatorial group theory, ANTHONY M. GAGLIONE, United States Naval Academy. The speakers were Michael Anshel, S. Bachmuth, Joan S. Birman, Frank B. Cannonito, Leo P. Comerford, Jr., Joan Dyer, Benjamin Fine, Chander Kanta Gupta, Narain Gupta, Robert M. Guralnick, Richard M. Hain, Ronald Hirshon, L.-C. Kappe, John P. Labute, R. C. Lyndon, S. K. Mahdavianary, Dennis Spellman, Ruth Rebekka Struik, F. C. Y. Tang, Carol L. Tretkoff, and K. Weston.

Sensitivity of functionals, VADIM KOMKOV, West Virginia University. The speakers were Roger Brockett, Edward J. Haug, Vadim Komkov, Jerzy Kyparisis, Pauli Pedersen, Herschel Rabitz, Michael Vogelius, and Walter M. Wonham.

Singularities of algebraic and analytic varieties, HENRY LAUFER, SUNY, Center at Stony Brook. The speakers were Ragnar-O. Buchweitz, David Eisenbud, Robert Ephraim, Henry Laufer, Anatoly Libgober, David R. Morrison, Donal B. O'Shea, Richard Randell, Michael Schlessinger, Susan Szczepanski, Hiroaki Terao, Philip Wagreich, Jonathan M. Wahl, and Stephen Yau.

The mathematical legacy of Hans Rademacher, JOSEPH LEHNER, Institute for Advanced Study, and MARVIN I. KNOPP, Temple University. The speakers were Raymond G. Ayoub, Bruce C. Berndt, D. M. Bressoud, S. Chowla, Harvey Cohn, Ronald J. Evans, E. Grosswald, James Lee Hafner, Marvin I. Knopp, Joseph Lehner, Thomas A. Metzger, V. Kumar Murty, M. Ram Murty, Morris Newman, L. Alayne Parson, Norman Purzitsky, Mark Sheingorn, Harold M. Stark, Kenneth B. Stolarsky, Robert Alan Styer, and Albert L. Whiteman.

Computational methods and fluid mechanics, OLIVER A. MCBRYAN. The speakers were James Bramble, P. R. Garabedian, Harold Grad, Anthony

Jamison, Malvin H. Kalos, Keith Miller, Steven A. Orszag, and Norman J. Zabusky.

Value distribution theory and its applications, CHUNG-CHUN YANG, United States Naval Research Laboratories. The speakers were Chi-tai Chuang, Albert Edrei, Fred Gross, Simon Hellerstein, J. K. Langley, Peter A. Lappan, Lennox S. O. Liverpool, Seiki Mori, Kiyoshi Niino, S. M. Shah, Daniel F. Shea, Leonard M. Smiley, Guo-dong Song, Charles S. Stanton, Sh. Strelitz, Nobushige Toda, Chia-Chi Tung, Hironubu Urabe, Jorg Winkler, and Niro Yanagihara.

Variational problems in Riemannian geometry, WOLFGANG ZILLER. The speakers were Paul Baird, Victor Bangert, Melvyn S. Berger, Dennis DeTurck, Doris Fischer-Colbrie, Michael E. Gage, Carolyn S. Gordon, Alfred Gray, David Hoffman, Anatoly Katok, Tilla Klotz Milnor, Wei-Ming Ni, L. M. Sibner, David A. Singer, Karen K. Uhlenbeck, S. Walter Wei, and Frank Williams.

Contributed Papers. There were, in addition, six sessions for contributed papers. Their titles and the names of those chairing were as follows: *Applied and applicable analysis*, Abdul J. Jerri and Emilio O. Roxin; *Number theory and algebraic structures*, Murray Gerstenhaber and Boris Z. Raykhshteyn; *Geometry and topology*, Bill Watson and J. S. Yag; *Integral and differential equations*, T. K. Puttaswamy and William F. Trench; *Logic and combinatorics*, Francine Abeles and Robert A. DiPaola; *Fourier series and spaces of functions*, Lewis C. Robertson.

Council Meeting. The Secretary's report of the Council Meeting held on April 14, in conjunction with this meeting, appeared on page 463 of the June 1983 *Notices*.

W. Wistar Comfort
Associate Secretary

Middletown, Connecticut

The April Meeting in Salt Lake City

The eight hundred and fourth meeting of the American Mathematical Society was held at the University of Utah in Salt Lake City on Friday and Saturday, April 29–30, 1983. The meeting was held in conjunction with a meeting of the Intermountain section of the Mathematical Association of America. There were 155 registrants including 103 members of the Society. W. J. Coles served as the local organizer of this meeting.

Invited Addresses. By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there were two invited one-hour addresses.

WILLIAM ARVESON, University of California, Berkeley, *Quasitriangular operator algebras*. He was introduced by Fletcher Gross.

LANCE W. SMALL, University of California, San Diego, *Finitely generated algebras satisfying a*

polynomial identity. He was introduced by Tom Lenagan.

Special Sessions. By invitation of the same committee, there were five special sessions of selected twenty-minute papers. The topics of these special sessions, the names of the organizers, and the lists of speakers are as follows:

Computer-aided geometric design, PETER ALFELD and ROBERT E. BARNHILL, University of Utah. The speakers were Peter Alfeld, Paul R. Arner, R. E. Barnhill, Gary Herron, Thomas Jensen, Peter Kochevar, Gregory M. Nielson, Chip Petersen, Kestutis Salhaushas, Tracy Whelan, and Andrew J. Worsey.

Theory and applications of cocycles for an irrational rotation, LAWRENCE W. BAGGETT, University of Colorado, Boulder. The speakers were Brian Amrine, Brendt Brenken, Robert P. Boyer, Ray Fabec, Henry Helson, Joe Jenkins, Kathy Merrill, and Arlan Ramsay.

Noncommutative ring theory, KENNETH R. GOODEARL and T. LENAGAN, University of Utah. The speakers were John A. Beachy, H. H. Brungs, Joe W. Fisher, Joel K. Haack, T. J. Hodges, Hans-Christian Mez, S. Montgomery, Stanley S. Page, Sudarshan Seghal, S. P. Smith, Kalathoor Varadarajan, and Roger Wiegand.

Nonlinear elliptic and parabolic partial differential equations, KLAUS SCHMITT, University of Utah. The speakers were Wolfgang Alt, Peter W. Bates, Jerrold W. Bebernes, Stephen Cantrell, Shui-Nee Chow, Chris Cosner, Steven R. Dunbar, Hans Engler, Frank Hoppensteadt, F. A. Howes, C. Jones, Gene A. Klaasen, Jean L. Mawhin, H. G. Othmer, D. Sather, Andrea Shiaffino, and James Ward, Jr.

Four-dimensional topology, RONALD J. STERN, University of Utah. The speakers were Fredric D. Ancel, Steven Bleiler, James W. Cannon, Tim Cochran, Donald Coram, Mark Culler, William T. Eaton, Allan L. Edmonds, Ronald Fintushel, Patrick M. Gilmer, Robert E. Gompf, Cameron McA. Gordon, Joel Haas, John Hempel, Terry Lawson, Youn Lee, Charles Livingston, Kenneth Millett, Luis Montejano, Ulrich Oertel, Daniel Ruberman, T. B. Rushing, Nobuyuki Sato, Martin G. Scharlemann, David J. Schorow, Laurence R. Taylor, Bruce Trace, John J. Walsh, and David G. Wright.

Contributed Papers. There was one session of contributed ten-minute papers of two speakers.

MAA Program. The MAA program included two invited speakers. RICHARD D. ANDERSON of Louisiana State University, Baton Rouge, spoke on *Some recent results in infinite dimensional topology*. JEAN J. PEDERSEN of the University of Santa Clara spoke on *Approximating n-gons by folding paper: An interplay of analysis, geometry and number theory*.

There was a session including nine student papers organized by L. J. KRATZ of Idaho State University. There was also a panel discussion on *Industrial Opportunities and Applications*, moderated by R. L. CARPENTER of Thiokol Corporation.

Pacific Northwest Geometry Seminar. On Saturday afternoon and Sunday morning there were addresses sponsored by the Pacific Northwest Geometry Seminar. The speakers were R. Barlow, J. Carrell, M. Green, and M. Vitulli.

Hugo Rossi

Salt Lake City, Utah

Associate Secretary

CONTEMPORARY MATHEMATICS

MARKOV RANDOM FIELDS AND THEIR APPLICATIONS

by Ross Kinderman and J. Laurie Snell

This book presents an introduction to Markov random fields and the related topic of infinite interacting particle systems. The principal concepts and theorems of the subject are illustrated in terms of models currently being studied. The Ising model is used to motivate the concept of a random field. The concept of a phase transition is discussed in terms of the breakdown of basic probability theorems such as the law of large numbers and the central limit theorem.

Infinite interacting particle systems are illustrated in terms of examples and as the dynamic Ising model, voter models, contact processes and the stepping stone model for genetic drift.

The relation of the study of these models to the problem of cell growth is brought out. Computer graphics are used whenever possible to illustrate the dynamics of these models.

The study of Markov random fields has brought exciting new problems to probability theory which are being developed in parallel with basic investigation in other disciplines, most notably physics. The mathematical and physical literature is often quite technical. This book aims at a more gentle introduction to these new areas of research.

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Fixed Points and Nonexpansive Mappings**Robert C. Sine, Editor**

A nonexpansive mapping is a natural generalization of a contraction mapping of Banach fixed point theorem fame. The asymptotic behavior and invariant structure which can arise with nonexpansive mappings offers a wide variety of interesting behavior in contrast to that of a Banach contraction.

The subject has grown out of work in the 30s on metric geometry and research in the early 60s on problems in nonlinear analysis. At the present time interest stems from applications to PDE, functional DE's, approximation theory and theoretical numerical analysis.

These lectures grew out of special sessions at the annual AMS meeting in Cincinnati in January of 1982. While the specialist will find much of interest, many of the lectures of the special sessions have been reworked for this volume to be surveys which will be accessible to any mathematician or graduate student either wishing to acquaint himself with this area or wishing to prepare himself to add to the research literature. The required background for a great deal of the exposition is a modest knowledge of metric spaces and analysis.

The extensive bibliographies of several of the surveys will prove to be of considerable value to both the specialist and the novice. There are a total of 575 bibliographic references for all these papers.

Ronald E. Bruck, *Asymptotic behavior of nonexpansive mappings*

Frank Deutsch, *A survey of metric selections*

David J. Downing, *Some aspects of nonlinear mapping theory and equivalent renormings*

J. Elton, Pei-Kee Lim, E. Odell and S. Szarek, *Remarks on the fixed point problem for nonexpansive maps*

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Mathematics Computer Science: Tougaloo College, Tougaloo, Mississippi has a tenure-track position available for a mathematician. Desirable to have a Ph.D. in Algebra, Applied Mathematics or in Statistics. However, a master's degree in mathematics or Ph.D. in other related area will be considered. Position will be filled for the fall semester of 1983. Rank and salary will be made commensurate with experience and degree. Please send application letter, Résumé, college placement files, or three letters of recommendation and an unofficial transcript to Glake Hill, Department of Mathematics and Computer Science, Tougaloo College, Tougaloo, Mississippi 39174. A member of the United Negro College Fund and Equal Opportunity/Affirmative Action Employer.

THE UNIVERSITY OF BRITISH COLUMBIA DEPARTMENT OF MATHEMATICS

Applications and nominations are invited for the position of HEAD Department of Mathematics which becomes vacant July 1, 1983. The Department of approximately seventy faculty members, about fifty graduate students and several postdoctoral fellows, has the responsibility for teaching mathematics and statistics to undergraduates in several Faculties, and carries on an active graduate program with individuals and groups involved in many areas of research in pure and applied mathematics and in statistics.

Applicants must be active and recognized internationally in a field of research that enhances the activities of the Department, must provide clear evidence of leadership and administrative ability, and must be dedicated to excellence in teaching. Applicants must qualify for the rank of full Professor in the Department.

The Head of Department must insure that both courses specific to the mathematics degree programs and service courses to other Faculties are maintained at a high level of instruction. The Head must also encourage the diverse research activities of the Department.

Applications to be received as soon as possible and must include a curriculum vitae, a list of publications, and the names of three referees.

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Replies directed to:

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Mathematics

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Applications and nominations are invited for anticipated tenure-track positions at the Assistant Professor level beginning September 1984. Candidates should have demonstrated strong research potential in an area of computational mathematics. These persons should have expertise in areas such as numerical analysis, numerical solutions of differential equations, software, hardware, and applications. Applications accepted until positions are filled.

Applicants should send a résumé and three letters of recommendation to Bruce E. Reed, Assistant Chairman, Department of Mathematics, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061-4097.

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Mathematics

Virginia Polytechnic Institute & State University

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Applicants should send a résumé and three letters of recommendation to Bruce E. Reed, Assistant Chairman, Department of Mathematics, Virginia Polytechnic Institute & State University, Blacksburg, Virginia 24061-4097.

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DEPARTMENT OF MATHEMATICS UNIVERSITY OF CALIFORNIA, SANTA BARBARA

Applications are invited for a tenure-track assistant professor position in statistics. Candidates must have outstanding research potential and have demonstrated excellence in teaching. Qualified candidates from minority groups and qualified women are encouraged to apply. Exceptionally well-qualified persons, whose background and experience warrant a tenure-level appointment are also encouraged to apply. Résumés and three letters of recommendation should be sent prior to December 15, 1983 to James B. Robertson, Department of Mathematics, University of California, Santa Barbara, CA 93106.

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Applications are invited for one position at the Assistant Professor level in Mathematics.

Responsibilities: To teach courses in Mathematics and Computer Science, hold related conference hours and to conduct advanced research in pure Mathematics.

Qualifications: Candidates must have a Ph.D. in Mathematics plus a proven record of outstanding research accomplishment. Experience teaching at both the undergraduate and graduate college level required, as is expertise in topology, algebraic geometry and experience in computer science. Salary: Negotiable.

Applications: Send résumé and at least three letters of recommendation to: Professor M. Gilmore (chair), Department of Mathematics, 521 Lake Hall, Northeastern University, 360 Huntington Avenue, Boston, MA 02115, on or before August 15, 1983. Northeastern is an Equal Opportunity/Affirmative Action Employer.

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Vol 5, issue 4

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