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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 the 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 *supplementary* 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. Abstracts must be accompanied by the **$15** processing charge. 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 for consideration for presentation at special sessions is usually three weeks earlier than that specified below. For additional information consult the meeting announcements and the list of organizers of special sessions.

MEETING #	DATE	PLACE	ABSTRACT DEADLINE	ISSUE
817	March 22–23, 1985	Chicago, Illinois	EXPIRED	March
818	April 12–13, 1985	Tucson, Arizona	EXPIRED	March
819	April 20–21, 1985	Worcester, Massachusetts	EXPIRED	March
820	May 3–4, 1985	Mobile, Alabama	EXPIRED	March
821	August 12–15, 1985 (89th Summer Meeting)	Laramie, Wyoming	May 28	August
822	October 26–27, 1985	Amherst, Massachusetts	August 19	October
823	November 1–2, 1985	Columbia, Missouri	August 21	October
824	November 8–9, 1985	Claremont, California	August 26	October
	January 7–11, 1986 (92nd Annual Meeting)	New Orleans, Louisiana	October 16	January
	January 21–25, 1987 (93rd Annual Meeting)	San Antonio, Texas		
	January 6–11, 1988 (94th Annual Meeting)	Atlanta, Georgia		
	August 8–12, 1988 (AMS Centennial Celebration)	Providence, Rhode Island		
	January 11–15, 1989 (95th Annual Meeting)	Phoenix, Arizona		

DEADLINES:			
Advertising	(*June* 1985 *Issue*) *April* 24, 1985	(*August* 1985 *Issue*) *June* 11, 1985
News/Special Meetings	(*June* 1985 *Issue*) *April* 8, 1985	(*August* 1985 *Issue*) *May* 23, 1985

Other Events Sponsored by the Society

May 27, 1985, Symposium on Some Mathematical Questions in Biology, Plant Biology, Los Angeles, California.

June 23–August 31, 1985, Joint Summer Research Conferences in the Mathematical Sciences, Humboldt State University, Arcata, California.

June 30–July 13, 1985, AMS-SIAM Summer Seminar on Reacting Flows: Combustion and Chemical Reactors, Cornell University, Ithaca, New York.

July 8–26, 1985, AMS Summer Research Institute on Algebraic Geometry, Bowdoin College, Brunswick, Maine.

August 10–11, 1985, AMS Short Course; Actuarial Mathematics, Laramie, Wyoming

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Notices
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Volume 32, Number 2, March 1985

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Position Open

Associate Executive Director

American Mathematical Society

Providence, Rhode Island

With the resignation of Dr. Jill P. Mesirov as of September 1985, the position of Associate Executive Director of the American Mathematical Society will become open.

Qualifications: the ideal candidate would

- have received a Ph.D. in one of the mathematical sciences within the past 20 years, and be familiar with the language and trends of contemporary American research mathematics,
- have a good command of the English language and be capable of writing well and easily,
- have both an interest and previous experience (at least at the departmental committee level) in administration,
- have an equable temperament and be able to work harmoniously with mathematicians and nonmathematicians alike,
- be able to commence work in Providence in early summer.

Some previous experience with computers (as text or data processors), publishing, government relations, or business management would be welcome but is of secondary importance.

Responsibility: About 125 people work in the Society's Providence office, and about half of them are concerned with publishing (editorial processing, translation, computer composition, printing/binding, marketing). In addition there are departments concerned with meetings, member services, order fulfillment, fiscal records, and computer programming and operations. The editorial offices for *Mathematical Reviews*, in Ann Arbor, employ another 70 persons. The two offices share some facilities, including the use of two DEC-2060 mainframes, but management is largely separate.

The person filling the open position will work with the Executive Director and the continuing Associate Executive Director, Dr. James W. Maxwell, in administering the work of this staff, and in executing the decisions of the Board of Trustees and of the Council. Sensitivity for the concerns of the mathematical research community is essential, since an important part of the job is to facilitate communication between members of the staff and the Trustees, the Council, editorial and other AMS committees, government agencies, and American and foreign mathematicians. Some travel will be involved, including attendance at the two national meetings.

Term of Appointment: Preferably this will be a three-year initial appointment, with a good possibility of reappointment on a term or continuing basis. Alternatively, the Society may consider the temporary appointment for one or two years of a mathematician on leave from a college or university.

Applications and nominations should be sent to

Dr. W. J. LeVeque, Executive Director
American Mathematical Society
P. O. Box 6248
Providence, R.I. 02940

Completed applications received by 1 April 1985 will be assured of consideration. Appropriate letters of reference should also be received by that date.

The Society is an equal opportunity employer, and has a generous fringe-benefit program, including TIAA/CREF. Salary for this position will be commensurate with the background of the appointee.

Gauss and the Arithmetic-Geometric Mean

by David A. Cox

In 1828, after seeing the first works of Abel and Jacobi on elliptic functions, Gauss wrote: "I shall most likely not soon prepare my investigations on transcendental functions which I have had for many years... . Herr Abel has now, I see, anticipated me and relieved me of the burden in regard to one third of these matters..." [3, X. 1, page 248]. This is a tantalizing quote—one wonders what Gauss knew that Abel and Jacobi did not. What do the other two thirds "of these matters" refer to? Part of the answer is well known, for Gauss's collected works show that he anticipated much of the later work on modular functions done by Riemann, Klein, and others. But a considerable portion of Gauss's unpublished work in this area dealt with the arithmetic-geometric mean. The agM (this is Gauss's abbreviation) is not widely known today, but for Gauss it lay at the very center of his study of elliptic and modular functions. This article will sketch the theory behind the agM and indicate briefly some of its history and applications.

1. To define the agM we begin with the familiar inequality $(a+b)/2 \geq (ab)^{1/2}$ between arithmetic and geometric means. Notice that from one pair of positive numbers, a and b, we obtain a second pair, $(a+b)/2$ and $(ab)^{1/2}$. If we iterate this process, we obtain sequences $\{a_n\}_{n=0}^{\infty}$ and $\{b_n\}_{n=0}^{\infty}$ defined by

$$(1)\qquad \begin{aligned} a_0 &= a, & b_0 &= b,\\ a_{n+1} &= (a_n+b_n)/2, & b_{n+1} &= (a_n b_n)^{1/2}. \end{aligned}$$

The above inequality enables one to show easily that these sequences converge to a common limit $M(a,b)$, which we define to be the agM of a and b.

One of the most striking features of the agM algorithm is how rapidly it converges. For example, the computation of $M(\sqrt{2},1)$ begins as shown in the table below:

n	a_n	b_n
0	1.414213562373905048802	1.000000000000000000000
1	1.207106781186547524401	1.189207115002721066717
2	1.198156948094634295559	1.198123521493120122607
3	1.198140234793877209083	1.198140234677307205798
4	1.198140234735592207441	1.198140234735592207439

The entries are rounded off to twenty-one decimal places. Since $M(a,b)$ always lies between a_n and b_n, we see that to nineteen decimal places

$$M(\sqrt{2},1) = 1.198140234735592074.$$

Such accuracy is easily obtained these days, though not without some efort, since we went beyond the usual sixteen digits of double precision. More surprising is the fact that Gauss did these calculations (correctly!) over 180 years ago (see [3, III, page 364]).

The theory of the agM begins with its relation to elliptic integrals. The key result is the formula

$$(2)\quad M(a,b)\int_0^{\pi/2} (a^2\cos^2\phi + b^2\sin^2\phi)^{-1/2}\,d\phi = \frac{\pi}{2}.$$

To prove this let $\mu = M(a,b)$, and let $I(a,b)$ denote the above integral. Following Gauss [3, III, page 352], we introduce a new variable ϕ' defined by

$$(3)\qquad \sin\phi = \frac{2a\sin\phi'}{a+b+(a-b)\sin^2\phi'}.$$

It can be shown that

$$(a^2\cos^2\phi + b^2\sin^2\phi)^{-1/2}\,d\phi = (a_1^2\cos^2\phi' + b_1^2\sin^2\phi')^{-1/2}\,d\phi',$$

and $I(a,b) = I(a_1,b_1)$ follows. Thus $I(a,b) = I(a_1,b_1) = \cdots = I(\mu,\mu) = \pi/2\mu$ since the a_n's and b_n's converge to μ.

We thus have a very efficient method for computing elliptic integrals, and this is the most common application of the agM. A nice example is a recent paper of Buhler, Gross, and Zagier [1] concerned with numerical evidence for the conjectures of Birch and Swinnerton-Dyer for a particular elliptic curve of rank 3 over $\mathbf{Q}$. Very delicate computations have to be made regarding the behavior of a certain L-series at $s=1$, and one of the factors of the L-series is the real period

Ω of the elliptic curve (see [9]). Since the curve in question can be written $y^2 = (x-e_1)(x-e_2)(x-e_3)$ with $e_1 < e_2 < e_3$, from (2) one can show that

$$\Omega = 4\int_{e_3}^{\infty} \frac{dx}{y} = \frac{2\pi}{M(\sqrt{e_3-e_1}, \sqrt{e_2-e_1})}.$$

The agM thus gives a wonderfully quick method for finding Ω.

Historically, this computational method was known before the agM was. This seems impossible, but Lagrange, in his 1785 paper on calculating elliptic integrals [5], defined the sequences (1) and showed how to use them to compute integrals. While he noted that the sequences had a common limit, he did nothing with this observation. Only six years later, Gauss, then fourteen, independently discovered the sequences (1) and defined the agM for the first time (although he did not see the connection with elliptic integrals until 1799). In this context it is amusing to note that the authors of [1] only recently realized that the agM was the best way to compute the elliptic integrals in question.

A more unusual computational application of the agM was discovered by Salamin in 1973. Consider Legendre's relation between complete elliptic integrals of the first and second kinds:

$$KE' + K'E - KK' = \pi/2,$$

where

$$K = K(k) = \int_0^{\pi/2} (1 - k^2 \sin^2\phi)^{-1/2}\, d\phi,$$

$$E = E(k) = \int_0^{\pi/2} (1 - k^2 \sin^2\phi)^{1/2}\, d\phi$$

and $K' = K(k'), E' = E(k')$ for $k' = (1-k^2)^{1/2}$. From (2) one easily sees that

$$K = \pi/2M(1, k').$$

Also, using the substitution (3), one can show that

$$E = \left(1 - \sum_{n=0}^{\infty} 2^{n-1} c_n^2\right) K,$$

where $c_n = (a_n^2 - b_n^2)^{1/2}$, and a_n and b_n are as in (1) with $a = 1$ and $b = k'$. (This formula was known to Gauss—see [3, III, page 353].) Setting $k = k' = 1/\sqrt{2}$, the above equations give us a formula for π:

$$\pi = \frac{2M(\sqrt{2},1)^2}{1 - \sum_{n=1}^{\infty} 2^{n+1} c_n^2}.$$

This might seem a strange way to compute π, but Salamin shows that it is very efficient (see [8]). Recently, some computer scientists in Japan have used this method to compute π to 10,013,395 decimal places, a world record (see [11]).

Purely theoretical applications of (2) are also known. For example, Reyssat recently proved in [7] that $M(a,b)$ is transcendental whenever a and b are distinct, positive, algebraic numbers. He has also proved that $M(\sqrt{2},1)$ and π are algebraically independent. (More generally, $M(1,\sqrt{1-\lambda})$ and π are algebraically independent whenever $-1 \le \lambda < 1$ is an algebraic number such that the elliptic curve $y^2 = x(x-1)(x-\lambda)$ has complex multiplication.)

The final application we give concerns the arc length of the lemniscate $r^2 = \cos 2\theta$. As is well known, the arc length is given by

$$4\int_0^1 (1-z^4)^{-1/2}\, dz = 4\int_0^{\pi/2} (2\cos^2\phi + \sin^2\phi)^{-1/2}\, d\phi.$$

Using (2) we see that the arc length equals $2\pi/M(\sqrt{2},1)$. Gauss, in his development of lemniscatic functions, used the notation $\tilde{\omega} = 2\int_0^1 (1-z^4)^{-1/2}\, dz$. Then the formula for arc length can be stated as

$$M(\sqrt{2},1) = \pi/\tilde{\omega}.$$

To see the importance of this equation we turn to the 98th entry in Gauss's mathematical diary. It is dated May 30, 1799 and reads as follows: "We have established that the arithmetic-geometric mean between 1 and $\sqrt{2}$ is $\pi/\tilde{\omega}$ to the eleventh decimal place; the demonstration of this fact will surely open an entirely new field of analysis" [3, X. 1, page 542]. Thus the first evidence Gauss had for (2) was this coincidence of two numbers! The applications just given support the truth of Gauss's claim of a "new field of analysis".

2. The surprising fact is that we have barely scratched the surface of the agM. Most people who have heard about it know more or less what has been discussed so far—i.e., the theory of the agM over $\mathbf{R}$. There is also a complete theory over $\mathbf{C}$! This makes sense because the agM is so closely related to elliptic integrals, and, as happens with the latter, the real power of the subject becomes apparent only when we use complex numbers.

We will assume $a, b \in \mathbf{C}^*$ and $a \neq \pm b$. The problem with algorithm (1) is that there seems to be no way to distinguish between the two choices for b_{n+1}. We thus get an uncountable number of sequences, and it is not clear that any of them converge. Fortunately, a distinguished choice of b_{n+1} can be made: since we want the sequences of (1) to have a common limit, it makes sense to let b_{n+1} be the square root of $a_n b_n$ closest to a_{n+1}. More precisely, we call b_{n+1} the *right choice* if $|a_{n+1} - b_{n+1}| \le |a_{n+1} + b_{n+1}|$, and if equality occurs, we require $\mathrm{Im}(b_{n+1}/a_{n+1}) > 0$. Given our restrictions on a and b, there is always a unique right choice for b_{n+1}.

We could thus always require b_{n+1} to be the right choice in (1). But Gauss saw that more is

possible. The following example is taken from his notebooks [**3**, III, page 379]:

n	a_n	b_n
0	3.0000000	1.0000000
1	2.0000000	− 1.7320508
2	.1339746	$1.8612098i$
3	$.0669873 + .9306049i$	$.3530969 + .3530969i$
4	$.2100421 + .6418509i$	$.2836903 + .6208239i$
5	$.2468676 + .6313374i$	$.2470649 + .6324002i$
6	$.2469962 + .6318688i$	$.2469962 + .6318685i$

Note that b_1 is the wrong choice and that the succeeding b_n's are the right choice. The agM algorithm seems to converge nicely.

Surprisingly, it turns out that *any* pair of sequences $\{a_n\}_{n=0}^{\infty}$ and $\{b_n\}_{n=0}^{\infty}$ as in (1) converge to a common limit. But the common limit is *nonzero* if and only if b_{n+1} is the right choice for all but finitely many n (see [**2**, Proposition 2.1] for a proof). Thus there are only countably many nonzero limits. This leads to the following definition:

DEFINITION. Given $a, b \in \mathbf{C}^*, a \neq \pm b$, a number $\mu \in \mathbf{C}^*$ is a *value of* $M(a,b)$ if it is the common limit of sequences $\{a_n\}_{n=0}^{\infty}$ and $\{b_n\}_{n=0}^{\infty}$ satisfying (1). μ is the *simplest value* if b_{n+1} is the right choice for all $n \geq 0$.

The next question is how to relate the different values of $M(a,b)$. The answer is as follows:

THEOREM. *Given $a, b \in \mathbf{C}^*$ with $a \neq \pm b$ and $|a| \geq |b|$, let μ and λ be the simplest values of $M(a,b)$ and $M(a+b, a-b)$, respectively. Then all values μ' of $M(a,b)$ are given by the formula*

$$1/\mu' = d/\mu + ic/\lambda,$$

where d and c are arbitrary, relatively prime integers satisfying $d \equiv 1 \bmod 4$ and $c \equiv 0 \bmod 4$.

This theorem is basically due to Gauss. He never stated it in this form, but the bits and pieces of proof he left behind show that he knew what was going on. The first complete proofs appeared in 1928 after the last volume of Gauss's collected works was published (see [**4**] and [**10**].) We will only sketch some of the ideas involved in the proof (see [**2**] for the details).

Though the statement of the theorem is elementary, the proof uses some sophisticated mathematics: specifically, theta functions and modular forms (a basic reference is [**6**]). We will use Gauss's notation for the Jacobi theta functions. For $\tau \in \mathfrak{H} = \{z \in \mathbf{C} : \mathrm{Im}(z) > 0\}$, set $q = e^{\pi i \tau}$ and define

$$p(\tau) = 1 + 2\sum_{n=1}^{\infty} q^{n^2} = \vartheta_{00}(\tau, 0),$$

$$q(\tau) = 1 + 2\sum_{n=1}^{\infty} (-1)^n q^{n^2} = \vartheta_{01}(\tau, 0).$$

The natural question is what do theta functions have to do with the agM? The answer lies in the observation that if

$$a = \mu p(\tau)^2, \qquad b = \mu q(\tau)^2, \tag{4}$$

for $\mu \in \mathbf{C}^*$ and $\tau \in \mathfrak{H}$, then μ is a value of $M(a,b)$. To see why this is true, consider the theta identities

$$p(\tau)^2 + q(\tau)^2 = 2p(2\tau)^2, \qquad p(\tau)q(\tau) = q(2\tau)^2.$$

It follows that $p(2\tau)^2$ and $q(2\tau)^2$ are the respective arithmetic and geometric means of $p(\tau)^2$ and $q(\tau)^2$. Setting $a_n = \mu p(2^n\tau)^2$ and $b_n = \mu q(2^n\tau)^2$, we get sequences satisfying (1), and the formulas for $p(\tau)$ and $q(\tau)$ show that $\{a_n\}_{n=0}^{\infty}$ and $\{b_n\}_{n=0}^{\infty}$ converge to μ.

To exploit this, set $k'(\tau) = q(\tau)^2/p(\tau)^2$, and note that solutions of (4) are equivalent to solutions of $k'(\tau) = b/a$ with $\mu = a/p(\tau)^2$. Thus the set

$$R = \{p(\tau)^2/a : k'(\tau) = b/a\}$$

consists of reciprocals of values of $M(a,b)$.

The function $k'(\tau)$ has some remarkable properties. Recall the action of $\mathrm{SL}(2,\mathbf{Z})$ on $\mathfrak{H}$ via linear fractional transformations, and set

$$\Gamma_2(4) = \left\{ \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \mathrm{SL}(2,\mathbf{Z}) : \begin{pmatrix} a & b \\ c & d \end{pmatrix} \equiv \begin{pmatrix} 1 & b \\ 0 & 1 \end{pmatrix} \bmod 4,\ b \equiv 0 \bmod 2 \right\}.$$

Then $k'(\tau)$ is a modular function for $\Gamma_2(4)$. Thus it is invariant under $\Gamma_2(4)$ and, in fact, induces a biholomorphism $\mathfrak{H}/\Gamma_2(4) \tilde{\to} \mathbf{C} - \{0, \pm 1\}$. Our restrictions on a and b ensure that $b/a \in \mathbf{C} - \{0, \pm 1\}$, so that if we fix one $\tau \in \mathfrak{H}$ with $k'(\tau) = b/a$, if follows that

$$R = \{p(\gamma\tau)^2/a : \gamma \in \Gamma_2(4)\}.$$

The next crucial fact is that $p(\tau)^2$ is a modular form of weight one for $\Gamma_2(4)$. Hence,

$$p(\gamma\tau)^2 = (c\tau + d)p(\tau)^2, \qquad \gamma = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \in \Gamma_2(4).$$

If we set $\mu = a/p(\tau)^2$, then a typical element of R can be written

$$p(\gamma\tau)^2/a = (c\tau + d)p(\tau)^2/a = d/\mu + ic/\lambda,$$

where $\lambda = i\mu/\tau$. It is easy to show that d and c can be any relatively prime integers with $d \equiv 1 \bmod 4$ and $c \equiv 0 \bmod 4$. Though λ may seem mysterious, it is possible to show (using theta identities) that

$$a + b = \lambda p(-1/2\tau)^2, \qquad a - b = \lambda q(-1/2\tau)^2.$$

From (4) we see that λ is a value of $M(a+b, a-b)$.

These last few paragraphs illustrate nicely the interaction between the agM and theta functions, modular functions, and modular forms. The formula for the values of $M(a,b)$ given by the

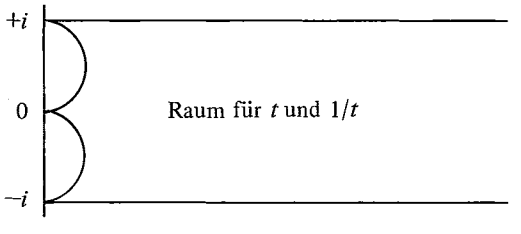
theorem now makes sense. Of course, we are not finished with the proof. The next step is to show that τ can be chosen so that μ and λ are simplest values. This follows from a lemma (due to Gauss) which states that $\mu = a/p(\tau)^2$ is the simplest value ("einfachste Mittel"—see [3, III, page 477]) whenever τ lies in a certain fundamental domain of $\Gamma_2(4)$. The final step in the proof is to show that R contains the reciprocals of all values of $M(a,b)$.

The formula $\lambda = i\mu/\tau$ has some nice consequences. By abuse of notation set $\mu = M(a,b)$ and $\lambda = M(a+b, a-b)$. If we let $c = (a^2 - b^2)^{1/2}$, then $M(a+b, a-b) = M(a,c)$ since a and c are the arithmetic and geometric means of $a+b$ and $a-b$. Thus $\lambda = i\mu/\tau$ implies that

$$\tau = M(a,b)/M(a,c). \tag{5}$$

This shows that τ can be explicitly computed in terms of a and b. An especially nice case is when $a = \sqrt{2}$ and $b = 1$. Then $c = 1$, giving us $\tau = i$!

3. Gauss's notes on the agM span thirty years and contain some amazing facts about modular function theory. In particular, he basically knew everything mentioned in the above sketch. (With regard to $p(\tau)^2$ being a modular form, he even computed the q-expansions at the cusps—see [3, X. 1, page 224].) Another example of what he knew is his famous drawing of a fundamental domain:



Note that Gauss worked in the right half-plane instead of the upper half-plane. His theta functions were thus power series in $e^{-\pi t}$, where $\mathrm{Re}(t) > 0$. In the third volume (1876) of his collected works, the above picture is reproduced inaccurately; the editor did not know its real meaning (see [3, III, page 478]). Only in the eighth volume (1900), edited by Fricke and Stäckel, do we find a correct drawing (see [3, VIII, page 105]). Another surprise found in Gauss's notes is his use of the reduction theory of positive-definite quadratic forms to analyze $p(\tau)^2$ (see [3, X. 1, page 224]). What he does is closely related to finding fundamental domains for subgroups of $\mathrm{SL}(2,\mathbf{Z})$.

While these fragments are quite compelling, we must be careful not to read too much into them. Gauss did not have a general theory of modular functions, and in some respects he is closer to Euler than to us. But is clear that he knew a tremendous amount about certain basic modular functions and forms.

The final topic we explore is the chronology of Gauss's discoveries about the agM. We've seen that everything began on May 30, 1799 when he noticed that $M(\sqrt{2},1) = \pi/\tilde{\omega}$. How long did Gauss take to get from this observation to the agM of complex numbers? We find part of the answer in his mathematics diary. The 101st and 102nd entries show that Gauss had proofs of both $M(\sqrt{2},1) = \pi/\tilde{\omega}$ and the more general formula (2) by December 1799 (see [3, X. 1, page 544]). But the 109th entry, dated June 3, 1800, reads as follows: "Between two given numbers a and b there are infinitely many means both arithmetic-geometric and harmonic-geometric, the observation of whose mutual connection has been a source of happiness for us" [3, X. 1, page 550]. (The harmonic-geometric mean of a and b is $M(a^{-1}, b^{-1})^{-1}$.) This quote is amazing: The infinitely many means and their mutual connection must refer to the theorem discussed above. Yet only six months have passed! Is it possible to discover so much mathematics in so short a period of time?

Unfortunately, such a question is beyond the scope of this article. Our goal will be more modest: We will show that Gauss, in June 1800, was aware of the theta functions and knew the formula (5) giving τ in terms of the agM. Our evidence comes from the 108th entry of the mathematical diary. It is also dated June 1800 and announces a complete theory of elliptic functions ("sinus lemniscatici universalissime accepti"—see [3, X. 1, page 548]). To see how this relates to the agM, we need to review Gauss's work on lemniscatic functions.

In January 1797 Gauss defined $\mathrm{sl}\,\phi$ and $\mathrm{cl}\,\phi$, the lemniscatic sine and cosine, as follows:

$$\mathrm{sl}\,\phi = x \Leftrightarrow \int_0^x (1-z^4)^{-1/2}\,dz = \phi,$$
$$\mathrm{cl}\,\phi = \mathrm{sl}(\tilde{\omega}/2 - \phi).$$

Notice the strong analogy with $\sin\phi$ and $\cos\phi$. The addition law came quickly, and by March 1797 he had defined $\mathrm{sl}\,\phi$ and $\mathrm{cl}\,\phi$ for complex ϕ, and he knew the double periods $2\tilde{\omega}$ and $2i\tilde{\omega}$. In October 1798 Gauss saw how to express $\mathrm{sl}(\phi)$ as a quotient of theta functions $P(\phi)/Q(\phi)$, where

$$Q(\psi\tilde{\omega}) = 2^{-1/4}\left(\tfrac{\pi}{\tilde{\omega}}\right)^{1/2}(1 + 2e^{-\pi}\cos 2\psi\pi + 2e^{-4\pi}\cos 4\psi\pi + 2e^{-9\pi}\cos 6\psi\pi + \cdots), \tag{6}$$

and $P(\psi\tilde{\omega})$ is given by a similar formula. Thus six months before the observation of May 30, 1799, Gauss was well aware of one side of the equation $M(\sqrt{2},1) = \pi/\tilde{\omega}$. Notice also that the general form of the theta function is easily discerned from the above formula.

We can now see the real significance of the diary entry of May 30, 1799, for when Gauss noticed that $M(\sqrt{2},1) = \pi/\tilde{\omega}$, he must have realized instantly that there was a deep connection between the

agM and the lemniscatic functions. This is the "entirely new field of analysis" that his diary refers to.

It remains to see how Gauss got from the lemniscatic functions to general elliptic functions. The goal is to construct a function $S(\phi)$ which inverts the elliptic integral

$$\int ((1-z^2)(1+\mu^2 z^2))^{-1/2}\,dz.$$

Note that $\mu = 1$ corresponds to the lemniscatic case. Gauss's idea is to generalize formula (6), using the agM. Specifically, he first sets

$$\tilde{\omega} = \frac{\pi}{M(\sqrt{1+\mu^2},1)}, \qquad \tilde{\omega}' = \frac{\pi}{M(\sqrt{1+\mu^2},\mu)},$$
$$\tau = i\frac{\tilde{\omega}'}{\tilde{\omega}} = i\frac{M(\sqrt{1+\mu^2},1)}{M(\sqrt{1+\mu^2},\mu)},$$

and $Q(\phi)$ is defined analogously to (6); i.e.,

$$Q(\psi\tilde{\omega}) = (1+\mu^2)^{-1/4}(\pi/\tilde{\omega})^{1/2} \cdot (1 + 2e^{\pi i\tau}\cos 2\psi\pi + 2e^{4\pi i\tau}\cos 4\psi\pi + \cdots).$$

A similar formula gives $P(\phi)$, and then Gauss sets $S(\phi) = P(\phi)/Q(\phi)$. The function $S(\phi)$ inverts the above integral, satisfies the appropriate differential equation, and has periods $2\tilde{\omega}$ and $2i\tilde{\omega}'$. This is the theory that Gauss announced in June 1800.

The formulas for P and Q are a classical method for producing elliptic functions. A standard difficulty is showing that such functions invert all elliptic integrals—this is called the uniformization problem. The wonderful thing about Gauss's theory is that it solves this problem explicitly: The uniformizing variable τ is computed by using the agM! The formula for τ also substantiates two of our earlier claims. First, we see that Gauss did know formula (5) for τ in June 1800, and second, we see clearly that the agM was essential to Gauss's study of elliptic functions.

The full story of Gauss's work on the agM is quite complicated. No short survey article can convey the real richness of Gauss's mathematical thought. We have only sampled some of the highlights. For more of the details the reader should consult [**2**] or [**3**, X.2].

There is one final point to consider. In §1 we saw numerous applications of the agM over **R**. Far fewer are known over **C**, partly because most people simply aren't aware that the agM of complex numbers can be defined. It is our hope that once this theory becomes better known, the applications will follow. Some of them could be very exciting.

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The article above is the tenth in the series of Special Articles published in the *Notices*. The author, David A. Cox, was an undergraduate at Rice University, where he earned his B.A. degree in 1970. He then went to Princeton University to study étale homotopy theory with Eric Friedlander. After receiving his Ph.D. degree in 1975, he taught one year at Haverford College and four years at Rutgers University. In 1979 he went to Amherst College in Amherst, Massachusetts, where he is currently Associate Professor of Mathematics.

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On Topology and Other Things

by Raoul Bott

On a beautiful fall day in 1949 my wife and I drove our brand-new Buick convertible, vintage 1934, into the little valley over which "Fuld Hall", the main building of Princeton Institute for Advanced Study, presides so majestically—in spite of its marked Howard Johnson overtones. For us this moment seemed like the entrance to Paradise. Partly, I suppose, it was a matter of contrasts: from Pittsburgh to Princeton, from near despair three months earlier due to illness and joblessness to health and the beginning of a wonderful adventure.

I start my account here because this was also soon to be the place where I first heard the word *topology*, which was to become my dominant professional love; and I thought that rather than try to sum up in the manner of wise—i.e. *old*—men the subject and its development on this occasion, I would prefer to tell you a bit about Princeton in 1949 and my first skirmish there with that subject and really with all of pure mathematics. The true title of this talk should therefore lie somewhere between *From Network Theory to Topology* or *An Engineer at the Court of Robert Oppenheimer* or *Reminiscences of a Brash Ignoramus at the Institute Circa 1949—1951.*

To return to that afternoon in 1949, I am proud to say that our euphoria did not even diminish when we were shown to our apartment in "the Compound"—as we referred to the derelict army barracks which housed all the "Temporary Members." Of course the drawbacks of a coal stove with a penchant for going out in the middle of a cold winter night were not apparent yet in September.

An indeed that whole first year seemed—to us at least—enchanted; we had to pinch ourselves at times to be certain that it was all real. But so you would have done also. Imagine a place where the suspicious-looking vagrant whom the police try to arrest turns out be Jean Leray; where around eleven each morning it is quite easy to chat with Einstein about weighty subjects such as the weather or the tardiness of the mail delivery. Where the friendly but *very* silent neighbor in the midst of a raucous group of young lunchers turns out to be P.A.M. Dirac, and so on and so on. What I am describing here then is the excitement of the young in the midst of their idols, an excitement and an inspiration which only increases as one becomes aware of their foibles. It is a phenomenon which I am sure goes on today also, and one of the great virtues of having an institute such as Princeton in our midst is precisely the excitement which is generated there and which bonds the young to the old and so to their subject. However I cannot resist the canonical "old man's" delusion, that in his day things were somehow grander; and so I can not help feeling that those were the truly Olympian days of the Institute: Veblen, Alexander, Morse, H. Weyl, von Neumann, and C. L. Siegel were the full professors in Mathematics; Selberg, D. Montgomery and Gödel the permanent members, while Lefschetz, Artin, and Bochner were still active at the University. Oppenheimer had been recently appointed director and his energy was apparent everywhere, especially when, after tea, he would literally herd the young physicists to their seminar.

Just as today, the mathematicians were a less homogeneous group that the physicists, each with their own rhythm of work and play, and the group of my contemporaries there firmly believed in the therapeutic effects of alcohol on a tired mathematical mind. One anecdote from such a very successful therapy session conducted at Dean Montgomery's house is the following. Some aspects of the cocktail party are blurry in my memory now—doubtless due to the long time span that has elapsed—but I remember distinctly that eventually a small number of us remained playing marbles on Dean's carpet. Von Neumann was one of the party, and somehow in the course of the game I came to ask him what it felt like to be a "great mathematician." In his characteristic quiet, thoughtful way, it behooved him to take my question seriously—although a moment earlier he had given us a sampling of his seemingly unlimited store of raunchy stories. Essentially what he said was that, in all honesty, he had known only one "great mathematician"—David Hilbert. And that as far as he was concerned, what with being a Wunderkind, he never really felt that he had lived up to what had been expected of him. So you see it is not difficult to be found wanting—one just needs an appropriate measuring rod.

But it is now really time to say a word about the "serious" subject of this talk: "Topology"

This article is based on a talk given at the Summer Meeting in Eugene, August 1984, as one of the series of historical lectures sponsored jointly by the Society and the MAA. LKD

or "Analysis Situs" as it was still then called by people like Veblen, Morse, C. L. Siegel and Hermann Weyl. Analysis Situs of old is now known under the ungainly title of "Algebraic Topology," and its purpose and aim is to construct and understand the more or less computable invariants which distinguish different geometric shapes—or more generally, topological spaces.

The most intuitively obvious such invariant is, of course, the number of pieces into which a space falls, and in some sense the whole vast edifice of this subject falls into two branches depending on how the concept of component is understood. If we use the concept of arc-component i.e. two points p and q of a topological space X are in the same component if and only if there is a map, i.e. continuous function: $\mu : I \to X$ of the interval I into the space with

$$\mu(0) = p \text{ and } \mu(1) = q,$$

then this concept naturally leads us into "homotopy theory." Thus in homotopy theory we have

FIGURE 1

$$\pi_0(X) = \text{set of arc-components in } X.$$

On the other hand, if we take the position that two points p and q are in the same component of X if and only if all locally constant functions, say, real-valued, f and X agree at p and q, then we are starting off in the tradition of cohomology theory: to wit, if we set $H^0(X)$ equal to the space of locally constant functions then in cohomology theory: # of components $= \dim_{\mathbf{R}} H^0(X;\mathbf{R})$.

In both these theories the higher invariants proceed from their zero counterparts by some sort of inductive step, rather geometric and naive for homotopy, and much more algebraic and subtle for cohomology. On the other hand it turns out that the cohomological extension of component is the more computable one, while the conceptually easier homotopy group $\pi_k(X)$ is very difficult to compute. Indeed, they can be defined *inductively* as follows. Let p be a part of X and denote by ΩX the space of all maps $\mu : I \to X$ with $\mu(0) = \mu(1) = p$. The space of *loops* on X based at p one calls ΩX in, say, the compact open topology. Then define $\pi_k(X)$ inductively by:

$$\pi_k(X) = \pi_{(k-1)}(\Omega X)$$
$$= \pi_{k-2}(\Omega\Omega X)\ldots = \pi_0(\Omega_{\cdot_k^{\cdot}}\Omega X).$$

This definition goes right back to the Hurewicz, and is easily seen to be equivalent to the Czech definition of the thirties.

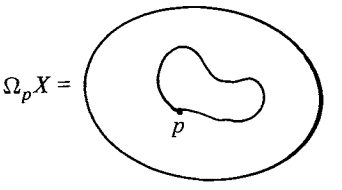

FIGURE 2

To give you an idea of the state of the art for determining these groups in 1949, let me tell you that one day Steenrod entered his class on fiber-bundles at Princeton—which I was attending as my "first topology course"—and proudly announced that Pontrjagin had just written to the effect that $\pi_4(S^2)$ was 0. A few weeks later came an excited word from Cambridge: George Whitehead had determined $\pi_4(S^2)$ as $\mathbf{Z}/2\mathbf{Z}$ instead. And soon thereafter Pontrjagin confirmed George's result.

But 1949 was not really a homotopy year at the Institute. Rather it was the year when, in H. Weyl's seminar two different but presumably "really watertight" proofs of the "Hodge Theory" were being presented by DeRham on the one hand, and Kodaira on the other. Apart from Steenrod's course at the University, this seminar was the one which intrigued me the most, for of course, the basic existence theorems of network theory may be thought of as a finite-dimensional analogue of Hodge Theory in dimension 0! To explain this, let me recall first of all how the cohomological extension of the component concept works—at least in the category which appeals to me most, the "category of smooth spaces"—i.e. the C^∞-manifolds M. Usually such a manifold is, by definition, glued together smoothly out of copies of $\mathbf{R}^n$, and so the concepts and constructions of analysis naturally extend from $\mathbf{R}^n$ to them. In particular, one can start with the C^∞ functions $A^0(M)$ in which the locally constant ones are characterized by the differential equation

$$\mathrm{df} = 0 \Leftrightarrow \frac{\partial f}{\partial x^2} = 0$$

relative to any local coordinate x!

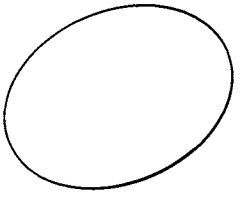

FIGURE 3

In this context we therefore find that # of *components* of M = dim of *the space* of *solutions* of the *differential equation* $df = 0$.

Now the inductive cohomological generalizations of this H^∞ is the *DeRham Complex:*

$$A^0(M) \xrightarrow{d} A^1(M) \xrightarrow{d} A^2(M) \xrightarrow{d} \dots$$

in which the $A^i(M)$ denote the "covariant" *alternating tensor* fields on M, and "d" is the *only natural extension* of the "d" already encountered, sending a function f to its differential df. The "DeRham Cohomology" of M is then simply given by

$$H^q(M) = \text{Ker } d/\text{Image } d \text{ in dim } q.$$

Now if in addition M is given a positive definite metric, then each of the vector spaces $A^i(M)$ inherit a natural inner product (ϕ, χ) and thus, correspondingly, each differential operator "d" has a well-defined adjoint "d^*", satisfying the usual adjoint equation: $(d\phi, \chi) = (\phi, d^*\chi)$. The Hodge Theory, then, deals with the operator $\Box = dd^* + d^*d$ and its space of solutions $\mathbf{H}^*(M)$—the harmonic forms on M.

The operator $\Box$ clearly preserves $A^i(M)$, and the Hodge theorem asserts that the *harmonic forms precisely give the cohomology on any compact oriented manifold* M: that is, we have the equality

$$\mathbf{H}^q(M) \simeq H^q(M).$$

Compare this situation now with the first and simplest question of network theory. Here one is dealing with an assembly of resistors R, which are hooked up according to a graph—as for example indicated in Figure 4.

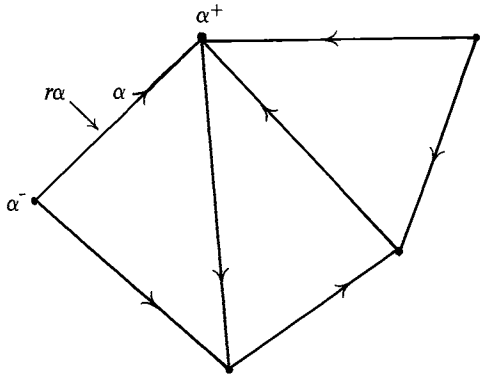

FIGURE 4

If $\{\alpha\}$ runs over the branches of N—which we orient in some fixed but arbitrary manner—and if we write $\alpha+$ and $\alpha-$ for the head and tail vertex of the branch α, then the "incidence" data

$$\alpha \mapsto \binom{\alpha+}{\alpha-}$$

completely determine the topology of N. In terms of linear algebra this incidence relation in turn is uniquely specified by the linear operator:

$$\delta : A^0(N) - A^1(N)$$

from the space $A^0(N)$ of $\mathbf{R}$-*valued functions on the vertexes of* N to $A^1(N)$ *the space of such function on the oriented branches,* given by

$$\delta\phi(\alpha) = \phi(\alpha^+) - \phi(\alpha^-).$$

Clearly then this δ is precisely the *finite difference analogue* of the earlier d, and the "combinatorial cohomology" of N is also defined, just as before, by

$$H^0(N) = \text{Ker } \delta,$$
$$H^1(N) = A^1(N)/\text{image of } \delta.$$

These vector spaces turn out to be topological invariants of the graph considered purely as a topological space. And indeed it is clear that the kernel of δ consists of those functions on the vertexes of N, which are constant on each connected piece so that pretty obviously one has the relation:

$$\dim H^0(N) = \#\text{ of connected pieces of } N.$$

The electrical behavior of N is of course only given once the positive resistances $\mathbf{r}_\alpha$ of the branches are specified. Mathematically the correct procedure is to interpret the reciprocals $g_\alpha = 1/\mathbf{r}_\alpha$ as determining a positive definite inner product on $A^1(N)$ by the formula:

$$(\phi\psi) = \sum g_\alpha \phi(\alpha) \cdot \psi(\alpha)$$

and at the same time to endow $A^0(N)$ with the "Kronecker" inner product

$$(f, g) = \sum_p f(p_1) g(p_i).$$

Just as before it is now meaningful to speak of the adjoint to δ—denoted by δ^*—and of the corresponding Hodge Laplacian $\Box = \delta^*\delta + \delta\delta^*$, and in terms of these the steady-state potential distribution E of N is related to an exterior current flow I by the equation

$$\Box_0 E = I, \quad \text{with } \Box_0 = \delta^*\delta,$$
the Hodge operator in dim 0.

The "Hodge Theory" in this context therefore implies that

$$\dim \text{Ker } \Box_0 = \dim H^0(N)$$
$$= \#\text{ of components of } N$$

an so immediately *proves* the first fundamental existence theorem of network theory—which is of course self-evident to any engineer worth his salt—to wit: that $\Box_0 E = I$ can be solved *uniquely* for E once every component of N is "*grounded*" at *one vertex* and provided *only* that the *total current flowing* into any *component* of N in zero.

By the way, this finite-dimensional Hodge theory is immediate linear algebra. On the other

hand the following, more precise, Ansatz for solving these equations was really my pride and joy in 1949—and is essentially the first theorem that I *thought* I had proved.

It is the following formula for the product

$$\det \Box_0' = \prod_{\lambda>0} \lambda$$

of the *nonzero* eigenvalues of the operator $\Box$.

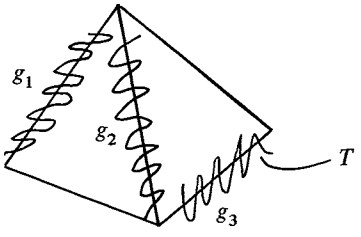

FIGURE 5

For each (spanning =) maximal tree of N, as indicated in Figure 5, let T_g be the product

$$T_g = g_{\alpha_1} \cdots g_{\alpha_k}$$

of the g's corresponding to the branches in T. With this understood one has

$$\det \Box_0' = \sum^T T_{g'}$$

where T ranges over the maximal trees of N.

I called this determinant $\Box_0'$, the *impedance potential* ψ of the network N, and in terms of it $\Box_0$ can be explicitly inverted on the complement of its null-space. In particular

$$\frac{\partial \log \psi}{\partial g_\alpha} = R_\alpha$$

gives a formula for the "Effective Impedance" of N across the branch α in terms of ψ.

Alas—as I learned much later—I had essentially been scooped on these formulas by Kirckhoff himself!! I mention them here only because the infinite-dimensional analogues of this determinant, i.e. the $\det' \Box_k$, in the *Hodge theory proper*, have played such a central role in modern physics to this very day and while preparing this talk I could not help puzzling about whether this impedance potential has some generalization to the infinite dimensional case.

I also wondered what the formula for all the *coefficient* of $\det(\Box_0 + \lambda I)$ might be, and I expect they involve only positive "tree" products.

Of course in the infinite dimensional context, each Laplacian $\Box_{(k)}$ on $A^k(M)$ is a second order differential operator so that it is not at all clear how its determinant *should* be defined. However on a compact manifold such a $\Box$ has a discrete set of eigenvalues and in 1949 enough was known concerning the asymptotic distribution of the eigenvalues—another favorite subject of Hermann Weyl's—to be able to define some sort of *regularized notion* of *determinant* for $\Box$.

The theorem I am alluding to, and which I heard for the first time in Hermann Weyl's address on *The Eigenvalue Problem Old and New*, is due to Minakshisundaram and Pleijel and asserts that the zeta function

$$\zeta_s[\Box] = \sum \lambda^{-s}$$

where λ ranges over the eigenvalues of $\Box$, not only makes *good sense* for Res large *enough* but has a *meromorphic* extension to the whole complex *s-plane*, the position of whose poles could be described explicitly. In particular $\zeta_s(\Box)$ was *analytic near* $s = 0$. Hence the formal computation

$$\begin{aligned} \frac{d}{ds}\zeta_s(\Box)0 &= |\sum -\log \lambda \cdot \lambda^S|_0 \\ &= -\sum \log \lambda = -\log \det \Box \end{aligned}$$

can be turned around to yield a *a regularized determinant* $\Box$:

$$\det \Box = e^{-d/ds\zeta(s)}|_{s=0},$$

and that is how these determinants enter the mathematical literature—notably in the Ray-Singer paper of the 1950s on the *Reidemeister Torsion*. They also occur increasingly in this form in the contemporary literature of field theory.

The name Reidemeister brings me back to those days in 1949, for Reidemeister and E. Specker were my private tutors at the Institute that year. Reidemeister was a warm, charming, urbane Philosopher-Mathematician, who spoke and lectured fluently in a language of his own—roughly 40% English and 60% German—and his lessons in a small seminar on Cartan's "Theory of Carapace"—lectures Cartan delivered at Harvard in 1948—remain as one of the most inspiring but also incomprehensible experiences of my life.

Reidemeister also introduced some of us young blades into an old—and by now, I am afraid, defunct—Institute tradition. These were the woodchopping expeditions which took off Wednesday afternoon at 2 p.m. sharp and ranged over the Institute grounds felling old trees or sawing fallen ones into manageable pieces. The participants were people like C. L. Siegel, Pauli, Alexander, Alexandroff, Reidemeister, etc., all people who seemed to me infinitely sage as well as venerable—in short, old—but who upon reflection turn out to have been in their early fifties at the time, and so quite a bit younger than I am now. Alas!

Although I am running out of time I cannot resist relating one anecdote (out of many!) concerning these expeditions. One Wednesday in November it was pouring rain and sleet, and as a matter of course I decided that woodchopping was out of the question. Then I started to wonder what C. L. Siegel would do. This curiosity finally get the better of me. I went to our meeting place a few minutes before 2 p.m. Sure enough, at 2 p.m.

sharp C. L. appeared. I next thought that as there were only two of us there, he would call it quits. Not a bit of it. We picked up a huge saw, carried it into the woods and went to work—for the most part silently and completely drenched. Then during a short breather, C. L. suddenly turned to me and said: "You know, I really admire those people who did not show up today. But how can one decide to go woodchopping on Wednesdays at 2 p.m.—and then stay at home just because the weather is bad!"

Ah where have the days of such high principle gone!

Carl Ludwig seemed to me the Prince among Princes at the Institute. His lectures were dramatic occasions where one felt in touch with every branch of mathematics. Starting with number theory one would encounter analysis, topology, and algebraic geometry, as well as P-adic numbers, all in one hour! Although totally opaque to a beginner in pure mathematics, they certainly inspired me more than anything else with the wish to understand this whole beautiful edifice and in particular to understand the role that topology played in the subject. And I suppose it is to this influence that I owe the position which I still hold today, of not seeing topology in isolation so much, as in interaction with analysis, geometry, and really all of mathematics.

Of course this attitude was shared by many of the great men in Princeton at that time; certainly H. Weyl, Morse, Bochner, and Lefschetz all pointed one in that direction, and were in fact somewhat hostile to the "new algebraic topology" as represented by the Eilenberg-Steenrod-Mac Lane school. Under these contradictory pressures I compromised by attending on the one hand Steenrod's course—as well as hanging out around him whenever I could—and on the other by learning "Morse Theory"—pretty much on my own, for Morse had little interest in his early theory at that time. He was deeply into his work with Transue on functions of bounded variation and such matters.

Let me recall for you that in the Morse theory the dimensions $b_k = \dim H^k(X)$ of the cohomology groups of a compact manifold are related to the extrema of a smooth function f or M. In fact, for the generic situation where these extrema occur at isolated points, let $m_k(f)$ denote the extrema of f with precisely k directions of "*steep descent.*" Then the Morse series of f

$$M_t(f) = \sum m_k t^k$$

turns out to be correlated to the "Poincaré series" of M defined by

$$P_t(M) = \sum \dim H^k(M) t^k$$

by a set of inequalities. Precisely the Morse theory in this context asserts that:

$$M_t(f) - P_t(M) = (1+t)Q(t)$$

where $Q(t)$ is a polynomial with *non-negative coefficients.*

From these inequalities it follows immediately that if the m_k are 0 for odd k, then

$$\dim H^k(X) = m_k(f);$$

in short, one can then deduce the entire additive cohomology structure from a *second order knowledge* of the *extrema* of f.

Morse had of course applied this principle in a grander setting, namely to function spaces, notably to the space of loops $\Omega_p M$, so that in 1927 he already had computed the *cohomology* of this loop-space for the n-spheres S^n. His result was that:

$$H^k(\Omega_p S^n) = \begin{cases} \mathbf{Z} \text{ when } k = n-1 \\ 0 \text{ otherwise,} \end{cases}$$

and from it he deduced the beautiful result that there must be an infinite number of geodesics joining any two points p and q on S^n in *any Riemannian structure.*

From the very start, I was much taken with this evaluation of $H^k(\Omega S^n)$ but I really did not know how to fit it into the scheme of things. I think none of us knew in Princeton, although I expect Serre in Paris had by then understood. On the whole the topologists proper had as little use for Morse theory as Morse had for them. We were of course in 1949 just in the lull before the storm. The French revolution in algebraic topology and especially in homotopy theory had not hit us yet. As a result, there was no strictly topological method known at the time for obtaining Morse's formula, and therefore for using the inductive definition of π_k which I gave you as a *computational device.* Thus in 1949 all one could really say with confidence about the higher homotopy groups of the spheres was that they were countable!

Nevertheless—in retrospect—the stage was really set by then for the whole subject as we know it today, save for two ideas. We knew from Eilenberg and MacLane (1945) that the correct way of looking at things was the *functorial* one. What our fathers had called a topological invariant was always associated with a function from the world of spaces and their maps to the algebraic world, say the world of groups. That is, behind any topological invariant there always lurked a way of attaching not only a group $F(X)$ to a space X, but also, by a *homomorphism* $F(h)$ attached to each map $h : X \to Y$, going from $F(X)$ to $F(Y)$ (in the covariant case) such as homotopy, and the other way in the contravariant case, such as cohomology. We also knew that for many of the classical questions of geometry—such as the existence of vector-fields without zeros, etc., on manifolds—the notion of a *twisted product of two spaces* was indispensible and that the *measurement of the twist* involved homotopy.

In its most geometrical setting, this realm of ideas came—like so much—from H. Hopf on the one hand and H. Whitney on the other. I recommend to every young topologist that he sometime look at the Michigan Colloquium in topology in the early forties. All the papers there seem to be landmarks and especially Whitney's, where the wnole theory of what we now call fiber-bundles is sketched out.

We also knew from Eilenberg, MacLane, and independently Hopf, that if a space Y had *only one* nontrivial homotopy group, say $\pi_k(Y) = \pi$ (with all $\pi_r(Y) = 0, r \neq k$), then the space Y was determined by π up to some form of homotopy equivalence, depending on the category of spaces one had in mind. Thus for each Abelian group π and integer n there is a well-defined space $K(\pi, n)$, the Eilenberg-MacLane space characterized by the equation

$$\pi_k\{K(\pi, n)\} = \pi, \text{ all other } \pi_k = 0.$$

On the other hand, it was also known that in general the homotopy type of a space was *not* determined by its homotopy groups alone, i.e., not every space was the product of the Eilenberg-MacLane spaces corresponding to its individual homotopy groups, but was rather some sort of *twisted* product of them

$$X = K(\pi_1, 1) \times_T K(\pi_2, 2) \times_T \dots$$

with the twist at each stage being measured by an element of $H^q((\text{preceding stage}); \pi_{q-1})$.

But all these deep original insights were far from the practical world of application because we really had no good way of computing the cohomology of a twisted product $X \times_T Y$, or indeed a really good definition of twisted product.

These two gaps were then filled on the one hand by the Leray spectral sequence which set definite limits to the extent to which the cohomology of a twisted product can differ from that of the Cartesian product, and Serre's insight that Leray's results, which were inspired by differential geometric considerations, carried over to a very general type of twisted product—his *fiber spaces.* In particular in his world he saw quite clearly that the loop space ΩX and X can be *twisted together to yield a contractible space*

$$\text{point} = X \times_T \Omega X;$$

and that as a consequence in simple cases such as the spheres, the Leray rules applied to this equation sufficed to compute the cohomology of ΩX in terms of that X! Thus Serre had reproved the Morse formula but with a method he could iterate and so he ushered in the era in which one could hope to compute $\pi_q(X)$ by purely *cohomological* means as $H^0(\Omega^q X)$. Although this is still hard to do in any individual case, this point of view changed matters fundamentally.

Today one knows, for instance, that the $\pi_q(X)$ are *computable in the technical sense* (a theorem of E. Brown) if X is a finite simplicial complex, and of course Serre immediately derived the *finiteness* of the *higher homology* groups of the spheres S^n by this method.

I think, however, that if we students in Steenrod's course had been allowed to gaze into a crystal ball, what would have surprised us most is the amazing development in the truly geometric aspects of topology which were to come. There was of course an active school of low-dimensional, "honest" topology at Princeton: Papakiriakopolous, Moise, Fox, but who would have then expected Thom's cobordism of five years hence, Milnor's exotic spheres and Smale's immersion and handlebody theory in ten years time, or the setting of the Hauptvermutung in higher dimensions let alone the recent results of Kirby and Friedman. Basically there was pessimism in the air about being able to prove honest topological classification theorems, even if progress in the basic questions of homotopy theory was achieved. This pessimism was so prevalent that it even deflected a wonderful geometric topologist like J. H. C. Whitehead from what he could do best, to messing around with various more algebraic aspects of the subject.

J. H. C. Whitehead, "Jesus He's Confusing Whitehead," we used to call him affectionately! What a wonderful way he had about him; the pulse rate of all of Princeton immediately doubled when he arrived for a short visit in—was it 1949 or 1950—I am not certain. But I remember distinctly a party at Steenrod's when Henry recounted to all of us how mind-blown he had been by Norman's original paper of 1945 where Steenrod had introduced his v_i products—later known as Steenrod squares—and immediately applied the construction to an obstruction problem. Steenrod would say that he just stumbled on it playing with the cocycle formula, but J. H. C. wanted details. Whitehead was lavish and generous in his praise but could be quite outspoken in his disapproval also. He was an old friend of von Neumann's but took a dim view of von Neumann's involvement in government affairs. "How can one foresake the world of the mind for the dull world of kings?" he admonished me once.

The Steenrod squares of course were very much in the developmental stage at that time—and my first paper in topology dealt with them and their relation with symmetric products and the Smith theory. Just like the theory of characteristic classes, they were treated by all of us gingerly and with great respect. After all, in Whitney's Proceedings announcement on characteristic classes he remarked that what we call the Whitney duality theorem was the hardest theorem he had proved!

So I can not help thinking how wonderful it would have been, if during that bull-session with Henry in Norman's kitchen, I could have regaled them with some of the things to come in this area,

such as that it is much more expedient to make this theorem the starting axiom of the theory, or how brazenly a young fellow called Hirzebruch would throw them about in six years' time.

And of course I must admit that it would have been even more fun to startle Henry that night with a consequence of the Morse Theory which I would stumble on, after an incubation period of six or seven years. Well, that would have been fun—but of course was not to be. But maybe it is appropriate to end this lecture with a short reminiscence concerning this application and how I came on it.

When I returned to the Institute for Advanced Study in 1955-1956, the scene had changed drastically—Serre, Kodaira, Spencer, Atiyah, Borel, Milnor, Singer, and Hirzebruch became my teachers and friends and homotopy was not at the top of my mind. I had already noted that the Morse Theory applied beautifully to the topology of a Lie group and that one could write down the homology of the loop-space ΩG from the basic data of G in a very simple manner. But, as I say, in 1956 I was learning about Riemann-Roch and such things from Serre and Company. But then a dispute arose among the homotopy theorists and the characteristic classes wizards such as Borel and Hirzebruch. It was already known in 1949 that the kth homotopy group of the classical groups: $U(n), O(n), Sp(n)$ became independent of k when n was large enough. These *stable groups* $\pi_k(U), \pi_k(O), \pi_k(Sp)$ now came into contention.

The homotopy theorists predicted that $\pi_{10}(U) = \mathbf{Z}_3$; Borel and Hirzebruch said no, this could not be. One had to have $\pi_{10}(U) = 0$. Now it so happened that the Morse theory point of view that Samelson and I had developed enabled me to make a quite independent computation—actually in the exceptional group G_2—to get at $\pi_{10}(U)$. The computation took a weekend where together with my dear friend Arnold Shapiro, we covered all the blackboards of the Institute with computations of Steenrod squares and such in the loop space of G_2. Finally the thing was done and we came out on the side of Borel and Hirzebruch, and I remember we put $5 of our money on them and in due course collected from John Moore.

Now once one removed the $\mathbf{Z}_3$ from $\pi_{10}(U)$ the known homotopy $\pi_k(U)$ took the form $\mathbf{Z}$ for k odd and 0 for k even up to $k \leq 10$.

That was enough for an old engineer like myself! This must be the pattern all the way, I decided. But the by then standard method of computing seemed hopeless. On the other hand if one could show that $\Omega \cdot \Omega U = U$ then of course the result would follow for all k immediately by induction. And in this light it was not difficult to deduce this theorem from previous work of mine and Samelson's using the Morse theory. Actually I tumbled to it only upon our return to Ann Arbor in the fall of 1956 and then quite literally during our moving from one house to another, I saw that the same method seemed to yield the equations

$$\Omega^{(4)}0 = SP \text{ and } \Omega^{(4)}SP = 0$$

so that really all the *stable homotopy groups of the classical groups* are periodic and in particular

$$\pi_{k+2}(U) = \pi_k(U),$$
$$\pi_{k+4}(O) = \pi_k(SP),$$
$$\pi_{k+4}(SP) = \pi_k(O).$$

But now my time is truly done! Graham Greene used to divide his oeuvres into "novels" and "entertainments" and it is in the latter genre that I profer this personal strand of history. Still, if sufficiently many of us of my vintage would do the same, we might collectively really bring to life a unique and certainly romantic era of American mathematics. Thank you very much.

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George Lusztig Awarded 1985 Cole Prize

The Frank Nelson Cole Prize in Algebra is awarded every five years for a notable research memoir in algebra which has appeared during the previous five years. This prize, as well as the Frank Nelson Cole Prize in Number Theory, was founded in honor of Professor Frank Nelson Cole on the occasion of his retirement as secretary of the American Mathematical Society after twenty-five years and as editor-in-chief of the Bulletin for twenty-one years. The original fund was donated by Professor Cole from moneys presented to him on his retirement. It has been augmented by contributions from members of the Society, including a gift made in 1929 by Charles A. Cole, Professor Cole's son, which more than doubled the size of the fund. In recent years, the Cole Prizes have been augmented by awards from the Leroy P. Steele Fund and currently amount to $4,000.

The Twenty-First Cole Prize was awarded to GEORGE LUSZTIG, of the Massachusetts Institute of Technology, at the Society's ninety-first Annual Meeting in Anaheim. The prize was awarded by the Council of the American Mathematical Society on the recommendation of a selection committee consisting of Michael Aschbacher (Chairman), Melvin Hochster, and Bhama Srinivasan.

The text below includes the Committee's citation, the recipient's response on presentation of the award, and a brief biographical sketch of the recipient.

Citation

To GEORGE LUSZTIG for his fundamental work on the representation theory of finite groups of Lie type. In particular, it is awarded for his contributions to the classification of the irreducible representations in characteristic zero of the groups of rational points of reductive groups over finite fields, appearing in *Characters of Reductive Groups Over Finite Fields*, Annals of Mathematics Studies **107**, Princeton University Press, 1984.

Response

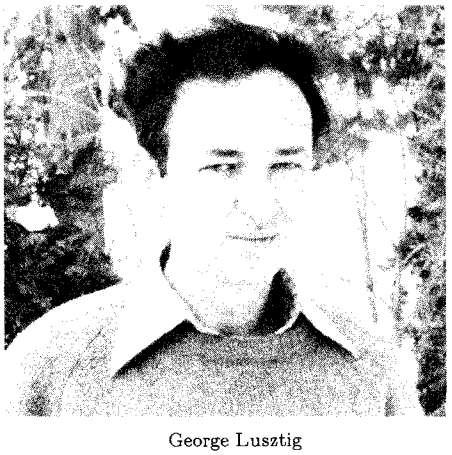
I feel very honored to receive the Cole Prize. My book which has been cited contains the classification of the complex irreducible representations of a reductive group $G(F_q)$ with connected centre over a finite field F_q and explicit formulas for their character at all regular semisimple elements. This completes a work done about ten years ago jointly with Deligne in which we constructed almost all representations of $G(F_q)$. After the book was written, I have removed the restriction on the centre. What has emerged is that the classification of representations is simpler than that of conjugacy classes; for instance, it is independent of characteristic. The combinatorics which enters in the classification of degenerate representations is closely related to that which enters in the classification of primitive ideals in enveloping algebras and to that in my work with Kazhdan on singularities of Schubert varieties. For the character values at non-semisimple elements one has quite a bit of information and it now seems reasonable to hope that the full character table of $G(F_q)$ will be determined in the not too distant future.

Biographical Sketch

GEORGE LUSZTIG was born May 20, 1946, in Timişoara, Romania. He received a Master's degree from the University of Bucharest in 1968, and both M.A. and Ph.D. degrees from Princeton University in 1971. From 1969 to 1971, Lusztig was a visiting member at the Institute for Advanced Study in Princeton, New Jersey. He has also been a research fellow, lecturer, and professor at the University of Warwick, in Coventry, England (1971–1978). In 1978 he became professor of mathematics at the Massachusetts Institute of Technology.

Lusztig has given several AMS addresses: at the 1977 Summer Research Institute on Automorphic Forms, Representations and L-Functions; at the Symposium on the Geometry of the Laplace Operator in Hawaii (March 1979); and at the Special Session on Cohomology and Representations of Algebraic Groups in San Antonio (January 1980, AMS Annual Meeting). He also gave an invited address in Philadelphia in April 1980. He has been an invited speaker at the International Congresses of Mathematicians in 1974 and 1983.

Lusztig received the Junior Berwick Prize in 1977 from the London Mathematical Society. He was a Guggenheim Foundation Fellow in 1982 and was elected a Fellow of the Royal Society in 1983.



George Lusztig

Reports to the Members of the Society

Introduction

The Council of the AMS has asked that henceforth an annual report be prepared describing the highlights of the Society's activities during the preceding year. This report will have three components: a report from the Secretary giving an overview of the professional activity of the Society; one from the Treasurer on the financial well-being of the Society, and recounting various actions of the Board of Trustees; and one from the Executive Director describing other activities of the Society and some of the activities and accomplishments of the AMS staff in Providence and Ann Arbor. All three reports will henceforth be published regularly in the March issue of the *Notices*. The reports of the Treasurer and the Secretary supplement the formal Report of the Treasurer and the reports of Council Meetings and Business Meetings that appear regularly in the *Notices*.

Report of the Secretary

The purpose of the Society has been unchanged since its inception though the wording has been altered slightly. The purpose of the New York Mathematical Society was stated in its constitution of 29 December 1888.

> The object of the Society shall be to incite and maintain an active interest in Mathematics Pure and Applied.

These words persisted when the name was changed in 1894 to the American Mathematical Society. In the published version of 1898 the words are

> to encourage and maintain an active interest in mathematical science.

This text was unaltered until the incorporation of the Society in 1923. The constitution vanished then, some of its features being incorporated in the existing bylaws, but the purpose was stated in the Certificate of Incorporation as follows:

> The particular business and objects of the Society are the furtherance of the interests of mathematical scholarship and research.

The Society carries out its purpose in three ways: through meetings, publication, and a variety of services. It does this work with the support of many volunteers; there are more than 400 names in the list of members of committees, which does not include many of the volunteers. It does it with the full-time services of about 200 persons in the offices of Providence and Ann Arbor.

One of the charges to the Executive Committee is to review the operations of the Society. It does this over a three-year cycle corresponding to the three categories that were just named. The year 1984 was the year to examine meetings, so that the report of the actions of the Council of January 1985 may well include Council reaction to the report on meetings to be presented to it.

Meetings in 1984 on diversified subject matter followed a standard pattern, with the required Annual Meeting in January, the Summer Meeting in August, both being joint meetings with the Mathematical Association of America, and five sectional meetings. At these meetings there were sets of Colloquium lectures by Barry Mazur and Paul H. Rabinowitz, the Gibbs lecture by Herbert A. Simon, thirty-three invited hour addresses, and 1027 shorter papers, either contributed or assembled by organizers of special sessions. This is a small offering compared with the year 1982, for which the comparable figures are at hand, a year in which there were nine such meetings (Annual, Summer, and seven sectional) with forty hour addresses and 1587 shorter papers.

The Society had grants or contracts to hold a number of conferences on specialized topics. Some details are given in the report of the Executive Director. The list includes a four-day Symposium on Pure Mathematics, a one-day Symposium on Some Mathematical Questions in Biology, ten one-week Summer Research Conferences, a two-week Summer Seminar in Applied Mathematics, and a three-week Summer Institute.

The decrease in the number of contributed papers between 1982 and 1984 was surprising. Accordingly the entire offering of 1964 was examined for comparison. The current offering is remarkably richer both in the content of general meetings and in specialized conferences. In 1964 there were two national meetings and nine sectional ones with one set of Colloquium Lectures (not two), the Gibbs Lecture, eighteen hour addresses (versus thirty-three), and 698 contributed papers (compared with 1027). In that year there was a Summer Institute in pure mathematics and a three-day symposium in applied mathematics but no other conferences.

On a different level, there were two short courses in 1984, but the concept of short courses at AMS meetings had not yet arisen in 1964.

The status of the Summer Meeting is as follows. There will be the usual joint meeting with the MAA in 1985 and 1987. There will be no Summer Meeting in 1986 only because it has deferred to the International Congress of August 1986 in Berkeley. The Centennial of the Society will be held in the Summer of 1988 in place of the usual Summer Meeting. The issue of continuing Summer Meetings indefinitely, which could affect 1989, is under study. The question of their scientific value was raised because they were losing money. At that point the issue was whether they are of sufficient value to be supported. It appears likely that with the increase

in registration fees that you have observed and with a new cost-sharing arrangement with the MAA now being negotiated, the joint meetings will not lose money, so that the nature of the issue has changed.

Publication is a substantial part of the activity of the Society. There are several components to journal publication. First is the publication of research through primary journals, namely *Mathematics of Computation, Memoirs, Proceedings, Transactions.*

In addition, the research component of the *Bulletin* consists of announcements of research results. On a different level, the *Abstracts* is devoted to the announcement of research results. Second is the reviewing component through *Current Mathematical Papers* and *Mathematical Reviews.* Finally, there are seven journals in translation from the original Russian.

Another aspect of publication consists of fifteen series of books. It should be noted that the *Colloquium Publications* and the *Mathematical Surveys and Monographs* welcome the offering of manuscripts for consideration by the editors. As a comment, it should be noted that the author's royalty in either of these series is unusually favorable.

Publication is a major fraction of the business of the Society, accounting for about seven-tenths of the annual budget. There is a narrow path to be traveled in this business. First, the officers, particularly the Trustees, are determined that the Society publications shall be inexpensive. As evidence of the effectiveness of this policy, one may consult the *Notices* for November 1983 where journal prices of some fifty-six typeset journals are compared. Even at list price, AMS research journals are in the lowest quartile in price and these journals are, in fact, sold at a discount to members, making their prices even more favorable. On the other hand, publications must produce a modest surplus in order to fit into the total financial picture of the Society and the mathematical community. The use of the surplus will become clear when service obligations of the Society are elucidated.

More detailed information on the publication business is contained in the reports of the Treasurer and the Executive Director.

Services to the profession are of two kinds. A common thread is that they cost money and bring in little income, so that they must be supported from dues or from surplus in other operations of the Society.

One kind of service consists in supplying information or facilitating its flow, for instance through

Combined Membership List
Professional Directory
Annual Survey
Listing of doctoral degrees
Listing of backlogs of journals
Listing of visitors here and abroad
Reciprocity Agreements
Listing of fellowships and assistantships
Listing of postdoctoral fellowships
Listing of lecture notes (to be resumed in 1985)
Listing of computer software (under study)
Employment Information in the Mathematical Sciences
Employment Register

No single member wants all of these services for personal use but many members want some of them. Almost no one opposes any of them except possibly for their cost.

The other kind of service consists in attempting to influence the climate or the social milieu of research. The most recent activity of this kind is the establishment of the Office of Executive Secretary for National Affairs. (See below.) This is an office concerned with the flow of information between the mathematical community and elective and administrative government officials. It is part of a joint venture with the MAA and SIAM called the Joint Policy Board for Mathematics, to which the Executive Secretary reports.

Other activities in this category include the work of committees on

Professional Ethics
Employment and Educational Policy
Academic Freedom, Tenure and Employment Security
Science Policy
Human Rights of Mathematicians
Opportunities in Mathematics for Disadvantaged Groups
Service to Mathematicians in Developing Countries
Public Understanding of Mathematics
Status of the Profession

In that the activities in the second class have a political or social content, the membership has from time to time been divided over the propriety of some of them as Society activities. This is particularly the case when one reflects on the fact that some of the activities are directed to the political or social scene in the United States while the membership includes several thousand persons from other countries.

The Society is not the only organization uniting and serving mathematicians. The *Professional Directory* lists thirty-five others in the U.S. and Canada serving various specialized intellectual, geographical, and social areas in the mathematical sciences.

A bit of history on the place of the AMS among these organizations may be pertinent. The American mathematical profession has had its turbulent times. In January of 1915 the Council of the AMS voted that, "It is deemed unwise for the American Mathematical Society to

enter into the activities of the special field now covered by the *American Mathematical Monthly*," adding that if a new organization were formed, concerned with collegiate mathematics education, the Society would have "feelings of hearty good will and encouragement." In December of 1915, H. E. Slaught resigned his position as Secretary of the Society and became one of the founders of the MAA; one may judge that emotions ran high during the intervening months. And there is no doubt that when SIAM was formed in 1952, it was because many applied mathematicians were concerned that their field was not receiving adequate attention within the Society.

In spite of these differences, many American mathematicians have worked to increase cooperation among the various organizations. The Conference Board of the Mathematical Sciences (CBMS) was formed in 1958, with representatives from the above three organizations as well as the Institute of Mathematical Statistics, the Association for Symbolic Logic, and the National Council of Teachers of Mathematics. There was a move toward amalgamation of the three organizations in 1973, but after considerable discussion, representatives of AMS, MAA and SIAM concluded that it was not feasible at that time. But they successfully recommended that a tripartite Joint Projects Committee for Mathematics (JPCME) be formed to collaborate on problems of common concern, under the aegis of CBMS. Within the past two years the name and structure of JPCM has changed; the new joint Joint Policy Board for Mathematics (JPBM) now operates independent of CBMS. It consists of the presidents and executive directors of the three organizations, and one appointed member from each (the secretary in the cases of AMS and MAA).

K. M. Hoffman is now JPBM's Executive Secretary for National Affairs, and provides one of the principal lines of communication between the three societies and various Federal agencies. (In particular, he has been appointed chairman of the NSF Advisory Panel on Mathematics Education.) JPBM will also be seeking funding this fall for a serious study by JPBM's Committee on the Status of the Profession of "the academic mathematical sciences profession: recent trends, present circumstances, and future outlook concerning the characteristics of college and university mathematics faculty, their changing responsibilities and their capacities to meet these responsibilities."

The Society also participates, through the individual memberships of its President and President-Elect or Ex-President, in the Council of Scientific Society Presidents, which is a club with considerable influence in Washington on pertinent aspects of administrative and legislative policy in scientific matters.

Questions considered through these contacts include inter-society issues of cooperation and jurisdiction and the formulation of a united front and concerted action when this represents the interest of all concerned.

There are of course many specific projects in which the Society has cooperated regularly with other mathematical organizations. As examples, the *Combined Membership List*, the Employment Register, and the Congressional Science Fellow are all jointly supported by AMS-MAA-SIAM; several conference series are sponsored jointly by AMS and SIAM and/or the Institute of Mathematical Statistics; and several aspects of publication are joint projects.

E. Pitcher

Treasurer's Report

I. Introduction

Over the past ten years, the country has been through several business cycles. Just prior to the years of double-digit inflation, the Society's finances were very strong and the mood of the Trustees was to hold prices down on member dues, publications, registration fees and other services. This policy, the inflation, and the fact that we must commit ourselves to a selling price long before the service is provided, brought the financial reserves of the Society to a level which caused the Trustees to reconsider pricing policy. During 1982 and 1983, cost-saving procedures were put into effect and prices were adjusted in an effort to bring the budget of the Society into balance. For the 1984 year, it is expected that a modest surplus of about $100,000, or 1% of the budget, will be realized.

The 1985 budget has been set to produce a surplus of about $500,000 or 4.5% of the $11,000,000 budget; experience has shown that the actual surplus will probably be less than that projected, but will still be positive. At the end of 1975, the total budget of the Society was approximately four million and its reserves were two million dollars, or about 50% of a year's operating budget. At the end of 1983, our reserves were only 24% of a year's operating budget. A Long Range Planning Committee, which was recently formed by the Executive Committee and Board of Trustees, is currently considering a method to increase our reserves over the next number of years to one full year of expenditures. This will provide the cushion desirable for developing needed programs and services for the profession. In summary, the Society's finances are in better shape now than they were a year or so ago.

II. Revenue

I now turn to a description of the Society's revenue, followed by explanations of each category. Revenue to support Society activities in 1985 is expected to come from the following sources:

Journals	63%	$6,810,000
Books	11%	1,227,000
Dues	9%	992,000
Grants & contracts	10%	1,038,000
Meetings	2%	223,000
Other	5%	485,000

Journals. Although journals provide the largest fraction of revenue, they have been operating at a net loss for the past several years. Costs are under constant scrutiny and cost-saving procedures are implemented where possible, for instance by placing more type on a page, reducing the size of type, using new and cheaper methods of composition, doing in-house printing, and using lighter paper to reduce postage costs. Even with the cost reductions made over the past several years, deficits in the journal accounts persisted, mainly because of fewer subscribers and a reluctance to raise prices too high. Of major concern to the Board of Trustees is the steady erosion of the subscriber base. This is not a problem unique to the AMS, but affects all learned societies. Most subscribers are foreign or domestic institutions, and the library budgets of most of them have been cut. Marketing and promotion efforts are being made to try to halt or reverse this trend, but without much success. Journal prices for 1985 have been raised substantially; fortunately, studies show that AMS journals are still priced near the lower end of the range, in comparison with other mathematical journals.

Books. Included in this category are not only books (monographs or collections of articles) but review volumes and indexes to journals. Books as a group are financially sound, and selling prices of AMS books compare very favorably to other mathematical books. It is interesting to observe that the number of copies printed is usually very small, only 800–1,200. A strong marketing and promotion effort is being made to increase the number of copies sold in an effort to keep prices down, and some success can be reported here.

Review volumes and indexes have been a financial burden to the Society. Prices have to be set very high because the costs of producing these extremely large publications are high. The question of whether to publish such volumes is a difficult one; on the one hand the profession needs such publications as research tools, and on the other the price needed to break even is too high for smaller institutions to pay. In some cases, prices have been set artificially low to address this problem.

Dues. The Society has about 450 institutional members and 20,000 individual members. Of the latter, about 6,000 pay no dues because they are student nominees, emeritus members, or reviewers without convertible currency. Dues from the approximately 14,000 paying members make up 6% of revenue, and the institutional members provide another 3%. Individual member dues are two-tiered to provide some relief to lower paid members. Institutional dues are set, in part, by the number of papers published by members employed by the institution. Increases in dues for individual members are set annually by a cost-of-living index.

Grants and Contracts. The amount of money available from the Federal government has declined substantially over the years. Currently, support is mainly for travel and subsistence for participants in research conferences, institutes and seminars, plus the Society's cost in preparing and running these conferences. The money received from Government agencies is reimbursement only, with no profit to the AMS. The Society does have contracts to perform services for other nonprofit organizations, and this helps to recover some fixed costs.

Meetings. Registration and exhibit fees at the two joint meetings each year have never been sufficient in the past to cover expenses. It will therefore be necessary gradually to increase fees over the next few years to bring revenues and expenses into balance.

III. Expenses

The expenses of the Society are not as easily categorized as revenues. Most expenses are assigned to departments, and these are later allocated to specific publications, meetings, or other accounts. The three major expenses of the Society are personnel ($5,700,000 or 55%), buildings and equipment ($1,326,000 or 13%), and direct publication costs ($1,500,000 or 14%). The remaining 18% , or $1,898,000 is made up of pass-through funds from grants, direct meeting costs, and general supplies.

IV. Assets and Liabilities

So far this report has dealt with sources of revenue and applications of expense. Another aspect of the Society's finances is what it owns and owes, or its assets and liabilities. Unlike revenue and expense, which are measured over a specific period (monthly, quarterly, yearly), assets and liabilities are measured on a specific day. It is estimated that on 31 December 1984, assets will be greater than liabilities by approximately $1.3 million. Besides cash of $2.5 million, which is kept in short-term negotiable investments, and inventory (both finished and in process) valued at approximately $1 million, the Society has a significant investment in fixed assets.

The Society owns buildings in both Providence and Ann Arbor. The Providence building was built in 1974, and a major addition for a combination warehouse and printing plant was added in 1981. The total cost of the Providence facility has been slightly more than $2 million. The Ann Arbor building was purchased in 1984 at a cost of approximately $1 million. This amount was financed with a mortgage against the Providence building.

The Society presently has furniture and equipment with a book value of $1.5 million (cost of

$3.4 less depreciation of $1.9 million); most of this value is made up of computers and computer-related equipment. The write-down in value for computer equipment is quite rapid, five years in most cases. Unlike buildings, which could have a substantial residual value, equipment eventually becomes worthless. This is perfectly proper because a building returns income when it is finally disposed of and equipment as it is used in production.

The liabilities of the Society are short term, with the exception of the mortgage on buildings of $1 million. Short-term liabilities as of December 31, 1984 will be approximately $500,000 owed to vendors, $5 million in prepaid 1985 subscriptions and dues, and $700,000 as reserves for employment-related expenses. When these liabilities are subtracted from assets it leaves a positive balance of $1.3 million.

Besides the assets mentioned above, there exists an Investment Fund with a value of approximately $2.6 million. About half of this fund consists of endowments with restricted use of principal, the other half, quasi-endowments created by the trustees from time to time. The income from these two groups helps to support the current operations of the Society, with the exception of a portion that is restricted to prizes. F. P. Peterson

Annual Report of the Executive Director

The present report will probably be longer than those in the future, in order to explain fairly fully just what the Society does and has been doing; later reports can build on this. Probably most members do not realize that the Society has more than 200 employees (about two-thirds of them in the headquarters office, the other third in the *Mathematical Reviews* editorial office), nor know what a broad spectrum of activities the Society is engaged in.

I. Meetings and Conferences

The Society regularly arranges for the following meetings and conferences:

Annual Meeting (January) and **Summer Meeting** (August). Normally joint with MAA and sometimes additional organizations.

Sectional Meetings. Normally eight per year, two in each of the four sections of the country.

Summer Research Institute in Pure Mathematics. Three weeks each summer on one topic; usually 200–250 participants. Supported by the NSF.

Summer Seminar in Applied Mathematics. Joint with SIAM; two weeks long; about 100 participants. Supported by various agencies.

Joint Summer Research Conferences. Joint with SIAM and IMS and supported by the NSF; normally ten conferences, each one week long, all on one campus. About 75–100 participants each.

Symposium on Mathematical Biology. One day, held at the annual AAAS meeting. Usually about 60 participants. Usually supported by the NSF.

In addition, the Society has in the past sponsored two series of two to four day symposia in alternate years, contiguous with spring sectional meetings, one in pure mathematics and one in applied mathematics. Partly because of changes in agency funding practices, these series are now in metamorphosis, with the steady state still to be determined. Probably the symposium in pure mathematics will henceforth usually focus on the work of some outstanding mathematician, as did the recent ones on Hilbert and Poincaré.

AMS Meetings. Summer meetings merit special discussion. For many years the attendance (and therefore income) at the August Joint Mathematics Meetings has been on the decline, whereas costs have continued to rise. Facilities and services previously provided by the host universities at no or low cost are now costing thousands of dollars. As the scientific program has become more complex and more events have been added, more hours must be devoted to preparation and plans. For the past few years, deficits in the $40,000 to $50,000 range have not been uncommon. The Trustees of the Society and the Council have both expressed concern over these deficits, and have devoted a great deal of time and thought to the problem. (See the Secretary's report.) It is hoped that a solution can be found so that the summer meeting can be continued in the future, and representatives of the Society and the MAA are working together toward this end. It has been decided that the usual joint summer meetings will be held in 1985 and 1987; the International Congress of Mathematicians will replace the usual meeting in 1986, and the Society will have a special Centennial meeting in the summer of 1988, so every summer is planned for until 1989, at any rate.

One element of cost pervading all the Society meetings is that of processing the abstracts of talks in order to prepare the program of the meeting. One person works almost full time on this task prior to deadlines for the meetings; this work is quite separate from the preparation of the *Abstracts* journal (pasting-up, photographing and printing), and is charged to the various meetings. In an effort to bring the meetings accounts into balance and to offset some of the preparation costs of the journal, the Trustees last year reluctantly imposed a fee of $15 for each abstract accepted. In January, the Council recommended to the Trustees that this fee be rescinded.

1986 International Congress of Mathematicians. The National Academy of Sciences, through the United States National Committee

for Mathematics, invited the International Mathematical Union to hold the 1986 International Congress in the United States at the University of California, Berkeley. The Academy, in turn, asked the Society to handle the organizational aspects of the Congress. The Society has chosen to do so through a nonprofit subsidiary corporation called ICM-86; Jill P. Mesirov is its Executive Director. Most of the preplanning and on-site supervision will be done by the Society's Meetings Department, augmented by some temporary personnel. In order to maintain good liaison with the U.S. mathematical community, the Board of Directors of the corporation has appointed a Steering Committee, chaired by Andrew M. Gleason of Harvard University, with members from all segments of mathematical life. Subcommittees of the Board and Steering Committee will seek to raise funds for support of ICM-86 from the private sector, schedule the various sessions at the Congress (at the direction of the IMU Program Committee), and look after the various publications (program, book of abstracts, proceedings).

Residence hall and hotel rooms have been reserved for Congress participants in Berkeley, Oakland, and San Francisco. Free shuttle service will be provided to and from most of these accommodations and the Berkeley campus, where all sessions of the Congress will be held. The IMU Program Committee is planning approximately sixteen one-hour invited lectures, a large number of invited 45-minute lectures, and sessions for short communications. The scientific program will be supplemented by an extensive social program, including a reception hosted by the Chancellor of the university, and a rodeo and western barbecue. A variety of pre- and post-Congress tours will be offered, as well as several day-trips to interesting locations in the northern California area. The Second Announcement of the Congress, containing detailed information and the preregistration and housing form, will be available in late 1985, and can be obtained by writing to ICM-86, Post Office Box 6887, Providence, Rhode Island 02940.

AMS Centennial Celebration. The Centennial of the Society will be celebrated by a special meeting which will take place in Providence, Rhode Island, August 8–12, 1988. Plans are being made for about eighteen-twenty special invited addresses representing a rather comprehensive survey of currently significant fields of mathematics. Sessions for contributed papers will be scheduled, but there will be no special sessions. A proceedings volume will be published at a later date. A paperback reprint of the history of the first fifty years (originally published in 1938) will be on sale at the meeting, and a history of the second fifty years will also be available. An extensive social program, including a reception at the State Capitol building and a real New England clambake, is being developed.

Conferences Held in 1984. The Summer Institute, on *Geometric measure theory and the calculus of variations*, was held at Humboldt State University in Arcata, California. The Summer Seminar was on *Nonlinear systems of PDE in applied mathematics*, and was held on the campus of the College of Santa Fe, Santa Fe, New Mexico. The Joint Summer Research Conferences were held on the campus of Bowdoin College, Brunswick, Maine, on the following topics (with organizers' names following):

New multivariate methods in statistics, P. Huber

Random matrices and their applications, J. Cohen

The mathematics of phase transitions, R. Durrett

Aspherical complexes, K. Brown and F. T. Farrell

Group actions on rings, S. Montgomery

Diophantine problems, including diophantine equations, diophantine approximation, and transcendency, D. J. Lewis and W. M. Schmidt

The Selberg trace formula and related topics, A. Terras

Linear algebra and its role in systems theory, B. N. Datta

Integral geometry, R. L. Bryant

Complex differential geometry and non-linear differential equations, Y. T. Siu

II. Publications

Mathematical Reviews and Subsidiary Publications. So many changes have taken place in recent years in the way MR is produced that a separate article will be devoted to the Ann Arbor operation in a forthcoming issue of the *Notices*. Here I will only mention some of the visible results of the labors of the seventy persons who work in that office.

About 10,000 pages were published in MR and CMP and their indexes in 1984, and both publications are completely up to date. CMP now appears triweekly rather than biweekly, to save on distribution and postage costs.

The *Cumulative Subject Index for 1940–58* appeared early in 1984. This index was made by pasting together fragments from the various annual subject indexes for those years; the task was complicated by the fact that the classification system was changed repeatedly and sometimes radically during the early years.

A substantial fraction of the work has been done on the preparation of the *Cumulative Subject Index for 1959–72*, and it will appear in early summer. Since no annual subject indexes were produced during the period 1959–1972 (they would have required substantial increases in staff, or else computers not then available), it was necessary to classify each review now and keyboard the bibliographic headings along with their classifications. It will be important in the future that this work not only provides the paper

copy of the missing index, but permits us to extend the bibliographic entries in MathSci back to 1959.

Another major effort directed in Ann Arbor was the preparation of R. K. Guy's *Reviews in Number Theory, 1973–83*, which appeared near the end of 1984. This collection of more than 17,000 reviews, taken together with the earlier volumes covering 1940–1972, provides research mathematicians in this field with a unique bibliographic tool. A companion volume edited by B. Magurn, *Reviews in K-Theory*, is well under way and should appear in mid-1985.

MathSci. Perhaps the most exciting developments in the Society's publishing program in 1984 were related not to paper products but to the on-line service MathSci, which started in 1982, under the name MATHFILE, merely as a computerized version of MR. Beginning in 1985, the following 1984 efforts will become visible:

> The MR file will be extended back to 1959, as mentioned above.
>
> CMP tapes will be supplied to the database vendors (Dialog, BRS, and ESA) as issues are printed, so that users will find citations (but not reviews) for articles as little as a month after their publication. These citations will be replaced by MR entries when the reviews are published.
>
> Both CMP and MR entries will be in TEX input code, so that in the not too distant future, citations from vendors can be converted into real mathematics by running them through the TEX program.
>
> The American Statistical Association and the Institute for Mathematical Statistics have agreed to add their joint publication *Current Index to Statistics* to MathSci; and the *Index to Statistics and Probability, 1902–1968*, compiled by J. Tukey, will also be added. It is hoped that funds can be found to eradicate the gap between these two files, now extending from 1969 to 1974, so that the file on statistics will be essentially complete.

With these enhancements, MathSci will unquestionably be the most powerful bibliographic retrieval tool available in the mathematical sciences—and we hope to add still more subfiles in the near future.

Other AMS Journals. About 12,000 pages were published in the Society's primary research journals,

Abstracts of Papers Presented to the AMS
Mathematics of Computation
Memoirs of the AMS
Proceedings of the AMS
Transactions of the AMS

and in the journals also containing non-research material,

Bulletin of the AMS
Notices of the AMS
Employment Information in the Mathematical Sciences

The Society maintains a no-backlog policy for its primary journals, thus ensuring authors of prompt publication.

Another 6,500 pages were published in 1984 in the Society's translation journals,

Mathematics of the USSR - Izvestiya
Mathematics of the USSR - Sbornik
Proceedings of the Steklov Institute of Mathematics
Soviet Mathematics - Doklady
Theory of Probability and Mathematical Statistics
Transactions of the Moscow Mathematical Society
Vestnik of the Leningrad University (Mathematics)

Unfortunately, it has been necessary to discontinue publication of the *Vestnik* with the 1984 volume, because of lack of subscription income. Translation journals are extremely expensive to produce, with fees to be paid to translators and royalties to the Soviet copyright agency, and there seemed to be no way that the *Vestnik* could become self supporting. (The Allerton Press has now obtained the rights to translate and publish future volumes.)

Books. The Society publishes original books in twelve different series,

CBMS Regional Conference Series
Colloquium Publications
Conference Proceedings, Canadian Mathematical Society
Contemporary Mathematics
Lectures in Applied Mathematics
Lectures on Mathematics in the Life Sciences
Mathematical Surveys and Monographs
Memoirs of the AMS (also sold by subscription)
Proceedings of Symposia in Applied Mathematics
Proceedings of Symposia in Pure Mathematics
Selected Tables in Mathematical Statistics
SIAM–AMS Proceedings,

and publishes translations in three series,

Translations of Mathematical Monographs
AMS Selected Translations
Selected Translations in Mathematical Statistics and Probability.

Anyone not familiar with the natures of these series may consult the AMS Catalogue of Publications, available free from 800-556-7774. In 1984, sixty titles were published in these series, amounting to almost 13,500 pages. (The *Steklov* and *Memoirs* volumes are also sold by subscription, as journals.) The new series *Contemporary Mathematics* is flourishing, with volumes appearing at the rate of about 15 books

per year, including the proceedings of many of the Summer Research Conferences.

Publication Services for other Organizations. Other societies have found that the AMS can provide high-quality editorial, composition and distribution services at very reasonable rates. We now do the keyboarding and computer composition for nine other journals, as well as the editorial preparation of manuscripts for several of them. Some of them we also warehouse and distribute, and we perform the latter service for two foreign journals as well, *Astérisque* and *Journal of Operator Theory.* We print a few journals besides our own. In the recent past the Society has prepared the *World Directory of Mathematicians* on behalf of the IMU, and will do so again for the 1986 edition. We will also produce the proceedings resulting from the 1986 Congress, on behalf of ICM-86.

Taking account also of various non-serial publications such as the *Combined Membership List,* the *Professional Directory,* and meeting programs, an average of about four publications prepared by Society staff went to press each week during 1984.

III. Membership Services

Employment Services. The Employment Register, providing for interviews at annual meetings between employers and applicants, is a service that is taken for granted by Society members, but in fact it seems to have no close parallel among other learned and scientific societies. In the background is an optimal matching algorithm published by D. Morrison in 1969 which arranges timed pairings between certain elements of two sets in such a way that there are no time conflicts. This algorithm was built into a program the Society has used since about 1962, first on a Sandia computer, then on the GE network, and more recently on our own computer. The program has been substantially enlarged and improved within the past couple of years, and at the January meeting in Louisville, 6,672 interviews were scheduled between 229 employers and 332 applicants during 48 interview periods stretching over two days. (Other societies which arrange employment interviews seem to manage only a few hundred during a meeting.)

It may be illuminating, as a commentary on the job market, to note the numbers (employers, applicants) since 1973:

1973 (60, 535)	1979 (115, 273)
1974 (51, 521)	1980 (135, 207)
1975 (71, 542)	1981 (175, 284)
1976 (63, 364)	1982 (203, 260)
1977 (75, 385)	1983 (172, 260)
1978 (91, 400)	1984 (229, 332)

However much the computer program may be improved, the human part of the job of making the Register work will always be a harried one. At the winter meeting, all the requests for interviews, from both sides, must be input in the late afternoon on a terminal connected by modem to Providence, the program must be run (about four hours on a DEC 2060), and the output records printed out on the terminal, separated, and organized, all in time for a nine o'clock start the next morning. Through changes in procedures, two people can now finish by midnight what used to require four people several more hours.

Employment Information in the Mathematical Sciences. This journal was recently supplemented by a special issue, published each year just prior to the January meeting and containing full resumés of each of the preregistered applicants who will participate in the Employment Register. This has proved to be a great convenience to everyone involved, since employers now have an opportunity to devote more time to the selection of applicants they wish to interview, and congestion at the site of the Employment Register has been reduced.

New Members. Over the years the membership of the Society has grown monotonically, although not very regularly. According to the *Combined Membership List,* there were 2,392 members in 1940, 4,434 in 1950, 6,725 in 1960, 14,197 in 1970, 19,994 in 1980, and 20,392 in 1984. In 1940 it was almost axiomatic that a new Ph.D. would join the Society; this is unfortunately no longer quite true. For many years we have provided free memberships to the nominees of institutional members of the Society (North American colleges and universities). Some of those student nominees never complete their Ph.D.'s, and others either discontinue their research efforts or concentrate in an area which they feel is better served by another organization than the AMS, but most of the remainder continue their memberships.

This past year, in an effort to be sure that every graduate student who would benefit from AMS membership knew about its value, we began asking mathematics departments for their lists of graduate students, so that we could contact them directly. This program will be continued. Also, a new brochure has been prepared to give clearer information to new members about just what the Society does and what it offers its members.

Other Member Services. A number of changes have been introduced to provide better service to current members. These include installing a toll-free telephone number for members' orders and questions, using UPS for faster book deliveries in the U.S., and accepting VISA and MasterCard for book orders and for registration and housing charges at annual and summer meetings.

W. J. LeVeque

Publishing a Book

As you surely know, the American Mathematical Society has long been recognized for its book and journal publishing program. You may not be aware, however, that the Society has recently taken a number of steps to increase the size and broaden the scope of its book publishing program, and to be more vigorous in acquiring the best manuscripts available.

Consider these developments...

• A new paperback book series, **Contemporary Mathematics**, was initiated in 1980 with Ross Kindermann and J. Laurie Snell's masterful *Markov Random Fields and their Applications*. The series consists partly of lecture notes and expository monographs such as this one, and partly of proceedings of conferences. In particular, the proceedings of most of the NSF Joint Summer Research Conferences are published in this series. All books in this series are printed from typescript prepared by the authors, and they are correspondingly inexpensive. About 35 volumes had appeared by the end of 1984.

• The scope of the series **Mathematical Surveys** was extended and the series was renamed as **Mathematical Surveys and Monographs**. The books in this series, which are cloth bound and typeset, extend back to Shohat and Tamarkin's 1943 classic, *The Problem of Moments*. Some of them have been graduate-level textbooks, and we expect to publish more texts of this sort in the future.

• Carl Pearcy, of the University of Michigan, has recently agreed to serve as an acquisition editor for the Society. He will actively seek out well-known mathematicians who are writing—or planning to write—monographs or textbooks that would be suitable for the two series mentioned above. With his help, and possibly that of additional acquisition editors, we expect the number of books published annually by the Society to increase noticeably.

• A marketing specialist has recently been added to the Society staff. This additional staff support will increase efforts already ongoing to promote AMS publications to librarians and researchers in the mathematical sciences.

Why should you publish with the Society? There are a number of good reasons, which together may seem compelling to you.

• The AMS keeps books in print indefinitely; you needn't worry about spending several years writing a book only to see it disappear from the market within a short period of time. (You can still buy the Shohat and Tamarkin book, published in 1943, mentioned above.)

• All AMS books are printed on acid-free paper, so that you can be sure they will still be on the library shelves years from now.

• Most mathematics libraries in the United States, and many abroad, have standing orders for all Society publications. Your book will have automatic sales from the day it is printed.

• The Society pays very generous author royalties on monographs and textbooks published in the **Mathematical Surveys and Monographs**, substantially in excess of the industry standard. Currently, for a book sold at the special price available to individual members, this royalty amounts to 25% of the sales price.

with the AMS

- The Society sells nearly half of its books abroad, so titles have a very broad distribution.
- Heavily discounted prices to AMS members make even relatively expensive titles affordable for individuals.
- The Society has an extensive computer file of the special interests of mathematicians all over the world. This file is used regularly to direct advertising to the collection of people most likely to be interested in each new title.
- Distributors and agents in foreign countries regularly produce catalogues and flyers, in their respective native languages, promoting AMS titles.
- In addition, every new book is featured in the *Notices*, which goes to 23,000 mathematicians six times a year, advertised repeatedly to individuals and libraries, and announced again each time it is reprinted.
- One final point. The Society supports many vital functions on behalf of the mathematical community which produce no income, or less income than they cost. It does this principally by using the revenue earned from its publications, which in another company might go to the stockholders. By publishing with the AMS, you will be helping to continue many other useful activities.

So if you have a manuscript or are thinking of writing one, you would be wise to give serious thought to publishing with the AMS. If you have a manuscript ready for publication, mail it to the AMS office for transmittal to the appropriate editorial committee. The address follows.

Director of Publication
American Mathematical Society
P. O. Box 6248
Providence, Rhode Island, USA 02940

If you are thinking of publishing a book, but are unsure of where to publish, contact Professor Carl M. Pearcy, AMS Acquisition Editor. At the time of this issue, Professor Pearcy is out of the country, but mail sent to his permanent address, listed below, will be forwarded.

Professor Carl M. Pearcy
Department of Mathematics
University of Michigan
Ann Arbor, Michigan, USA 48104

Retirement of Lincoln K. Durst

After nearly fifteen years as Deputy Executive Director of the Society, Dr. Lincoln K. Durst retired on 31 December 1984. Speaking for all of the officers of the Society, the Board of Trustees "record[ed] its thanks to Lincoln K. Durst for his years of skilled, perceptive, and devoted service." The quotation is from the resolution of the Trustees, which subsequently appeared on the certificate presented to Dr. Durst at a dinner in his honor attended by staff and friends. He will be greatly missed by both the staff and members of the Society.

Lincoln K. Durst was born August 5, 1924, in Santa Monica, California. He received his B.A. from the University of California, Los Angeles, in 1945. He also received a B.S. (1946) and a Ph.D. (1952) from the California Institute of Technology.

Dr. Durst served as deputy executive director of the American Mathematical Society from 1970 until his retirement in December 1984. His activities during this period included terms as managing editor of *Notices* and *Abstracts*, and membership on the Data Subcommittee of the Society's Committee on Employment and Educational Policy.

Before coming to Providence, he was a member of the mathematics departments at Rice University (instructor, assistant professor, associate professor, 1951 to 1967) and Claremont McKenna College (professor of mathematics, 1967 to 1970). During the 1950s he was associated with School Mathematics Study Group projects and during the 1960s he worked with the Mathematical Association of America's Committee on the Undergraduate Program in Mathematics, serving as executive director of CUPM in 1966-1967.

Durst's mathematical efforts have been centered in the theory of numbers and related areas. He is a member of Phi Beta Kappa, AMS, MAA, SIAM, and the Canadian Mathematical Society.

American Science and Mathematics

by J. B. Mooney, Jr.

American science and mathematics are the strongest in the world. Yet there are problems.

There are problems because we do not have enough young people going into careers in science and particularly going into careers in mathematics and the mathematical sciences.

There are problems because American science has been operating with obsolete equipment and instrumentation.

There are problems because American science is not adapting quickly enough to the revolutions in biotechnology, computerized experimentation and simulation and the increased role of mathematical abstraction.

There are problems because our American system of public education has not adequately prepared our students for scientific careers or even for living in this society which in many ways is defined by the high technology surrounding us.

I will discuss some of these issues with you and offer what the Office of Naval Research will do over the next several years to help remedy these significant problems. In particular, I will describe some recent actions and some planned actions which will impact directly on the mathematical sciences.

In relating ONR policy and the action to the mathematical sciences, I will emphasize an apparent paradox. The world, our world, is becoming more cerebral, more abstract and more mathematical. Nations such as the United States are shifting the intensive concentration of our working population from the manufacturing industries just as we shifted our working population from agriculture a century ago, many would argue that intellectually-based service industries will, in fact, become the dominant form of employment. I remark parenthetically that this is probably nowhere more evident than in Washington, D.C. The fact is that an abstract, mathematical understanding of our world continues to gain ascendency over an empirical, trial and error approach. Our society is changing from a "hands-on" to a symbol oriented "minds-on" society. The paradox is that even while this is so, the federal support available to the mathematical research community has declined in constant dollars and, as the recent David Committee report showed, has come to be markedly out of balance with support with related fields of science.

This article comprises the text of a Special Invited Address given at the Annual Meeting in Anaheim, January 1985 by Rear Admiral J. B. Mooney, Jr., Chief of Naval Research, ONR.

One may well argue, what does it matter? The intellectual state of American science is good. During the last 35 years Americans have won more Nobel Prizes in science than any other nation. Indeed, the steady stream of Fields Medals and the large proportion of mathematicians winning the Waterman Award affirm the excellence of American mathematics. Why then should we be concerned?

The general public sees warning signs. Those warning signs are most evident in the weakened competitive position of the United States in internation technology. You know the answer in more pointed terms—it lies precisely in the problems I enumerated at the outset. If we are challenged in science and technology now, we, as a nation, must be concerned for the future. We must recognize that while we are winning Fields Medals and Nobel Prizes now, we must also be concerned about winning them in 20 years. We must care for the infrastructure of our scientific community now in order to insure its integrity in the future.

If there is concern for the general state of science and mathematics, why, you may ask, is the Department of Defense and the U.S. Navy in particular so interested in these problems? Is this not the business of the National Science Foundation? If support for science and mathematics falters, is it not the business of the National Science Foundation to correct the deficiencies?

Part of the responsibility does fall to the National Science Foundation. The reason is simple. The U.S. Navy is technologically intensive and technology is driven by scientific progress. The health of the scientific enterprise now and twenty years from now guarantees the health of our technological innovation ten and thirty years from now. In turn, this guarantees the health of our naval services for the remaining decades of the 20th century, and those early decades of the 21st century.

Let me make it clear. Investment by the U.S. Navy in the basic sciences not only makes good economic sense, it is an absolute necessity. The demographics are simple. The post World War II baby boom generation is now in its late 20s and 30s. They are, on the whole, past

the age for entering the military service. The Navy has a choice of a low technology, manpower intensive force or a high-technology, manpower efficient force. The demographics, the national policy on conscription and, in fact, common sense all lead us to the choice of a high-technology force. The alternative is in reality not an alternative. The U.S. Navy is committed to fulfilling its mission via an efficient force whose superiority is guaranteed by strong technological innovation. The Office of Naval Research is therefore unequivocally committed to the health of American science, including mathematics.

This linkage of American science to the Navy is neither accidental nor is it new. The first systematic federal support of basic scientific research was provided by the Office of Naval Research in 1946. The Office of Naval Research was founded by an act of Congress in 1946 as a successor to the very successful office of research and inventions formed during World War II.

From 1946 until the founding of the National Science Foundation in 1951, the Office of Naval Research was the only federal agency supporting basic research in science and mathematics. Within the mathematical sciences, the Office of Naval Research sponsored an extremely broad range of pure and applied mathematics. Early ONR programs included support for abstract algebra, topology, real and complex analysis, geometry, applied mathematics and statistics. The early establishment of the Princeton topology group can be traced to funding by the Office of Naval Research. Similarly, much of the early funding for the Courant Institute at New York University originated with the Office of Naval Research. As a matter of fact, the Office of Naval Research still provides substantial funding to the Courant Institute. In the field of mathematical statistics, the early work in statistical quality control was supported by the Office of Naval Research. The military requirements in logistics lead to sponsorship of work on mathematical optimization including development of the simplex algorithm. Such topics as game theory trace their origin to the Office of Naval Research. The early development of the fast Fourier transform in the 1960s, originate with ONR. More recently, such innovations as systolic computing architecture and robust statistical methods have their roots in research sponsored by the Office of Naval Research.

Stated simply, the Office of Naval Research has a long-standing tradition of funding basic research in support of science and mathematics. It is a tradition of which we in the Navy are justly proud. With the increasing importance of the National Science Foundation, however, the focus of ONR activity shifted somewhat. Around 1970, emphasis was placed by Congress and the executive branch on mission relevance for the Department of Defense Agencies. For the mathematical sciences, emphasis at ONR was placed on supporting basic research in applied mathematics, statistics, operations research, computer science and fluid mechanics. I am, however, personally committed to the long-term support of a broad range of basic research. I believe that a fundamental, long-term commitment to basic academic science is the appropriate policy for ONR. I will describe in a few minutes some of the policies I have put in place. Before I do that, however, I would like to describe ONR a bit more.

The Office of Naval Research serves several basic functions for the Navy. As Chief of Naval Research, I have responsibility for all basic research activities in the Navy. This includes responsibility for basic research in the naval systems commands such as the naval sea system command, the naval air system command and the naval electronic system command, for basic research in the naval research laboratory and, of course, for basic research in the extramural contract research program. Thus my office has responsibility for allocating monies to all basic research claimants within the Navy community. I should, perhaps also mention that I have collateral duty as the Chief of Naval Development. In this role, I have responsibility for allocating the so-called exploratory development or category 6.2 monies. Exploratory development involves that stage of applied research and early engineering development arising from concepts developed from the basic research program. Basic research together with exploratory development, forms the so-called Navy technology base and together account for some $900 million per year. By tradition, exploratory development is carried out largely within the Naval laboratory system whereas the majority of basic research is contracted to academic institutions. In addition to the scientific research function the Office of Naval Research is a focal point for all patent and copyright activity for the Navy. Now you may suppose that leading a command full of esoteric scientists is exasperating enough for a navy commander, but imagine throwing in an equal number of lawyers, particularly those with concomitant degrees in engineering or science!

The Contract Research Program is our primary point of contact with the academic community. The program is headed by Dr. Fred Saalfeld and is administratively divided into four directorates; the life sciences, the engineering sciences, the environmental sciences and most importantly, at least for our purposes here today, the mathematical and physical sciences. This latter directorate, headed by Dr. Ted Berlincourt, contains four divisions; physics, chemistry, electronics and, the mathematical sciences. The latter is headed by Dr. Edward Wegman. Also of interest to some in the audience may be the computer sciences division found in the engineering sciences directorate. This division is headed by Dr. Paul Schneck.

The total Contract Research Program involves some $218 million with approximately $14 million allocated to the mathematical sciences extramural program. Most of these monies are made available to academic researchers through the competition of unsolicited proposals. An unsolicited proposal originates with the proposed principal investigator and represents an initiative on the part of the proposer in defining an area of research. Unsolicited proposals are evaluated by the ONR scientific merit, technical feasibility, potential relevance to the navy and overall availability of funds. An unsolicited proposal may be sent to ONR at anytime throughout the year. The federal fiscal year begins on the 1st of October and funding obligations must be made by the scientific officers by about mid-June of the subsequent year.

In addition to the opportunities represented by the unsolicited proposal competition, there are many others. Notable among these is the Selected Research Opportunities Program at ONR and the Defense University Research Instrumentation Program. The Selected Research Opportunities Program is a competitive program held on a biennial cycle beginning in odd fiscal years. In this program, the Office of Naval Research selects between four to six high priority naval research topics and invites proposals. The selected research opportunities program is intended to be interdisciplinary in nature and to stimulate interactions between academic scientists and researchers in the naval laboratory system. A successful selected research opportunities proposal is funded over a three year period at a level of from $200,000 to $500,000 per year. Thus the Selected Research Opportunities Program represents an opportunity for significant money to begin building an important research center. By its nature, it encourages the development of young investigators. Recent mathematically oriented Selected Research Opportunities Programs have included topics in non-Gaussian stochastic processes and mathematical inverse methods.

The Instrumentation Program is a response by the Department of Defense to the problem of obsolete research equipment in American universities. Some $30 million annually is being invested in reequipping the universities; $10 million each by the Army Research Office, the Air Force Office of Scientific Research and the Office of Naval Research. A joint announcement is made and proposals are received. The competition for FY 85 is already completed. The next competition will be held again in fiscal year 1986. Announcements for this cycle will appear in the late spring of 1985. Within the mathematical sciences division, the competition is held in much the same manner as the NSF scientific computing and research equipment for the mathematical sciences program except that the average award size in the DOD program is somewhat larger.

One last Program I would like to single out to this audience is the Navy Summer Faculty Research Program. In this program, academics are invited to work in one of the naval laboratories for the summer. This exposure to naval problems often offers an extermely valuable boost to a career by providing working relationships with naval scientists and by providing further access to the Office of Naval Research.

The programs I have just been describing are part of our normal research programs. Yet, as indicated by the recent national academy of sciences report, *Reviewing U. S. Mathematics*, the David Report, the situation in the mathematical sciences is not normal. I would like to spend a few minutes with you highlighting what I have done and will do as a response to the David Report. Indeed, I am pleased to say that ONR recognized many of the problems before they were codified by the David Report. Having anticipated what was announced on June 6th, we have already begun a revitalization program within ONR.

First and foremost, we must recognize that the scientific staff within ONR is a vital resource for making the case on behalf of the mathematical sciences. Half of the scientific officers within the mathematical sciences division have been there less than seven months. We have hired a vigorous, aggressive new management team for mathematics. We are, in fact, still recruiting to fill a position in probability theory. We believe that this new staff will continue to press the case for the mathematical sciences in ONR's internal competitive process long after the special considerations spawned by the David Report are history.

The David Report mentions four areas as particularly ripe for development: discrete mathematics, nonlinear mathematical methods, computational mathematics and probabilistic methods. I am pleased to say we have been working to establish or strengthen programs in all four areas. We have established a new core program in discrete mathematics in this fiscal year, 1985. I encourage any of you who are conducting research in this area to consider sending a proposal to Dr. Allen Schwenk of ONR's mathematics division. All aspects of discrete mathematics will be considered for funding. In addition, we are planning a special focus program in the area of discrete mathematics related to communication over networks to begin in fiscal year 1986. These areas would include random and topological graph theory, queueing theory on networks, theory for protocols and combinatorial design for coding.

In the area of nonlinear methods, ONR established a small core program in the autumn of 1983. It is planned to supplement this program with a special program on nonlinear dynamics again beginning in fiscal year 1986. This program will address all aspects of nonlinear dynamics, chaos, bifurcation and related topics. Again, I invite those of you working in these areas to consider

sending ONR a proposal to Dr. Mike Schlesinger of ONR's physics division.

We have had a program in numerical analysis and computational methods for some years now. Indeed, ONR began a program in large scale scientific computing in 1982. We believe that this area has been a successful one and are planning to expand its scope with an additional program in computational mathematics scheduled to begin in fiscal year 1987. We have also presently scheduled a special research program in parallel algorithms to begin in fiscal year 1986. Dr. Richard Lau of the Mathematical Sciences Division is the scientific officer for all to these program areas.

Finally, in the arena of probability theory, we are currently recruiting a scientific officer. Our plan is to begin a new core program in probability theory in fiscal year 1986. This program will cover all aspects of probability theory including stochastic process theory. Again, I invite your participation. You may send proposals in this area directly to Dr. Edward Wegman who is present here today and who heads our Mathematical Sciences Division.

Finally, I want to mention our selected research opportunities program on topological and graph theoretic methods in chemistry. This is a new selected research opportunities topic for fiscal year 1985 and is a very exciting one for us. We had an extraordinarily strong response to the announcement of this program. I am pleased to report that for the first time in nearly two decades, ONR is again supporting research in algebraic topology which we think is something of a landmark.

I have mentioned a large number of new programs. I do not want to leave you with the impression that our response to the David Report is simply the creation of new programs. We are also planning to add resources to existing programs. Plans call for an additional $500,000 to $700,000 in fiscal year 1985 and an additional $1,000,000 in fiscal year 1986 to be added to our Contract Research Program in mathematics. If ONR's growth in FY 85 is as large as presently programmed by the Navy, significant research will be added in FY 87. These monies will enhance existing programs in analysis and mathematical statistics. In addition, we are adding substantial resources to our mathematics programs in our naval systems commands and at the naval research laboratory. We do this because the health of mathematics within the naval research establishment is directly related to the health of mathematics in academia.

The fate of young people in the mathematical sciences was a major theme of the David Report. Emphasis on attracting them and encouraging their research careers is well placed. In fiscal year 1985, the current fiscal year, ONR has established mathematics as one of the priority topics in the ONR graduate fellowship program. These fellowships are very desirable since the stipend begins at $13,000 for the first year, going to $15,000 in the third year. The fellowhsip covers full tuition and fees and provides an additional $2,000 annually to the fellow's department. Fellowships are awarded for three years with satisfactory progress.

Earlier, I mentioned the ONR summer faculty programs as a means for encouraging investigators to get involved with our naval laboratories. This program is particularly well suited to helping young investigators become established. I have established the mathematical sciences as priority areas for this program. I am especially enthusiastic about this since the naval laboratories tend to be weaker in mathematics than in most other discipline areas. This will not only create opportunities for young people, but hopefully give the labs a much needed infusion of technical skills in mathematics.

A final new program I want to mention is still on the drawing boards, but will be in place soon. That is our Naval Young Investigators Program. The operational details have not yet been completed, but the program will be aimed at identifying outstanding young investigators early in their careers and giving them a boost. Again, this will be a program that has the mathematical sciences as a priority area.

I will conclude my remarks on ONR's response to the David Report by mentioning two administrative actions I have taken. Within the Navy, our accounting categories (really disciplines), called subelements, have over the years aggregated mathematics and computer science. This was reasonable when computer science was a fledging discipline. However, while the composite growth within the mathematics and computer science subelement has been healthy, the aggregation of these two disciplines has obscured the fact that growth in computer science has been accompanied by stagnation in mathematics funding. Thus, I have taken steps to disaggregate these funding categories so that we may track progress and growth in mathematics more clearly.

Finally, I recognize that ONR alone will not solve the problems within the mathematics sciences, nor will we do it this year. Recognizing that we are committed to an on-going process, I have established a special advisory panel on mathematics which will report to Dr. Marvin Moss, ONR's technical director, and to me. This distinguished panel of mathematicians will give expert advice at the policy level.

The actions I have just outlined represent a turning point, a new beginning. I am hopeful. I am looking forward to better things in our immediate future, not only for the mathematical sciences but for all of the scientific activities within the Office of Naval Research. We recognize the difficulties the mathematics community faces and the serious implications for national security

that these difficulties imply. ONR is determined to do its part in correcting these problems and personally, I pledge to work hard and long for this revitalization.

In return I ask for your assistance, for you as citizen-scholars play a vital role.

First, the mathematics and university communities can play a vital role in increasing congressional understanding of the ONR role. ONR funds basic academic research. This fact is not always understood in the halls of Congress. The simple fact is that budget cuts for ONR hurt academic research.

Second, the mathematics community must play a key role in describing the significance of results and trends in mathematics. Without public awareness of and enthusiasm for the vital role of mathematics in modern technology, it is difficult to muster financial support for the discipline.

Third, the mathematics community can help in packaging initiatives responsive to general naval interest. I have said that ONR supports basic research, but it should never be forgotten that ONR's client is the navy.

And finally, the mathematics community can offer advice. ONR prides itself on listening. We want your input for it is ultimately the vitality of the American scientific research community which must create and strengthen itself.

In one of my frequent discussions with my technical director, Dr. Marvin Moss, he expressed his concern over budget cuts in basic research and stated that the surest way for this country to mortgage its future is to not adequately fund academic research today. Realizing that I was to be here with you today, he also seriously added that the surest way for us to mortgage innovative technological programs in the future was for us to fail to adequately fund mathematics now. He really meant that. And I'm also convinced that he is right.

New Directions in Two-Year College Mathematics

The Curriculum and the New Technologies

Mathematics courses in two-year colleges should be of immediate use to students and not be seen merely as preparation for distant goals. The material should be connected to real life. Those parts of the subject of broadest usefulness in problem solving should be emphasized.

Computers and other elements of information technology are changing in fundamental ways both the mathematics that it is important to learn (such as discrete mathematics, statistics, and technical mathematics) and the ways that mathematics, traditional and otherwise, can be learned. This will have profound and continuing implications for students, faculty, and the curriculum.

Successful integration of information technology into the curriculum requires immediate access to computers; thus all mathematics faculty members must be provided by their institutions with appropriate computer equipment and support and with training opportunities in information technology and related mathematical subjects.

- Statistical literacy should be a fundamental goal of schooling. Basic mathematics courses should contain elementary statistical ideas and must prepare students for statistics as well as for calculus. Mathematics faculty members should be trained in statistics.
- Geometric concepts, including the use of computer graphics, should be integrated into entry-level courses wherever appropriate.

EDITOR'S NOTE: With financial support from the Alfred P. Sloan Foundation, the first national conference on the state of mathematics in two-year colleges was held at Menlo College in Atherton, California, in July 1984. At the conference twenty-two papers were presented and discussed. The main topics addressed by participants included the following: A case for curriculum change, technical mathematics, the influence of new technologies on the learning of mathematics, faculty renewal, and collaboration with secondary schools, colleges, and universities.

It is worth noting that fifty percent of all college freshmen in the United States are enrolled in two-year colleges, and that more than one-third of all undergraduate enrollments are in such institutions.

This report presents the recommendations from the conference; the proceedings of the meeting, *New directions in two-year college mathematics*, will be published by Springer-Verlag. LKD

- Entry-level courses for students who lack arithmetic skills should be organized around mathematical content new to these students (for example, vocational mathematics) and should utilize approaches different from what they may have experienced in school mathematics (for example, an approach emphasizing problem solving with calculators).
- Liberal arts mathematics (mathematics appreciation) is an important course and should integrate basic mathematical competencies including new technologies. These courses should be organized around the great ideas of mathematics and should offer a variety of topics for choice by instructors. Included in this choice should be topics from statistics, computing, and discrete mathematics.
- New mathematics curricula and approaches based on information technology (for example, spreadsheets, databases, and computer graphics) should be developed to serve the special vocational/technical and functional needs of the diverse two-year college student population.
- Planning should begin immediately to deal with the impact of symbolic manipulation software, graphics-based software, and the algorithmic point of view on the content of all mathematics courses.
- Two-year colleges must be prepared to meet the needs of entering students having a wide range of prior experience with computers.

Two-year colleges enroll nearly one-half of all college freshmen and share common concerns about mathematics students with secondary schools, colleges, and universities. The success of our students will be enhanced by collaboration including the following general activities: development of policies and methods for cooperation by the principal mathematics organizations concerned with teaching at these levels (American Mathematical Association of Two-Year Colleges, Mathematical Association of America, National Council of Teachers of Mathematics); joint efforts by state and local mathematics organizations and institutions; personal initiatives on a professional and social basis by individual faculty at all levels to promote a coherent and appropriate mathematics curriculum.

- *It is imperative to reduce the need for remediation in the colleges.* Two-year colleges along with other post-secondary institutions must work together with high schools to this end.

- Two-year college faculty members in mathematics and in vocational/technical areas should meet within their own institutions and at regional levels to form better working relationships and to improve the quality of mathematics courses for vocational/technical students.
- Training programs should be instituted for mathematics faculty members in order to increase skills in teaching technical mathematics. These programs will require collaboration and support by the private sector, two-year colleges, foundations, and professional organizations.
- High schools, four-year colleges and universities, and two-year colleges should establish faculty exchange programs for mutual benefit.

Faculty Development and Renewal

Faculty development and renewal are essential in maintaining the vigor of instruction and the quality of the curriculum. Faculty members must commit themselves to continued and on-going professional growth and development. Thus, the educational community, industry, government, and foundations should provide adequate funding to ensure continued and frequent opportunities for faculty development. Professional organizations should provide a variety of activities and assistance for faculty growth. College administrators should encourage, support, acknowledge, and reward renewal efforts by faculty members.

- Faculty members must foster their own continued growth. Two-year colleges should view these efforts of faculty members as essential and support them financially. Such growth activities include regularly teaching a variety of courses, reading, writing papers, participating in seminars and in professional organizations, and learning new material through workshops and courses.
- Two-year colleges and their supporting bodies should view employment compensation and status more flexibly in order to encourage and reward professional excellence.
- The private sector and two-year colleges should facilitate faculty participation in industry, including short-term work experiences, as a valuable form of development.
- Universities should provide graduate programs appropriate for two-year college mathematics faculty members.

Conference Participants

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Menlo College, Atherton, California

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Tallahassee Community College
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GEOFFREY AKST of the Borough of Manhattan Community College prepared a paper for the conference but was unable to attend due to illness. JEROME A. GOLDSTEIN, Tulane University, co-authored one of the conference papers.

Second Report

A first report of the 1984 Survey appeared in the November 1984 *Notices*, pages 744–756. It included a report of the survey of faculty salaries, a first report of the survey of new 1983-1984 doctorates, and a list of the names and thesis titles of the 1983-1984 doctorates included in the Survey. This second report includes an update of the fall 1984 employment status of new doctorates, an analysis of faculty mobility, and a report on fall 1984 enrollments and class sizes.

The 28th Annual AMS Survey was made under the direction of the Society's Committee on Employment and Educational Policy (CEEP), whose members in 1984 were Lida K. Barrett, Stefan A. Burr, Lisl Novak Gaal, Gerald J. Janusz, Irwin Kra and Donald C. Rung (chairman). A Data Subcommittee of CEEP, consisting of Lida K. Barrett, Susan J. Devlin, Lincoln K. Durst, Wendell H. Fleming, Arthur P. Mattuck and Donald C. Rung (chairman), designed the questionnaires with which the data were collected. The committee is grateful to members of the AMS staff, especially Marcia C. Almeida, for the diligence and efficiency with which the data were collected and compiled. Comments or suggestions regarding this program may be directed to the subcommittee.

Employment of Mathematical Sciences Doctorates, Faculty Mobility, Nonacademic Employment and Enrollments, Fall 1984

by Donald C. Rung

This report is one in a series of annual reports on employment patterns, enrollment and class size in the mathematical sciences. It begins with an update of the fall 1984 employment status of new 1983-1984 doctorates, followed by an analysis of trends in the academic job market based upon the 1984 AMS Survey of Faculty Mobility. It also contains estimates on the total enrollment in courses for fall 1983 and fall 1984 as well as average class size for both fall 1983 and fall 1984. Also included are estimates for the number of majors at the junior and senior level and graduate student enrollment.

Estimates based on AMS Survey data suggest that 910 full-time positions in U.S. colleges and universities were filled by nondoctorates last fall and for 522 of these positions, the department would have preferred someone with a doctorate. Of these positions, 471 were in Groups M and B departments. (See the box for descriptions of the groups.) The estimated total increase for this year in the size of the full-time faculty (682) is the largest in recent years, as is the 134 increase in doctorate faculty for Groups I, II and III (Table 3). This is the largest increase in over eight years. The net increase in the nondoctorate faculty (259) is positive for the fifth consecutive year, after nine consecutive years of decline.

The enrollment data (Table 6) yields several interesting comparisons. Total enrollment showed no increase for the first time in memory, certainly for the first time in these surveys. Given the downturn in total collegiate enrollment caused by demographics, it seems likely that mathematics enrollment will show modest declines over the next decade. Not surprisingly, average class size (Table 7) also declined in most categories. However,

Groups I and **II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.[1]

Group I is composed of 39 departments with scores in the 3.0–5.0 range.

Group II is composed of 43 departments with scores in the 2.0–2.9 range.

Group III contains the remaining U.S. departments reporting a doctoral program.

Group IV contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

Group V contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

Group VI contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

Group M contains U.S. departments granting a master's degree as the highest graduate degree.

Group B contains U.S. departments granting a baccalaureate degree only.

Response rates varied from one group to another, with the largest response rate from Groups I, II, and III. Of an estimated total in 1983 of 18,527 full-time U.S. mathematical sciences faculty members, 9,425 are members of departments which responded to the survey.

[1]These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of the *Notices*, pages 257–267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392–393.

junior-senior mathematics majors and graduate students continued to show impressive increases (Table 8).

Special note should be taken of the decline in computer science enrollments in Groups M and B. This decline is also reflected in a joint study of the Cooperative Institutional Research Program at UCLA and the American Council on Education, reported in the *Chronicle of Higher Education*, January 16, 1985, which showed a two-year decline in Freshmen interested in careers as computer programmers or analysts. A small fraction of the decline is a result of a reporting change: recently some colleges and universities have established separate departments of computer science. Some of these new computer science departments are not included in this year's survey report. However, an analysis shows that this fact did not account for very much of the reported decline.

Part-time members of the faculty continue to play a significant role in undergraduate instruction in departments in Groups M and B where there are an estimated 5,497 part-time faculty members as compared with 12,700 full-time faculty members. In contrast there are 904 part-time faculty members in Groups I, II, III where there are 5,757 full-time faculty members.

The number of graduate students increased by 9% in Groups I, II and III, as compared to last year's increase of 8% (Table 8). The percentage of new doctorates taking nonacademic employment continued at the same 22% figure as in 1983 (Table 4). There was a large increase in the net outflow of doctorate-holding faculty members (125) to nonacademic employment (Table 5).

Fall 1984 Employment Status of 1983-1984 New Doctorates

Table 1 contains the fall 1984 employment status by type of employer and field of degree for 789 new mathematical sciences doctorates who received the degree between July 1, 1983, and June 30, 1984. The names of these 789 people and the titles of their doctoral theses were published in the November 1984 *Notices*, pages 757–770. Table 1 updates the corresponding table on page 755 of the November 1984 *Notices*, using more recent information provided by departments and the recipients of the degrees. The total does not include a few more recipients of doctorates who were reported too late to gather employment information for these reports. (A supplementary list of recipients appears in this issue of the *Notices*.)

TABLE 1: 1984–1985 Employment Status of New Doctorates in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS: Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
Group I	22	23	15	3	1	2		1	6		2	75
Group II	7	10	7	2		3	1		9		1	40
Group III	4	5	6		4	8		2	5	1	4	39
Group IV		1				19					1	21
Group V			1	1		2		6	7			17
Masters	18	15	10	3	3	19	4	6	14		9	101
Bachelors	21	11	14	2	1	8		1	8		8	74
Two-year College or High School		2	1		1	2				1		7
Other Academic Departments	1	4	1	1	1	19	2	23	5	1	16	74
Research Institutes		2	4	1		2	1	1	8		3	22
Government	1				1	12	1	4	3		1	23
Business and Industry	9	6	5	1	3	35	8	11	14		19	111
Canada, Academic	4	1	4	2		8	1	4	2			26
Canada, Nonacademic									1			1
Foreign, Academic	14	16	8		2	20		5	13		10	88
Foreign, Nonacademic	6	3	1	2	2	10	1	2	7		4	38
Not seeking employ.		1							3		1	5
Not yet employed	3		2	1		4	1		3		2	16
Unknown	1	2	1	2					2		3	11
Total	111	102	80	21	19	173	20	66	110	3	84	789

The first five rows in Table 1 refer to those 1983-1984 new doctorates employed by doctorate-granting departments in the U.S. The next two rows refer to those employed by U.S. mathematical sciences departments which grant masters and bachelors degrees only. Again there seem to be good job prospects for new doctorates in departments in Groups M and B. It should be noted that the survey of enrollments shows that in Groups M and B computer science and statistics enrollments are plentiful. Mathematicians prepared to teach these courses will find no lack of opportunity to do so at those schools.

The numbers in Tables 2, 3, 5, 6 and 8 were obtained by extrapolation from the AMS Survey and are not actual counts. The various totals from each Group were multiplied by the ratio of the size of the faculty in various groups (obtained by adjusting the figures in the 1980 CBMS report or using actual counts in Group VI) to the number of faculty members represented in the responding departments.

Continuing the policy enunciated in the first report of the 1983 Survey, the survey no longer contains data from departments of computer science. The limited response from these departments made reliable estimates difficult. For the second year, returns from Group V departments were too small to be included. This survey, then, is an analysis of what might be called the traditional mathematics and statistics community. Because the response rate in the remaining groups continues at a high level, this year's survey gives a fairly accurate picture of faculty mobility, enrollments etc. within this community. It should be noted that while departments of computer science are not included in the survey many departments of mathematics in Groups M and B teach the computer science courses whose enrollment (281,000) is at least 60% of all computer science enrollments in the U.S.

Faculty Mobility

This part of the Annual AMS Survey is concerned with the number of faculty members newly hired from various sources, as well as with the number of those individuals leaving faculty positions and with information on their subsequent employment status. The Survey also monitors trends in the percentage of faculty members with tenure, and the percentage of faculty members with doctoral degrees. The number of departments in each of Groups I, II, III, IV, M and B responding to the 1984 Survey of Faculty Mobility is similar to that of previous years. The responding departments represent about half (51%) of all mathematical sciences faculty members. About 70% of the faculty members in doctorate-granting mathematics departments (Groups I-III) are included among responding departments.

TABLE 2: Faculty Flow 1983–1984 To 1984–1985

Full-Time Mathematical Sciences Faculty in Four-Year Colleges and Universities in the U.S.

	Sources of New Faculty		Fall 1984 Employment Status, Faculty Leaving		
FROM	Doctorate-Holding	Nondoctorate	TO	Doctorate-Holding	Nondoctorate
Graduate School	452	347	Two-year college or high school	3	66
Another college or university position	637	208	Another college or university position	514	155
Nonacademic employment	66	83	Nonacademic employment	170	104
Outside U.S.	115	23	Deaths and retirements	133	89
			Position outside U.S.	48	7
			Graduate or professional school	27	93
			Seeking employment	14	35
Other sources (1)	66	249	Other (3)	43	63
Total	1336	910	Total	952	612
Received doctorate and not moving (2)	(+39)		Received doctorate and not moving		(+39)
	1375				651

Estimated size of full-time U.S. mathematical sciences faculty, Fall 1984

Doctorate-holding	14,535	(+423 from Fall 1983)
Nondoctorate	4,674	(+259 from Fall 1983)
	19,209	(+682 from Fall 1983)

(1) Part-time to full-time in same department, from postdoctoral or two-year college position, etc.
(2) Mostly in Group M and B departments.
(3) No longer full-time in department, unknown employment status, etc.

Table 2 shows estimated faculty flow between 1983-1984 and 1984-1985 for U.S. departments. Further analyses for Groups I–III are given in Table 3. The left side of Table 2 shows the estimated numbers of new full-time faculty members hired from various sources between fall 1983 and fall 1984. The right side of Table 2 shows the fall 1984 employment status of those full-time faculty members (as of fall 1983) who permanently left their departments by fall 1984. The row "graduate school" on the left side includes new faculty members coming from departments outside the mathematical sciences, or from mathematics education. Similarly, the second row in Table 2 includes some moving to or from departments in other fields or other positions in academia (e.g., in a university computer or statistical laboratory). The number (+39) in parentheses represents a change from nondoctorate to doctorate status of individuals who remained as full-time faculty members in the same department.

Table 2 shows an estimated increase, between fall 1983 and fall 1984, of 422 in the size of the doctorate-holding faculty and an increase of 259 in the nondoctorate faculty, for an overall increase of 681, as compared to last year's increase of 672.

The pattern of faculty mobility obtained by comparing the two sides of Table 2 continues somewhat the trend of last year. Many full-time nondoctorate faculty members are being hired. The figure of 910 shown in Table 2 corresponds to the estimate of 435 seven years ago (February 1978 *Notices*, page 101). Most (92%) of the new nondoctorate faculty members were hired by departments in Groups M and B.

Attrition due to deaths and retirements is about (1.2%) of the total faculty. This figure seems to hover about the 1% level. The number of faculty members who received tenure in their institutions is 453, up from last year's total of 418.

Doctorate-granting Departments of Mathematics (Groups I, II, III). Table 3 gives a somewhat different perspective of faculty mobility in and out of the 155 U.S. departments with doctoral programs. In Table 3 the sources of new tenured and nontenured doctorate-holding faculty members are shown, as well as the employment status of those leaving between academic years 1983-1984 and 1984-1985. The increase of 134 doctorate faculty is one of the largest in recent years.

Group VI. The number of faculty in Canadian doctorate-granting universities (Group VI) increased from 896 in fall 1983 to 953 in fall 1984; with ten receiving tenure.

Groups M and B. The number of nondoctorate faculty members hired by Groups M and B departments had been steadily increasing, from about 350 newly hired for fall 1977 to 734 for fall 1982; there was a slight decrease to 674 for fall 1983, and a large increase to 834 for fall 1984.

TABLE 3: Faculty Flow 1983–1984 To 1984–1985

Full-Time Doctorate-Holding Faculty in 155 Doctorate-Granting Mathematics Departments in the U.S.

(Groups I, II, III)

	Sources of New Faculty		Fall 1984 Employment Status, Faculty Leaving		
FROM	Nontenured	Tenured	TO	Nontenured	Tenured
Graduate School	179	0	Doctorate-granting departments	97	33
Another college or university position	146	33	Other college or university position	41	10
Nonacademic employment	9	1	Nonacademic employment	21	19
Outside U.S.	48	7	Deaths and retirements	1	44
Other sources	14	—	Position outside U.S.	21	
			Seeking employment	3	6
			Other	14	
Total	396	41	Total	198	112
Received doctorate and not moving	(+7)				
Received tenure and not moving		(+125)	Received tenure and and not moving	(+125)	
	403	166		323	112

Estimated size of full-time faculty, Fall 1984 Groups I--III

Doctorate, Nontenured	1,378	(+80 from Fall 1983)
Doctorate, Tenured	3,986	(+54 from Fall 1983)
Nondoctorate faculty	393	(+3 from Fall 1983)
Total full-time faculty	5,757	(+137 from Fall 1983)

The M and B departments are very diverse, ranging from medium-to-large departments in public institutions to quite small departments in private colleges of varying degrees of selectivity. Besides mathematics instruction, mathematics departments in Groups M and B often have responsibilities in applied areas which in larger universities are taken by separate departments of statistics, operations research or computer science. As mentioned earlier, there are opportunities for young mathematicians with a strong commitment to teaching who fit the needs of Groups M or B departments.

Nonacademic Employment of Doctorates in the Mathematical Sciences

Table 4 is a summary of AMS Survey data on the employment of new doctorates during the last six years 1978-1979 to 1983-1984.

TABLE 4: New Mathematical Sciences Doctorates Taking Nonacademic Positions in U.S.

	1978 -79	1979 -80	1980 -81	1981 -82	1982 -83	1983 -84
In government	34	37	28	22	24	23
In business/industry	168	165	169	141	105	110
Total	202	202	197	163	129	133
Total new doctorates employed in U.S.	690	691	732	659	583	597
% in govt./bus./ind.	29%	29%	27%	25%	22%	22%

Table 4 shows a levelling in the hiring of new doctorates by business and industry. Many of these jobs are in companies in high technology, computer-information processing, or communications areas. A significant number are with organizations which do consulting work in operations research, statistics or applied physics, or which provide computer software or data management services. The November 1980 issue of *Employment Information in the Mathematical Sciences* contains lists of the names and addresses of nonacademic employers of the individuals included in Table 1 on page 608 of the November 1980 *Notices*, with an indication of the thesis field of the employee. Also see a related article by David H. Bailey in the November 1983 *Notices*, pages 756–758. (*Errata*—In the Bailey article, there are two errors. An employer's name is misspelled. The last entry under Massachusetts should be: Verbex (5) 2 Oak Park, Bedford, MA 01730. Also, there is an incorrect address. The second entry under Virginia should be: Center for Naval Analyses (35) 2000 North Beauregard, Alexandria, VA 22311.)

TABLE 5: Estimated Net Outflow of Doctorate-Holding Faculty Members To Nonacademic Employment

	1979	1980	1981	1982	1983	1984
Net outflow	165	168	116	94	46	125

Table 5 shows the estimated annual net outflow of doctorate-holding faculty members to nonacademic positions since 1979. The number 125 for 1984 is the difference between 170 doctorates shown in Table 2 leaving academia and 66 hired in academia from nonacademic positions: the 1984 number is again comparable to earlier figures after a low last year of 46.

In summary, the 1984 AMS Survey showed an increase of 423 in the number of doctorate-holding faculty members in U.S. colleges and universities and a corresponding increase of 259 in nondoctorate faculty members. Most new doctorates (70%) found employment in academic positions, while 22% took positions in government or industry in the U.S. These are the identical figures as given in last year's survey. There are very few unemployed Ph.D.'s in mathematics at

TABLE 6: Total Course Enrollments (in Thousands)

(Percent increase from fall 1983 in parentheses)

By Type of Course, Fall 1984

Type of Course	Groups I, II, III	Groups IV	Groups VI	Groups M, B	All Groups
Below calculus	286 (0%)	3.4 (4%)	*	612 (1%)	
First year calculus	228 (-2%)	*	30.3 (-11%)	262 (-2%)	
Statistics	*	43.6 (6%)	12.9 (-6%)	118 (8%)	
Computer Science	*	*	*	281 (-4%)	
Other undergraduate mathematics courses	175 (1%)	*	47.0 (-7%)	207 (3%)	
Graduate courses	24.5 (4%)	13.4 (+6%)	1.01 (-16%)	24.5 (7%)	
All courses	763 (0%)	62.1 (5%)	94.1 (-9%)	1505 (0%)	2424 (0%) Total

*Enrollments in this type of course amount to less than 5% of total undergraduate enrollments for this group of departments.

TABLE 7: Average Class Size in Fall 1984
(Average class size as reported in Fall 1983 survey in parentheses)

Type of Course	Groups						
	I	II	III	IV	VI	M	B
Below calculus	34(38)	41(46)	44(48)	34(--)	--(--)	38(40)	30(32)
First year calculus	38(35)	39(43)	44(43)	--(--)	84(96)	35(36)	28(29)
Statistics	—(--)	--(--)	38(--)	46(44)	57(54)	37(35)	30(30)
Computer Science	—(--)	--(--)	29(--)	--(--)	--(--)	29(33)	26(29)
Other undergraduate mathematics courses	31(33)	33(35)	35(34)	--(--)	52(52)	27(26)	18(18)
Graduate courses	11(11)	11(10)	9(9)	17(13)	6(6)	11(11)	12(13)
All courses	32(34)	36(39)	37(39)	33(32)	55(57)	32(33)	26(28)

A dash indicates that these courses represent less than 5% of total undergraduate enrollment for departments in this category.

TABLE 8: Junior-Senior Majors and Graduate Enrollment
(Percent increase over fall 1983 enrollment in parentheses)

	Fall 1984			
	Groups			
	I, II, III	IV	VI	M, B
Total junior-senior majors in department	18,600 (6%)	712 (23%)	4245 (11%)	68,430 (10%)
Total full-time graduate students (including teaching assistants)	7,797 (9%)	1,935 (-5%)	804 (6%)	4,693 (10%)
Total full-time first year graduate students (including teaching assistants)	2,595 (10%)	553 (-11%)	277 (-14%)	2,218 (10%)

any level and there seems to be a shortage of new doctorate faculty members at schools in Groups M and B.

Changes in Enrollments and Class Size

For the second year total enrollments have been estimated. Table 6 gives these figures.

Table 7 gives class sizes for mathematical sciences departments for Fall 1983 and Fall 1984.

Junior-Senior Major and Graduate Student Enrollments. Another set of data is given in Table 8, where total enrollment of junior-senior majors and graduate students is presented. Doctorate-granting mathematics departments in the U.S. (Groups I, II, III) reported a 9% increase in the number of full-time graduate students from fall 1983 to fall 1984. Further, the number of entering full-time first-year graduate students in Groups I, II, III increased by 10%.

This was the fourth year of such increases. Junior-senior majors also showed a good increase in all categories.

By way of a postscript the author welcomes any comments or suggestions on the format, data presented, etc. of these annual reports, as well as the various ad hoc reports of CEEP. Please send your remarks to Donald Rung, Department of Mathematics, 203 McAllister Building, Pennsylvania State University, University Park, Pennsylvania 16802.

Doctorates Conferred in 1983–1984 (Supplementary List)

The following list supplements the list of thesis titles published in the November 1984 issue of the *Notices* (see page 757 for an explanation of the numbers in parentheses).

CALIFORNIA

University of California, Berkeley
(1;1,0,0,0,0,0,0)

MATHEMATICS

Aitchison, Iain Roderick, *Isotoring and twisting knots and ribbons.*

MARYLAND

Johns Hopkins University
(8;2,6,0,0,0,0,0)

BIOSTATISTICS

Burt, Vicki Lynn, *Variance estimation for a stratified multistage sample in the analysis of the health care experience of primary individuals.*

Diener, Marie Diane, *Reaction time models-a mixed model and bayesian approach.*

Dorfman, Alan Harvey, *T-robust variance estimation in least squares linear regression.*

Friedman, Lisa Aronson, *Alcohol consumption and CHD mortality in the Framingham study.*

Ross, Eric Andrew, *Changes in obstetrical practices and infant mortality. New York State.*

Salvo, Edward Lawrence, *A statistical description of nutrient flux rates of the Patuxent River of Maryland.*

Valliant, Richard, *Estimation of Bernoulli totals in a finite population.*

Yates, Katherine Parker, *The design of occupational studies to assess the effects of low level exposure to ionizing radiation.*

MASSACHUSETTS

Harvard University
(4;0,4,0,0,0,0,0)

STATISTICS

Donoho, David L., *A tool for research in data analysis.*

Goodall, Colin R., *The statistical analysis of growth in two dimensions.*

Jonas, Andrew B., *Persistent memory random processes.*

Singer, Judith Donna, *An intraclass model for the effects of group composition on individual outcomes.*

OHIO

Case Western Reserve University
(2;0,1,0,0,1,0,0)

MATHEMATICS AND STATISTICS

Akbarzadeh-Yazdi, Abolfazl, *Optimal attribute life testing.*

Ammar, Gregory Steven, *Riccati equations and the numerical matrix eigenvalue methods.*

TENNESSEE

Memphis State University
(4;1,3,0,0,0,0,0)

MATHEMATICAL SCIENCES

Gastardo, Maria T., *A stochastic model for carcinogenesis with special applications to the initiation and promotion phenomena.*

Gubbi, Ananda V., *A class of projective topological spaces.*

Tabatabai, Mohammad A., *Robust procedures for comparing several means and testing for parallelism of several straight lines under heteroscendasticity and nonnormality.*

Tou, Kung-Pau, *Statistical analysis of some mutation models useful in testing carcinogenesis and mutagenesis.*

TEXAS

Texas Tech University
(2;0,1,0,0,1,0,0)

MATHEMATICS

Ford, Ceicle Henry, *Numerical and symbolic methods for transforming control systems to canonical form.*

Scariano, Stephen, *Regression analysis with correlated observations.*

WISCONSIN

University of Wisconsin, Madison
(11;0,11,0,0,0,0,0)

STATISTICS

Atilgan, Taskin, *Parameter parsimony, model selection, and smooth density estimation.*

Chen, Shu-Mei, *On some inference problems concerning life test experiments under type I or hybrid censoring.*

Faraggi, David, *Spatial patterns in field trials.*

Little, James Kevin, *Analysis of the scale-contaminated normal model: diagnostics and robustness.*

Muhly, Alan E., *Some aspects of tests of fit.*

Nychka, Douglas, *The solution of Abel-type integral equations and their application in stereology.*

O'Suilleabhain, Sean F., *The analysis of some penalized likelihood estimation schemes.*

Raubertas, Richard F., *A location test for normal means when alternatives are restricted by linear inequalities.*

Velu, Rajabather P., *Topics in reduced rank regression.*

Villalobos, Miguel A., *Estimation of posterior probabilities using multivariate smoothing splines and generalized cross-validation.*

Whitney, Paul, *Nonparametric regression.*

CANADA

University of British Columbia
(1;1,0,0,0,0,0,0)

MATHEMATICS

Salisbury, Thomas S., *Construction of strong Markov processes through excursions, and a related Martin boundary.*

University of Toronto
(5;3,0,0,0,1,0,1)

MATHEMATICS

Chalmers, Bruce A., *Optimisation and approximation problems arising from continuous translocation.*

Franek, Frantisek, *Some results about saturated ideals and about isomorphism of x-trees.*

Gagnon, Rene, *Path integrals and scattering theory in non-relativistic stochastic quantum mechanics.*

Kimura, Kyoko, *Kernels for the $\bar{\partial}$-Neumann problem on the unit ball.*

Severn, Edward Anthony, *Maximal partial Steiner triple systems.*

The 1984 AMS Nonacademic Salary Survey

by Arthur Mattuck

The AMS conducted salary surveys in 1977 and 1980 of mathematicians with full-time nonacademic employment. The survey, somewhat modified, was repeated last year, with the data taken as of June 1, 1984. The results are summarized in the tables following.

How the survey was conducted. The questionnaire shown was sent to 2,000 persons randomly selected from the geographic listings at the end of the *Combined Membership List*, after those affiliated with academic institutions were eliminated. Thus it represents members of the AMS, MAA and SIAM; it does not really sample statisticians or computer scientists, who tend to belong to other professional organizations.

People were asked to respond only if they had full-time nonacademic professional emloyment in the United States. We hope they interpreted professional as meaning mathematics-related in some way, perhaps entirely in a supervisory role. About one-third—682 in all—responded.

In most surveys this would not be considered a high enough response rate to avoid bias. Here however it is hard to say, since the non-responders could be in large part retired and part-time mathematicians, academics who prefer to use their home address in the *Combined Membership List*, or MAA members who retain an avocational interest in mathematics even though they are now doing other things professionally.

People were asked to indicate their employer, and this has been suggested as a possible source of bias. At an agency or company employing very few female mathematicians, for example, these might be identifiable by their questionnaire responses. This possible loss of confidentiality may have produced a lower response rate, even though assurances were offered in the questionnaire. In the future, the employer's name will not be asked.

Profile of the respondents. The two earlier surveys concentrated on Ph.D. mathematicians. The present one includes a sampling of those whose highest degree is a master's or bachelor's degree. Since they belong to one of the three societies, they are not entirely typical of the general lower-degree-holding population; as a group we think they are likely to have higher salaries.

The following charts and tables give some picture of the respondents.

Type of Employer	**Sex**
Industry 66%	Male 87%
Government 19%	Female 13%
Federal Contract Research Center 13%	
Highest Degree	**Type of Position**
Bachelors 11%	Managerial 46%
Masters 29%	Non-managerial 54%
Ph.D. 59%	

Comments about the tables. The vertical bars in each table run between the first and third quartiles. The median salary is marked.

Below each table is noted the number of respondents in each category, to give some feel for the validity of the data.

In Table 1, "Federal Contract Research Center" refers to places like Los Alamos that receive essentially all of their funding from the federal government but are not run directly by the government. Thus their employees are not under the Civil Service salary schedules.

In Table 3, "manager" refers to those who answered "yes" to question 3: "do you have managerial responsibilities ...?"

Tables similar to the three shown, but based upon actual years of experience since the highest degree, turn out to be not significantly different from the ones given.

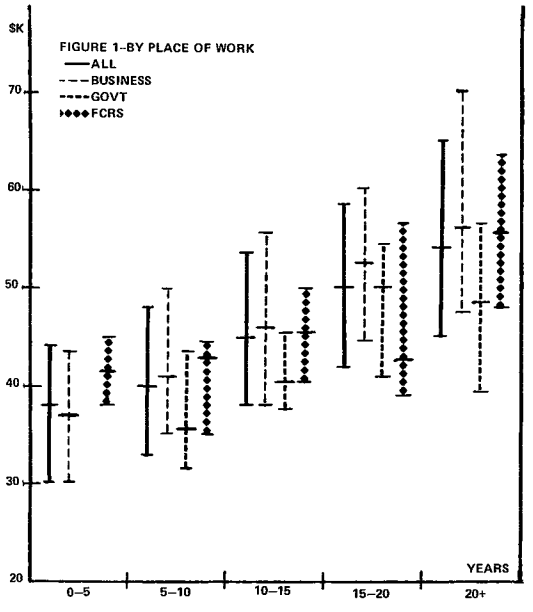
American Mathematical Society, P.O. Box 6248, Providence, RI 02940

NONACADEMIC SALARY QUESTIONNAIRE

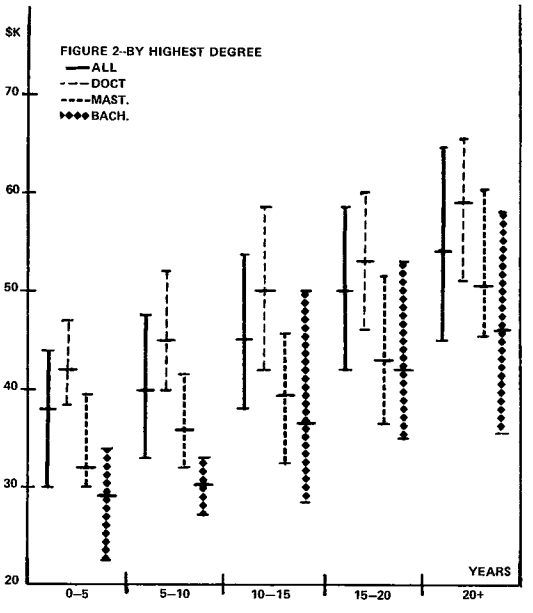
This questionnaire is addressed to individuals who have a degree in the mathematical sciences, who have full-time nonacademic professional employment in the U.S. If you are not in this category, please do not return this questionnaire.

Answers to the questions will be kept confidential. Published summaries will not permit identification of individuals or employers. The information furnished should be as of June 1, 1984.

1. Employer _____ City _____ State _____ Zip _____
2. Type of employer:
   ☐ Business or industry ☐ Government ☐ Federal contract research centers ☐ Other (Describe): _____
3. Do you have management responsibilities – that is, are you a supervisor, group leader, section head, etc.?
   ☐ Yes ☐ No
4. ☐ Female ☐ Male 5. Annual professional income: $ _____
6. Highest degree: ☐ Bachelor's ☐ Master's ☐ Doctorate 7. Number of years since receipt of highest degree ___
8. Number of years of full-time-equivalent professional experience since receipt of highest degree _____
9. Primary field of graduate study (if applicable):
   ☐ Pure mathematics ☐ Probability and statistics ☐ Operations research
   ☐ Computer Science ☐ Other applied mathematics ☐ Other (Describe): _____
10. How do you spend your time at work? (Total should equal 100%)
    ___% Supervising others or administration ___% Applied research ___% Computer programming
    ___% Consulting or problem solving ___% Basic research ___% Other (Describe): _____



All	100	171	66	103	138
B	87	117	107	64	80
G	3	32	32	27	36
F	10	19	26	10	20



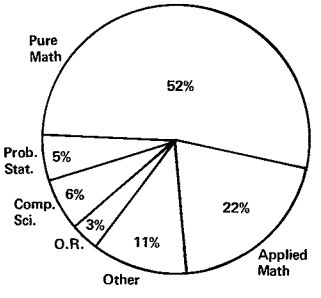
All	100	171	166	103	138
D	47	95	95	66	67
M	39	52	60	27	43
B	13	24	10	10	28

third quartile
median
first quartile

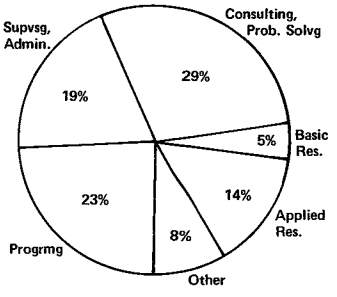
Years means years since the highest degree.
Salary is in thousands of dollars.
Number of respondents is shown beneath the graph.

third quartile
median
first quartile

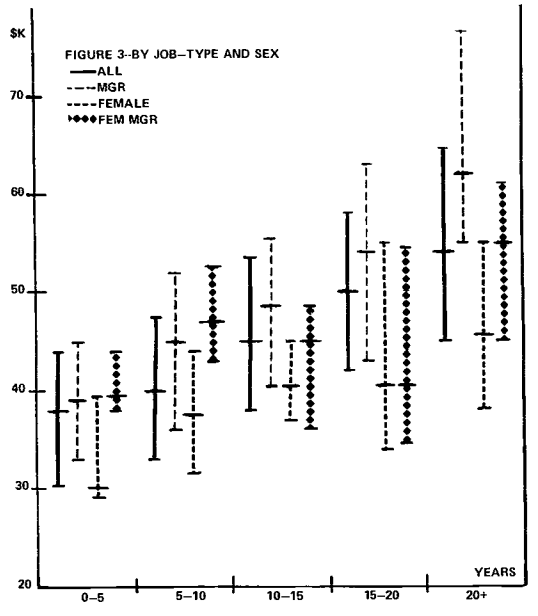
Years means years since the highest degree.
Salary is in thousands of dollars.
Number of respondents is shown beneath the graph.



PRIMARY FIELD OF GRADUATE STUDY



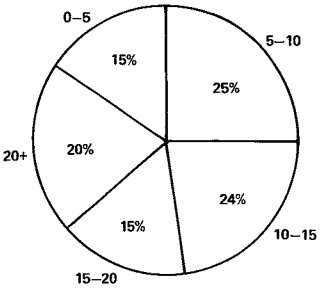
ACTIVITY AT WORK TAKING MOST TIME



All	100	171	166	103	138
Mgr.	35	62	92	57	61
F	20	30	21	10	10
F-M	6	10	10	8	5

third quartile
median
first quartile

Years means years since the highest degree.
Salary is in thousands of dollars.
Number of respondents is shown beneath the graph.

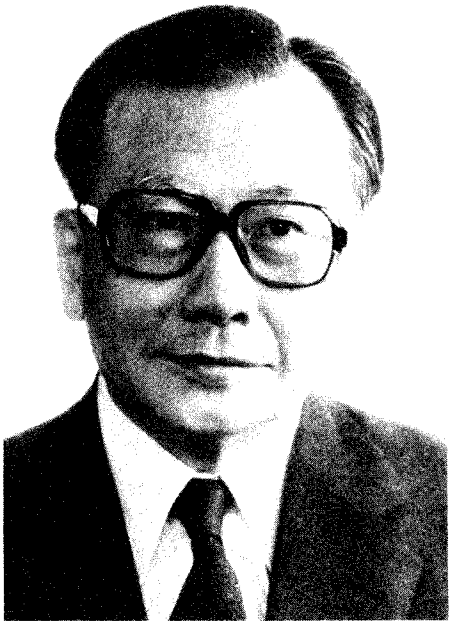


YEARS SINCE
HIGHEST DEGREE

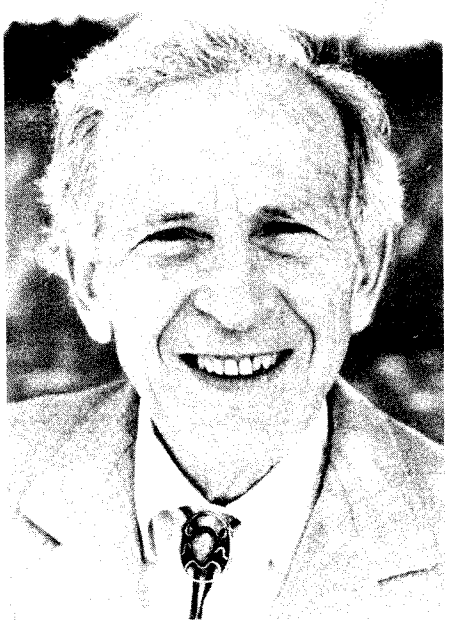
Kodaira and Lewy Awarded Wolf Prize

The Wolf Foundation has announced that the 1984–1985 prize in mathematics is to be shared by Kunihiko Kodaira of the Japan Academy, and Hans Lewy of the University of California at Berkeley. The prize for mathematics is $100,000.

Kunihiko Kodaira is being honored for his outstanding contributions to the study of complex manifolds and algebraic varieties. His study of harmonic integrals has incisive applications to algebraic and complex geometry. These include the projective imbedding theorem, deformations of complex structures (with D. C. Spencer), and the classification of complex analytic surfaces. Kodaira received his Ph.D. from the University of Tokyo, has been a member of the Institute for Advanced Study at Princeton, and has taught at Princeton University, Harvard University, Johns Hopkins University, Stanford University, the University of Tokyo and Gakushuin University.



Hans Lewy is being awarded this prize for initiating many developments, now classic and essential, in partial differential equations. His early work with Courant and Friedrichs heralded the development of numerical methods for solving partial differential equations. He produced the famous example of a smooth linear partial differential equation having no solution. His other contributions include the study of the Monge-Ampere equation, work in fluid dynamics and the theory of cavities, and an early study of variational inequalities. Lewy was awarded a Ph.D. from Gottingen University, Germany, and began his American career at Brown University. He has since taught at Harvard University, Stanford University, New York University, in Italy and China, and at the University of California, Berkeley, where he is currently Professor Emeritus.



Previous recipients of these awards were: I. M. Gel'fand and Carl L. Siegel (1978), Jean Leray and André Weil (1979), Henri Cartan and Andrei N. Kolmogorov (1980), Lars V. Ahlfors and Oscar Zariski (1981), Hassler Whitney and Mark Grigor'evich Krein (1982), Shiing Shen Chern and Paul Erdös (1983).

Freedman Named MacArthur Fellow

Twenty-five new grants have been awarded by the MacArthur Fellows Program of the John D. and Catherine T. MacArthur Foundation. Among the recipients is Michael Freedman, professor of mathematics at the University of California, San Diego.

The MacArthur Fellows Program endeavors to promote creativity by relieving creative scholars and artists from financial constraints. Ranging from $128,000 to $300,000, depending on the age of the Fellow, grants are allotted over a five year period. In addition, the Foundation offers a comprehensive health insurance plan and the

possibility for a further grant of $15,000 to the university or institution with which the Fellow is associated. No performance standards or follow-up reports are involved in this program; recipients have the freedom to range within their subject areas, or to experiment with different fields.

There are no applications for MacArthur grants. Instead, nominees are chosen by specifically designated nominators, who refer their choices to a fifteen member selection committee. Nominees are not informed that they are being considered for selection. With the addition of these twenty-five new Fellows, the Foundation now supports the creative efforts of 141 individuals.

Michael Freedman has proven the four-dimensional Poincaré conjecture, one of the most outstanding problems in his field, topology. In addition, his work has involved taut submanifolds, surgery theorems, and knots.

Everett Pitcher Honored by MAA

Everett Pitcher, Secretary of the AMS, was presented the 1985 MAA Award for Distinguished Service to Mathematics at the MAA business meeting in Anaheim. He was honored as "a man who has given long, devoted and outstanding service to the American Mathematical Society and to the larger mathematics community."

Pitcher was born in Hanover, New Hampshire, where his father, Arthur Dunn Pitcher (who had taken a Ph.D. in general analysis under E. H. Moore at the University of Chicago in 1910) was a faculty member at Dartmouth. It is of interest that Arthur Dunn Pitcher served as a member of the Council of the AMS.

Pitcher attended Adelbert College of Western Reserve University (A.B., 1932). He proceeded to Harvard University where he received an M.A. (1933) and a Ph.D. (1935).

At Harvard, Pitcher became a student of Marston Morse. Pitcher and Morse worked on a problem on distribution of conjugate points and this problem became the body of Pitcher's dissertation. When Morse left Harvard University in 1935 to take up an appointment at the Institute for Advanced Study, he took Pitcher with him as his first assistant.

Pitcher returned to Harvard in 1936 and served two years as a Benjamin Peirce Instructor. He was looking for a position of more permanence during 1937-1938 and learned of just one opening, namely an instructorship at Lehigh, which he accepted. He was on active duty in the U.S. Army Ordnance Department from May 1942 until the end of 1945.

Subsequent to his Army assignment, Pitcher returned to the Institute for Advanced Study for the year 1945-1946 where he and J. L. Kelley co-authored *Exact sequences in homology theory*, Annals of Mathematics (2) **48** (1947), 682–709. He returned to Lehigh University in the fall of 1946 and was promoted twice in two years, the second time to the rank of professor. In 1960 he was given the title Distinguished Professor of Mathematics; in 1978 he became Distinguished Professor Emeritus. In addition to his faculty assignments, he has served Lehigh University as Department Chairman (1960–1978) and as Consultant to the President (1978–).

Pitcher has long been active in the professional activities of the mathematical community. He was Associate Secretary of the AMS (1959–1966), a founder of SIAM and a member of its Board of Trustees (1961–1963). He has served as Secretary of the American Mathmatical Society since 1967. He was elected to Phi Beta Kappa (1930), Sigma XI (1939) and is a member of the Pi Kappa Alpha fraternity. His service to AMS, MAA, SIAM and Lehigh University have been noteworthy. (Complete citation is to appear in an upcoming issue of the American Mathematical Monthly.)

Keller Awarded Timoshenko Medal

Joseph B. Keller, professor of mathematics and mechanical engineering, Department of Mathematics, Stanford University, has been awarded the Timoshenko Medal of the American Society of Mechanical Engineers (ASME). This medal is conferred annually in recognition of distinguished contributions to the field of applied mathematics. Keller's award notes his "... development of powerful mathematical methods for the solution of significant problems in mechanics, engineering, and science; ...his preeminence in employing

mathematics to explain natural phenomena; and his influence on future generations through his writing and teaching."

Educated at New York University on both the graduate and undergraduate levels, Keller has taught and researched at Princeton University, Columbia University, the Courant Institute of Mathematical Sciences, and New York University. He headed the mathematics branch, Office of Naval Research, 1953-1954. Among his awards are two Lester R. Ford awards from the MAA; Doctor Technices Honoris Causa, Technical University of Denmark; and the Von Karman Prize, SIAM. He is chairman of the U.S. National Committee on Theoretical and Applied Mechanics, and a member of the National Academy of Sciences, American Academy of Arts and Sciences, AMS, SIAM, and International Society for Biorheology.

—ASME News Release

Kemeny Receives the New York Academy of Sciences Award

John G. Kemeny, Professor of Mathematics and President Emeritus of Dartmouth College, is the recipient of the annual New York Academy of Sciences Award. Craig Burrell, President of the Academy, presented the award to Kemeny for his brilliant contributions to the computer sciences and to the mathematical aspects of the social sciences.

Kemeny's contributions to mathematics include the development of novel mathematical curricular materials which resulted in the publication of his book, *Introduction to finite mathematics* (co-authored with Thompson and Snell), his application of mathematical models for the social sciences, his creation (with Thomas Kurtz) of the computer language BASIC, his development of time sharing in computers, and his chairmanship of the commission (often called the Kemeny Commission) to investigate the accident at Three Mile Island.

Kemeny came to the United States in 1940 from Hungary and became a naturalized citizen in 1945. He served in the U.S.Army as an assistant in the theoretical division of the Los Alamos Project (1945–1946). Kemeny received his Ph.D. in mathematics from Princeton University (1949), and, during 1948–1949, he was a research assistant to Albert Einstein at the Institute for Advanced Study. He has been associated with Dartmouth College since 1953.

Carl M. Pearcy Acquisition Editor

Professor Carl M. Pearcy was recently appointed to serve as an Acquisition Editor for the American Mathematical Society. In this capacity, he will work with potential AMS authors, referring book manuscripts to the particular AMS committee responsible for final acceptance for publication. Professor Pearcy is interested in manuscripts or proposals for various types of publication projects, including lecture notes, surveys, advanced research monographs, advanced-level graduate textbooks, and general books about mathematics. See *Publishing a Book with the AMS* elsewhere in this issue for related details of interest to potential authors.

News from the Institute for Mathematics and its Applications

Minneapolis

After a highly successful period of concentration on liquid crystals, polymers, and non-newtonian fluids, the 1984–5 program in *Continuum Physics and Partial Differential Equations* will turn to problems in dynamics and stability. This period will be highlighted by three workshops.

The first workshop, *Oscillation Theory, Computation and Methods of Compensated Compactness*, will be held April 1–5. One goal of this workshop is to examine the implications of the methods of compensated compactness and dispersion in analysis and in numerical analysis. In their present form, these methods are not powerful enough to be applied to very realistic models. It is expected that specialists in these and related fields will work together with physicists and engineers who are experts in numerical methods and related problems.

The second workshop, *Metastability and Incompletely Posed Problems of Contemporary Continuum Physics* will take place from May 6–10. Most equilibrium events in nature do not actually realize configurations of minimum energy. They are only metastable. The configurations may not be unique and it may not be possible to know all boundary conditions or constitutive relations. The central purpose of this workshop is to approach these questions mathematically. Methods of global functional analysis and nonconvex variational problems are especially pertinent. Speakers will include theoreticians and experimentalists from mathematics and other sciences.

The third workshop, *Dynamical Problems in Continuum Physics* will be held June 3–7.

Jerald Ericksen and David Kinderlehrer are coordinating this program. A list of speakers and organizers will appear in the Special Meetings Sections of the *Notices*.

The Participating Institutions of the IMA, a consortium of midwestern universities which provide advice and support to the IMA, are co-sponsoring a *Symposium on the Occasion of the Proof of the Bieberbach Conjecture*. This symposium, which will take place at Purdue University from March 11–15, is the second annual meeting sponsored the Consortium.

For additional information please contact H. Weinberger (612) 373-0355.

Fulbright Awards for 1984-1985

Among the Fulbright Scholar Awards conferred for the 1984–85 academic year are thirteen for mathematics and five for computer sciences. The awards, for lecturing, research, or travel, were announced by the Council for International Exchange of Scholars.

In mathematics: Charles F. Amelin (California State Polytechnic University) will lecture in differential equations, functional analysis, and complex variables at the University of Iasi, Romania. Florencio G. Asenjo (University of Pittsburg) will lecture in logic and probability at the University of Lisbon, Portugal. Vernon L. Bakke (University of Arkansas) will lecture in mathematics at Sardar Patel University, Vallabh Vidyangar, India. Bernard R. Gelbaum (State University of New York, Buffalo) will lecture on and research mathematics at University College, Galway, Ireland. Larry C. Grove (University of Arizona) will lecture on and research mathematics at Technical University, Aachen, West Germany. Robert A. Gustafson (Texas A & M, College Station) will research mathematics at Tata Institute of Fundamental Research, India, on an Indo-American Fellowship. William B. Jones (University of Colorado, Boulder) will research the analytic theory of continued fractions at the University of Trondheim, Norway. Shirley Kolmer (St. Louis University) will lecture in determinants and matrices at the University of Liberia. Ronald L. Lipsman (University of Maryland, College Park) will research mathematics at Tel Aviv University, Israel. Torrence D. Parsons (California State University, Chico) will research algebraic and topological graph theory at the University of Ljubljana, Yugoslavia. Paul C. Shields (University of Toledo) will research interaction between ergodic and information theory at the Mathematics Institute of the Hungarian Academy of Science, Budapest. Stanley Wearden (West Virginia University) will lecture in computer science at the University of the West Indies, Jamaica. Gregory P. Wene (University of Texas, San Antonio) will lecture in mathematics and computer science at the University of Cluj, Romania.

In computer science: George J. Boggs will research production engineering at the University of Nottingham, United Kingdom. Thomas J. Higginbotham (Southern Louisiana University) will lecture in and research computer science at the University of Coimbra, Portugal. James I. Hoath (AGENA/SAFECOM, Seattle) will research computer processing of Yugoslav languages at the University Computer Center, Zagreb, Yugoslavia. Assaf J. Kfoury (Boston University) will lecture in computer science at the University of Jordan in Amman. Robert David Preuss (Nitre Corporation, Bedford) will lecture in computer design technology at Tampere University of Technology, Finland.

Travel Support Available for Foreign Graduate Students

The Institute of International Education has informed the Society that its STEP program has been funded again this year by the U.S. Information Agency, and the Society anticipates receiving a grant of at least $2,500. The grant will be made to the AMS to assist non-U.S.-government sponsored foreign students to participate in the joint Summer Research Conferences in the Mathematical Sciences, June 23–August 31, 1985, Arcata, California; the AMS-SIAM Summer Seminar in Applied Mathematics, June 30–July 13, Ithaca, New York; and the AMS Summer Research Institute, July 8–26, Brunswick, Maine. For topics of the Summer Research Conferences, please refer to the October 1985 issue of the *Notices*. For the Summer Seminar and Summer Research Institute topics, please see the announcements elsewhere in this issue. Awards to individual students may be made up to a maximum of $250.

To be eligible for these grants the foreign student must be enrolled in full-time graduate studies at a U.S. institution of higher learning. A student is ineligible if he/she is receiving any U.S. government funds for either academic or travel expenses or if one is on refugee, immigrant or tourist visa status. Previous recipients of STEP awards are ineligible for a second grant.

Interested applicants should send all necessary information, including the conference for which the grant is requested, to Dr. James W. Maxwell, Associate Executive Director, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940.

AMS Trustees Honor Two More Twenty-Year Employees

At its meeting in November 1984, the Board of Trustees of the Society adopted the following resolution:

Statement of the Proceedings and Transactions Editorial Committees

It has been the policy of the respective editorial committees that shorter papers be published in the *Proceedings* and longer papers in the *Transactions*. As a general rule, papers of eleven manuscript pages or fewer have appeared in the *Proceedings* and those longer than eleven pages in the *Transactions* or *Memoirs*. The size of the *Proceedings* has remained substantially constant at about 2000 pages per year while that of the *Transactions* has grown steadily in recent years to more than 5000 pages annually. As a result, the editorial committees of these journals have agreed to change the threshold between the journals from eleven to fifteen manuscript pages.

"This year the Board of Trustees takes special note of the fact that two more employees of the Society have completed twenty years of service. The Board expresses its profound gratitude to THOMAS BENEDETTI and SANDRA E. SCOTT, who bring to fourteen the number of employees of the Society who have devoted more than twenty years as members of the AMS staff. The Trustees offer their special thanks and their best wishes to all of these long-term employees, wish them well in the future, and hope that they continue to serve the Society for many years to come."

For several years these reports have appeared in the *Notices*, as employees on the staff of the AMS have completed terms of service extending over twenty years or more. (The most recent such report will be found in the January 1984 issue, page 9.)

THOMAS BENEDETTI joined the staff of the AMS in January, 1964. He was first assigned to an unused Multilith machine located in a corner of the Society's basement. Office forms, memo pads, and stationery were his bailiwick for some time. From that basement operation, manned by Tom and one assistant, the Society's in-house printing activity has increased gradually but steadily, as has Tom's expertise in the field. His first major undertaking was the reprinting of small quantities of journal issues. With the Society's acquisition of the necessary equipment, he and his staff expanded the printing program considerably. He is now responsible for the printing and binding of most of the Society's journals, and all of its softcover books.

SANDRA SCOTT became a member of the Editorial Department in September, 1983, leaving only for a three-month period during which time she lived in Norfolk, Virginia. She has been involved in all phases of editorial work: proofreading, copyediting, corrections and issue makeup. Over the years she has been production editor of several journals, including *Transactions, Proceedings* and *Mathematics of Computation.* Today she continues in this role with the *Transactions* and *Proceedings* journals, as well as handling some of the production work on the two journals of the Australian Mathematical Society, one of the societies for which AMS does composition work. Throughout these past twenty years, Sandra has seen an evolution in the composition of AMS journals, from using outside typesetters such as Clowes in England, to keyboarding in-house on Varitype machines and then IBM Composers, to using computerized systems, first CTI, then STI and now TEX also.

Symposium at Courant Institute

Courant Institute of Mathematical Sciences of New York University is planning to celebrate its fiftieth anniversary with a scientific symposium October 21–24, 1985. The celebration will also honor the eightieth birthday of former director J. J. Stoker and the sixtieth birthdays of Loius Nirenberg and Peter Lax. Further information will be available at a later date.

–Cathleen S. Morawetz, Director

Tamkang University Book Drive

The largest university in Taiwan, Tamkang University, is currently holding a book drive. As a private university, Tamkang receives no government assistance. With a book collection of 340,000 volumes, the university cannot respond appropriately to the needs of its 16,000 students and 2,000 faculty members.

Your assistance in donating any used, duplicate, extra print resources, monographic or serial, or your own publications would be greatly appreciated. If mailing expenses are a concern, the university is prepared to cover the cost of shipping upon receiving notice of your proposed donations. Among the subject areas needed are physics, mathematics, engineering, computer science, and statistics.

Notice of proposed donations should be sent to Shih-Hsion Huang, Director, Tamkang University Library, Tamsui, Taipei, Taiwan 251, Republic of China.

AFOSR Initiative on the Control of Distributed Parameter Systems

The Air Force Office of Scientific Research (AFOSR) is planning a major initiative for basic research to develop analytical tools and computational algorithms for identification, control, and optimization of systems modeled by partial differential equations, integro-differential equations and functional differential equations. The objective of the initiative is to stimulate basic mathematical research on the control of a variety of infinite dimensional systems useful in the study of aeroelastic systems, large space structures, combustion models, and thermodynamical systems. Research proposals should pay careful attention to the question of which mathematical models best describe the physical process to be controlled, and simplifications introduced in order to design and analyze the control system must have physical fidelity. The primary issues of interest in the control of distributed parameter systems are approximation methods for parameter estimation, stabilizability, computation of stabilizing controllers, and optimization methods for control design.

Prospective investigators should submit proposals prior to **July 1, 1985.** Proposals submitted at a later date will be evaluated but will have less opportunity for funding. AFOSR assumes no obligation to support proposals submitted. Proposals should define a specific technical problem, outline the proposed approach and

explain the uniqueness of the proposed approach in the context of other ongoing research. They should describe the expected payoff to the Air Force if the proposed research is successful. The qualifications of the principal personnel to perform the basic research in the control of distributed parameter systems should be included. Proposals from individual researchers will be considered, as will those for potential centers comprising several researchers with related interests.

The AFOSR Proposer's Guide and the Air Force Systems Command Guide for Unsolicited Proposals describe procedures for preparing and submitting proposals and are available by writing AFOSR/PK, Bolling AFB, Washington, D.C. 20332-6448.

Proposals for basic research in the control of distributed parameter systems should be sent to: Air Force Office of Scientific Research, Initiative on the Control of Distributed Parameter Systems, AFOSR/NM, Bolling AFB, Washington, D.C. 20332-6448. Prior to submitting a proposal, AFOSR encourages investigators to contact the AFOSR Program Advisor, Marc Q. Jacobs, 202-767-4940.

Budapest Semesters in Mathematics

Through this program, mathematics and computer science majors in their **junior/senior years** may spend *one or two semesters* in Budapest and study under the tutelage of eminent Hungarian scholar-teachers. Initiated by Paul Erdös and László Lovász, Budapest Semesters in Mathematics provide a unique opportunity for North American undergraduates to study in Hungary, a country with a long tradition of excellence in mathematics research and education. All courses are taught **in English**. Classes are held in small groups.

Instructors are members of Eötvös University and the Mathematical Institute of the Hungarian Academy of Sciences. *Credits are transferable* to American and Canadian universities. Living costs in Budapest are modest. Tuition is $1850 (U.S.) per semester.

The semesters begin around the first of September and February, and end around the 20th of December and May, respectively.

For further information about this program, write to the American Representative of Budapest Semesters in mathematics: W. T. Trotter, Jr., Chairman, Department of Mathematics and Statistics, University of South Carolina, Columbia, South Carolina 29208.

Hardy Lecture

The 1985 London Mathematical Society (LMS) Hardy Lecturer is R.H.Bott of Harvard University. He will present the Hardy Lecture to the LMS in London on June 21, 1985.

Bott will also present other lectures at participating institutions during his time in the United Kingdom.

–London Mathematical Society Newsletter

U.S. Withdraws from UNESCO

On December 31, 1984, U.S. membership in the United Nations Educational, Scientific, and Cultural Organization (UNESCO) terminated. The U.S. had charged that UNESCO is overly politicized and hostile towards the institutions of a free society, particularly in the areas of communications and human rights. The U.S. has vowed to continue its efforts to bring about reform to UNESCO so that re-entry might be considered. While it had been anticipated that resources previously earmarked to support U.S. membership in UNESCO might be available to permit continued U.S. association with valuable UNESCO-related programs, it now appears that only a token amount of resources may be proposed in the Administration's FY 1986 budget for this purpose.

During 1984 the State Department conducted a review of U.S. participation in UNESCO. As a part of that effort, the National Academy of Sciences was invited to assess the impact of a U.S. withdrawal on the science component of UNESCO's work and to suggest alternative interim arrangements whereby essential U.S. scientific collaboration might be maintained. A report was issued in the fall of 1984 which identified a number of key areas in the sciences, including UNESCO's work in strengthening national research potential and infrastructures in mathematics in the developing world. The UNESCO program for 1984-1985 includes the organization of mathematics courses for developing countries, research grants, the convening of seminars and some support for publications, including preparation of the *World Directory of Mathematicians* in cooperation with IMU. Some support is also provided in the International Center for Pure and Applied Mathematics in France. In addition UNESCO provides an annual subvention to the International Council of Scientific Unions (ICSU) which is in turn apportioned among the constituent unions of ICSU, including the IMU. At this time, it is not known how the U.S. withdrawal will affect these programs and patterns of financial support. It is expected that the cutbacks will be less severe in the sciences than in other areas covered by UNESCO. Nonetheless, the present uncertainties are bound to create disruptions in terms of future program planning, as well as discontinuities in U.S. participation, and a concern with respect to the U.S. commitment to international cooperation in general. The NAS report concluded that the present situation emphasizes the need to examine the objectives, consequences, and benefits of U.S. participation in intergovernmental organizations and the kinds of multilateral institutions that

are needed to deal with the contemporary requirements of international science cooperation.

New Center for Research of Stochastic Process

With the support of the Volkswagenstiftung, a new center, "Bielefeld-Bochum Stochastic Processes-Mathematics and Physics" (BiBoS) has been established at the Universities of Bielefeld and Bochum. The activities of the center have begun with a symposium at the Center of Interdisciplinary Research (ZiF), University of Bielefeld.

The center is devoted to the study of stochastic processes, with particular attention to the close interaction between mathematical theory and applications, especially in physics. There will be symposia arranged twice a year. The center will offer both long and short term appointments for established mathematicians and scientists as well as for promising newcomers. A number of working seminars will be arranged.

For more information write to: S. Albeverio, Ph. Blanchard, L. Streit, BiBoS, Universität Bielefeld, D 5-147, Postfach 8640 D-4800 Bielefeld 1, Federal Republic of Germany; Telephone 0521/106 5305.

Office at Home

The federal tax deductibility of an office at home has been a source of contention between individuals and the Internal Revenue Service. There are three criteria to be met to justify deductibility by an employee. The home office must be used exclusively for business purposes on a regular basis, it must be maintained for the convenience of the employer, and it must be the principal place of business of the employee.

In a recent case before the U.S. Court of Appeals for the Second Circuit, it was ruled that a professor whose institution did not provide him with a suitable private office in which to work is entitled to the deduction for an office at home. The argument centered on the office at home as the principal place of business.

Interested parties may wish to explore the applicability and the precedential weight of the decision. A news reference is the *Chronicle of Higher Education* for January 9, 1985. They may wish also to consider that their consulting and/or publishing constitutes a separate trade or business, and that the office in the home is the principal place of that business.

Colloquium Lecture Notes

A set of four Colloquium Lectures was presented by Daniel Gorenstein of Rutgers University, New Brunswick, at the annual meeting of the Society in Anaheim, California in January 1985. Copies of the lecture notes, *The classification of the finite simple groups*, are still available.

Requests should be accompanied by a check or money order for $3 per copy to cover the costs of handling, and mailed to the Society at P.O. Box 1571, Annex Station, Providence, Rhode Island 02901. The notes, which were distributed to those who attended the Colloquium Lectures in Louisville, do not constitute a formal publication. Please note that informally distributed manuscripts and articles should be treated as personal communications and are not for library use. Reference to the contents of such an informal publication should have the prior approval of the author.

New Quarterly on Mathematical Ecology

The Rocky Mountain Mathematics Consortium announces the establishment of a new quarterly journal, *Natural Resource Modeling.*

Natural Resource Modeling is an interdisciplinary journal devoted to mathematical modeling of natural resource systems: of their inherent physical, chemical, and biological processes, and of the economic and operational basis for their management. The major theme for the journal is the development of analytical mathematical models as tools for resource management and policy development. The analysis may be applied to a wide variety of resources: renewable and exhaustible resources, terrestrial and marine resources, energy, minerals and materials, land and soils, water resources, problems of pollution and residuals, managed biological populations, integrated pest management, agriculture and fisheries, rangeland and forest, wildlife and wilderness, preservation of endangered species and of genetic diversity, and still others.

The journal will publish both primary research articles and expository survey articles on resource modeling themes. It will attempt to keep its readers abreast of important new thrusts in research, and to encourage new research initiatives. Through its Short Communications section it will promote lively debate on current issues in dispute.

The Editor is Robert McKelvey, Department of Mathematical Sciences, University of Montana, Missoula, MT 59812; Associate Editor is Roland Lamberson, Department of Mathematics, Humboldt State University, Arcata, CA 95521. Thomas L. Sherman, Executive Director of the RMMC, Department of Mathematics, Arizona State University, Tempe, AZ 85287 will serve as Business Manager.

NSF Director Responds to the David Report

In an interview published in the November 15, 1984 issue of *Science and Government Report*, Erich Bloch, director of NSF, responded to questioning concerning the David Report by saying: "Let me say a couple of things about this, because I happened to talk to the advisory committee on it. First of all, the thing I asked them to do was to go take the David report, and I told them you might agree 100 percent with it, but go look at it through your own eyes, and tell me what is the right level of funding that you would think is practical. Also, knowing what goes on in the rest of the Foundation, you know that we don't have infinite resources. So tell me what is the right level that we should put in and in what areas. They came back with an answer which was different from the David report. Their answer was roughly a 60 percent level of what the David report called for. We asked them to break it down on how many people to support and so forth, and they came out with the 60 percent level.

I promised them what we would try to do is take that into consideration, over a period of years. They agreed it couldn't all be done in one year. The David report didn't contemplate that, either. But the advisory committee was a lot more careful, and they really looked at where do we want to be 5 years from now. I promised them I would take [their views] into consideration as we moved through the years, and we would tell them at all times what we're going to do about it, so we'd have a continuous kind of a dialog, and they'd see that we're going to take it seriously."

NSB Views the David Report

The following statement and resolution was approved by the National Science Board at a meeting of its execution committee on December 20, 1984:

The National Science Board is concerned with the strength of a balance among scientific and engineering disciplines, especially where a specific field, such as mathematical sciences, affects much of the scientific, engineering and technological enterprise of the nation.

The ad hoc committee on resources for mathematical sciences of the National Research Council and its chairman, Edward E. David, Jr., are to be commended for their timely and compelling report "Renewing U.S. Mathematics—Critical Resources for the Future." This broadly based group, including scientists and engineers, as well as mathematicians representing both industry and academia, has documented requirements to keep mathematics research in balance with other fields. The very core of most science and engineering efforts is dependent on mathematics and owes many advancements to sophisticated application of the techniques of mathematicians.

The National Science Foundation has made important increases in support for graduate students and young researchers in mathematical sciences. Various funding agencies have also increased funding. The National Science Board, therefore,

> resolves that a concerted effort should be made by all funding agencies to increase support for the mathematical sciences for several years until a proper level of sustaining support has been achieved." —NSF News Release

National Science Board Increases Strategic, Oversight Roles

The National Science Board (NSB), governing body of the National Science Foundation, has made a sweeping set of changes in its committee structure and operations, aimed at increasing the Board's involvement in strategic NSF and national science policy, its oversight of NSF programs, and its attention to education and human resources.

"The Board believes," Roland Schmitt, Chairman of the NSB, said, "that right now many of the threats and opportunities for the U.S. scientific and techical enterprise focus on people. For that reason, the Board voted to establish as one of its two principal committees a new Committee on Education and Human Resources." The new Committee will oversee the Foundation's Directorate for Science and Engineering Education, now being rebuilt, and the new programs being put in place there. It will address issues and programs that deal with efforts to bring minorities, women, the handicapped, and the disadvantaged into scientific careers—issues that had been assigned to a smaller Board Committee, but now will get more attention. —NSF News Release

Cooperative Science Programs with Latin American and the Caribbean

The National Science Foundation will consider several types of interactions between United States and Latin American and Caribbean scientists for financial support. Such activities include: cooperative research projects, research-oriented workshops, short-term visits for cooperative activities, and developing detailed plains for joint

projects. To receive such grants, the co-principal investigators must submit parallel proposals. Foreign investigators may be affiliated with specific counterpart agencies of the NSF in Latin America and the Caribbean, or with other agencies, which will be considered on an ad hoc basis. U.S. investigators must hold a doctoral degree or equivalent professional experience, and be U.S. citizens. All branches of science and technology are eligible for consideration, so long as the goal of the project is the advancement of knowledge or methodology.

Proposals should follow the guidelines established by the NSF pamphlet 78-41, "Grants for Scientific Research." Yearly deadlines fall on May 1 and November 1; the NSF requests that submissions be restricted to these approximate time periods. The Cooperative Science Program is located in room 1212, 1800 G Street, N.W., Washington, DC, (202)357-8563. Correspondence should be addressed: U.S.-Latin American Cooperative Science Programs Division of International Programs, NSF, Washington, DC 20550.

Science in Developing Countries Program

In order to encourage cooperation between scientists in the United States and those in developing countries, the NSF is offering grants for a number of research activities in the third world. Grants are made directly to the U.S. scientists; this money may potentially be used to support counterparts in the host country. Local enthusiasm and planning for the proposed projects are considered essential to this program.

Categories of grant awards include research participation, conferences, and dissertation improvement. The latter grants are awarded to students from developing countries who are enrolled in universitites in the United States, and who wish to undertake a dissertation research project.

Those applying for principle investigator positions must be professionally qualified through training and work experience, and currently employed by a U.S. institution. Grant proposals are read twice a year, on March and September 1, but accepted at any other time. Proposals should be submitted in deca-copy to the following address: Central Processing Section, National Science Foundation, Washington, DC 20550.

For more information concerning programs in specific geographic areas, contact the following: North Africa and Turkey: Francis E. Field 202-357-9402, Sub-Saharan Africa: Robert Bell 202-357-9550, South and West Asia: Osman Shinaishin 202-357-9402, East Asia: Gordon Hiebert 202-357-9537, Latin American and Caribbean: Christine French 202-357-9563. All the above may be reached by mail at: Division of International Programs, National Science Foundation, Washington, DC 20550.

United States-Japan Cooperative Science Program

One of the earliest cooperative science programs of the NSF, the United States-Japan program continues to offer a variety of grants for scientific and technological advancement. The NSF is the "Implementing Agency" for the United States, and the Japan Society for the Promotion of Science (JSPS) and the Science and Technology Agency play this role in Japan. Operating as a liason between the two countries, and as an overseer of the program as a whole, the U.S.-Japan Committee on Scientific Cooperation coordinates the exchange of research and personnel.

The U.S.-Japan Committee mandates that both Japan and the U.S. must participate in each project supported by the committee. Both countries must jointly approve each project, and the government of each will support its own scientists.

Projects eligible for funding under this program include: cooperative research, joint seminars, and long-term visits to Japan by U.S. scientists. Proposals should be paralleled between the cooperating scientists. U.S. scientists should follow standard NSF guidelines, as outlined in "Grants for Scientific Research" (NSF 78-41). Japanese investigators should request current guidelines from the following address: Research Cooperative Division, Japan Society for the Promotion of Science, 5-3-1, Kojimachi, Chiyoda-hu, Tokyo 102, Japan.

Deadlines for proposal submissions are: April 1, cooperative research; June 1, joint seminar; rolling applications, long term visits. All proposals must be submitted, in deca-copy, to: Central Processing Section, U.S.-Japan Cooperative Science Program, NSF, Washington, DC 20550.

U.S.-Australia/U.S.-New Zealand Cooperative Science Programs

The NSF continues to offer grants for collaborative work between scientists of the U.S. and those of Australia and New Zealand. Proposals for cooperative research or joint seminars are accepted and considered for funding.

Dealines for application are April 1 for proposals which would be effective the following January through to the following June 1, and October 1 for problems which would be implemented from July 1 to December 31. To apply, or for more information, contact: U.S.-New Zealand or U.S.-Australia Cooperative Science Program, Division of International Programs, National Science Foundation, Washington, DC 20550.

Cooperative Science Programs with Western Europe

The NSF announces the availability of grants for joint efforts between United States and Western European scientists. Various types of coordinated programs are eligible for funding, such as cooperative research projects, joint seminars (workshops), long-term research visits, and regional seminars. The NSF has specific programs with Belgium, Finland, France, the Federal Republic of Germany, Italy, Sweden, Switzerland, and the United Kingdom. However, selection will consider activities within the region as a whole, or with countries not specifically covered by formal programs.

Deadlines for application vary by the countries involved. Interested scientists should write: Data Support Services Section, National Science Foundation, 1800 G Street N.W., Washington, DC 20550, French scientists may write Service des Relations Internationales, Centre National de la Recherce Scientifique, 15 Quai Anatole France, 75700 Paris, France; and Belgian sicentists Fonds National de la Recherche Scientifique, Nationaal Fonds voor Weteuschappelijk Onderzaak, 5 Egmont, B-1050 Brussels, Belgium.

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. This is not intended as a problem corner, except for occasional lists of problems collected at mathematical meetings.

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

322. Dennis Spellman (Department of Mathematics, Sacred Heart University, P. O. Box 6460, Bridgeport, CT 06606-0460). We consider natural numbers n that are composite and relatively prime to $\phi(n)$. For which of these n does there exist a non-Abelian group of order n^2?

323. Vladik Ya. Kreĭnovich (P. O. Box 21, Leningrad 22, 197022, U.S.S.R.).

A. On a differentiable manifold the set of noncausal metrics (Lorentz metrics with a closed time-like curve) is easily seen to be of 2nd category in the space of metrics (C-topology). Is it true that for any elementary formula A involving causal ordering $x < y$ either the set of metrics for which A holds or its complement is of 1st category ("the general 0-1 law")? (V. Ya. Kreĭnovich)

B. Let q_n be the number obtained by reversing the order of the binary digits of the nth prime. The fraction of primes in this list is abnormally high up to n about 40. Is this true for larger n? If so, is there a reason? (R. R. Pimenov)

C. For linear programming the notion of dual program is useful. But the new methods (ellipsoid, Karmarkar's) don't use duality. Is there any interpretation or use of duality for these new methods? (I. M. Davidova)

D. What algorithms are known for solving Boolean equations in intuitionist logic? (G. E. Minc)

E. Define a version of Kolmogorov complexity as follows: $K(x,t)$ is the minimal possible length of a program y that allows x to be obtained in time t (on some fixed universal machine). Is the problem to construct such a y from x, t, and k (with $K(x,t) \leq k$) NP-difficult (i.e., equivalent to NP-complete problems)? (L. A. Levin)

Responses

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

308. (vol. 31, p. 480, August 1984, Francis D. Lonergan) Techniques for determining whether a group given by generators and relations is finite. (See earlier reply these *Notices* **31**, p. 784). **Reply:** There is a group theory computer system called CAYLEY that can handle questions of this sort. For the two groups in question (with the relation $x = 1$ added) it gave the answer "infinite" (printout available from the AMS office). (Contributed by M. C. Slattery)

313. (vol. 31, p. 631, October 1984, Elvin Lee) Conjecture about amicable pairs of numbers. **Reply:** The numbers 967947856 and 1031796176, $\equiv 7$ and $\equiv 5 \bmod 9$, respectively, contained in a list of 183 new amicable pairs found by H. J. J. te Riele, Stichting Centrum, Amsterdam, give a counterexample. (According to te Riele there are 586 pairs with the smaller number under one billion.) (Contributed by E. J. Lee)

314. (vol. 31, p. 631, October 1984, Marwan Awartani) Explicit analytic functions f, whose set S of local maxima and minima on $[0,1)$ is discrete and that take each value in $f(S)$ infinitely often in S. **Reply:** Such functions can be constructed in a reasonably explicit way. The construction uses the functions $x^k - x^{k+1}$, which have a fairly sharp maximum $\sim 1/ek$ at $k/(k+1)$. One now superimposes these functions, with k running through a rapidly increasing sequence, with suitable coefficients. This gives "almost" the answer; now one corrects the coefficients inductively by an explicit, converging process. Details available through the AMS office. (Contributed by G. Piranian)

319. (vol. 1, p. 9, January 1985, T. M. Rassias) Distance 1 preserving maps $\mathbf{R}^2 \to \mathbf{R}^3$. **Reply:** With $\mathbf{R}^6$ instead of $\mathbf{R}^3$ the existence of such maps that are not isometries has been announced by B. V. Dekster (these *Notices* **32**, p. 64; Abstracts Amer. Math. Soc. **6**(1985), 42). (Contributed by D. Lenard)

Corrections

1. In Volume 31, page 631 in the response to Query 299, M. *Seller* should be M. *Salles*. We apologize for the error.

2. In Volume 31, page 633, column 2, line 2, read "$B = V$" for "$B = V - \Delta$".

Letters to the Editor

Article by Arthur M. Jaffe

The fine survey article by Arthur M. Jaffe, "On the Role of Mathematics in Ordering the Universe" (*Notices*, October 1984, pages 589–608) may be misleading in its recounting of the early development of computers. At issue is the reference (page 593) to "devices like von Neumann's ENIAC, built at the Institute for Advanced Study in Princeton."

The ENIAC (Electronic Numerical Integrator and Computer) was built at the Moore School of Electronic Engineering of the University of Pennsylvania.

It is not clear in what sense the ENIAC was von Neumann's. Readers interested in his contribution to the early developments of computers may consult an article by J. Presper Eckert, "Thoughts on the History of Computing" (*Computer*, December 1976, pages 58–65). Eckert was co-inventor, with John W. Mauchly, of the ENIAC. According to Eckert, von Neumann is "frequently (improperly) credited with the concept of internal programming and internal storage.... We had fully discovered this idea before his arrival [at the Moore School]. I verified this fact by looking at old records and also checking the dates of the clearance papers on which he got permission to visit the project...". The *Computer* article contains some further discussion of von Neumann's contributions in this area.

Leo Hellerman
Lake Katrine, New York
(Received October 25, 1984)

EDITOR'S NOTE: H. H. Goldstine, who was associated with Eckhart and Mauchly as a representative of the U.S. Army during the development of ENIAC and with von Neumann during the development of the IAS Machine makes these comments:

1. The U.S. Federal District Court decided that Eckhart and Mauchly were not the sole inventors of the ENIAC and threw out their patents as being invalid.

2. von Neumann did not contribute to the design and development of the original ENIAC project. In fact, he did not become aware of it until about 1944. At that time, he did become enormously involved in the successor machines to the ENIAC, and he did program the ENIAC to be a centrally-programmed machine.

Polish Mathematics

One of the consequences of the current economic and political situation in Poland has been a drastic reduction in the funds provided to the main scientific libraries for the purchase of monographs and books (funds for periodicals are for the moment being continued). In many cases this support has been cut off altogether. Although this is an intolerable situation for any library, it is particularly disastrous for the library of the Mathematical Institute of the Polish Academy of Sciences in Warsaw. This library is a central resource for all scientific research in Poland and, until recently, could boast a collection of current works second to none in Eastern Europe. For the library, the inability to purchase new books for even a few years will create a gap which will not be easily closed in the future.

We are seeking help from our colleagues around the world to enable Polish mathematicians to maintain the quality of at least this library. At the moment, we see the problem as an issue of short-term support to avoid rapid deterioration of the collection. Simultaneously, with this appeal we are trying to apply political pressure to convince the Polish government to restore the funds. We recognize that outside help will not suffice to support the library in the long run.

Persons wishing to help may do so in one of several ways. We have a list of books which the library would like to have, but cannot buy. Some of you may have spare copies of these to donate. This list may be obtained from any of the undersigned. If you prefer to give money toward the purchase of books, please send it to Polish Book Fund, c/o Peter G. Hinman, Department of Mathematics, University of Michigan, Ann Arbor, Michigan 48109. Finally, if you are writing or have recently written a mathematics book at any level, please earmark at least one

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.

of your complimentary copies for the library of the Polish Academy. Books may be sent directly to: Bibliotek, Instytut Matematyczny PAN, ul. Sniadeckich 8, Warszawa 00-950, Poland. The Institute has a large number of its publications, both journals and books, which it would be happy to trade for your books. If you have some particular desires, please contact any one of us.

Peter G. Hinman
University of Michigan,
Ann Arbor
Alistair H. Lachlan
Simon Fraser University
Angus Macintyre
Yale University and
University of Illinois,
Urbana-Champaign
(Received November 15, 1984)

Scientific Cooperation with Vietnam

I am writing to you concerning a most grievous matter.

On 13 October, in the Los Angeles area, Professor of Physics Edward L. Cooperman, chairman of the U.S. Committee for Scientific Cooperation with Vietnam, was shot and killed in his office at California State University at Fullerton. A Vietnamese émigré has been charged with the killing. The shooting was preceded by a series of threats from extremist factions of the Los Angeles Vietnamese émigré community. These threats were reported to law enforcement authorities. The killing also followed, by four months, the attempted murder in San Francisco of the president of a U.S.-Vietnam friendship group (whose wife was killed in the shooting).

Cooperman, like many of us, believed that scientists from technologically advanced countries have a duty to assist scientists in developing countries. Cooperman took full responsibility for the difficult work of the U.S. Committee for Scientific Cooperation with Vietnam in several fields of science. His extensive personal, professional and government contacts both in the U.S. and Vietnam enabled him to obtain financial support, donations of supplies, visas, and other necessary materials.

Except for the medical sciences and agriculture, the largest program of exchange and cooperation was in the mathematical sciences. In recent years, about ten of Vietnam's leading mathematical researchers were able to visit American universities and attend international conferences in the U.S., in each case because of the personal efforts of Cooperman.

At the time of his death, Cooperman was planning to arrange for several mathematicians from Vietnam to participate in the 1986 International Congress of Mathematicians in Berkeley. Now, however, the killing has cast grave doubts on these plans.

I am writing to each officer and member of the International Mathematical Union and the IMU Committee on Development and Exchange in order to ask for your assistance in these difficult times. I respectfully request that the IMU:

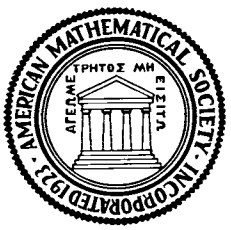
(1) condemn the killing of Cooperman, and ask the U.S. government for an investigation of all circumstances surrounding the attack;

(2) strongly urge the U.S. government to take appropriate measures to guarantee the safety of mathematicians from Vietnam and other potential target-countries who attend the ICM in Berkeley;

(3) urge the governments of Vietnam and other potential target-countries to continue to support the participation in the ICM of mathematicians from those countries.

Neal Koblitz
U.S. Committee for
Scientific Cooperation
with Vietnam
University of Washington
(Received October 26, 1984)

EDITOR'S NOTE: Professor Koblitz's letter presents only one of many current theories as to the motivation for Professor Cooperman's murder. The other theories are of a nonpolitical nature.



Automated Theorem Proving: After 25 Years

W. W. Bledsoe and D. W. Loveland, Editors

This volume contains papers based on a special session for automated theorem proving held at the annual meeting of the American Mathematical Society in Denver, January, 1983. At the meeting special awards were given to honor historically significant work (the *Milestone Prize*: Hao Wang, awardee) and to honor excellent current work (the *Current Research* prize: Lawrence Wos and Steven Winker, awardees). Roughly a dozen leading contributors to the field were invited to present papers; papers characterizing their research work or a broader perspective were encouraged. Papers range from a historical overview of twenty-five years of research in the automated theorem proving field to significant technical papers, including a reprint of a *Scientia Sinica* paper giving a new and elegant decision procedure for a portion of elementary geometry.

Most of the major efforts in building automated theorem provers (or theorem proving assistants) are covered by papers in this volume, a notable but less familiar example (to the ATP community) being the Suppes interactive theorem prover for teaching logic and axiomatic set theory. The well-known provers of Andrews, Bledsoe, Boyer and Moore, and Wos, et al. are represented as are term rewriting, combining decision procedures and automating mathematical discovery. The book is intended for every mathematician and computer scientist interested in the state-of-the-art in automated theorem proving, but in particular, it is intended to encourage active research mathematicians to contribute their insight to this field.

Contents

Contemporary Mathematics
Volume 29, x + 366 pages (softcover)
1980 *Mathematics Subject Classifications*: 68G15, 03B35
ISBN 0-8218-5027-X; LC 84-9226
Publication date: July 1984
List price $30, institutional member $24
individual member $18
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1985 AMS Elections

Nominations by Petition

Vice-President or Member-at-Large

Two positions of vice-president and member of the Council ex officio for a term of two years are to be filled in the election of 1985. The Council intends to nominate four candidates, whose names may be expected to appear in the June issue of the *Notices*, which is scheduled to be mailed by the printer on May 17. Nominations by petition as described in the box are acceptable.

Five positions of member-at-large of the Council for a term of three years are to be filled in the same election. The Council intends to nominate seven candidates, whose names may be expected to appear in the June *Notices*. Nominations by petition in the manner described in the box are acceptable. The Council has stated its intent to have at least ten candidates and will bring the number up to ten if the nominations by petition do not do so.

Petitions are presented to the Council, which, according to Section 2 of Article VII of the bylaws, makes the nominations. The Council of 23 January 1979 stated the intent of the Council of nominating all persons on whose behalf there were valid petitions.

Prior to presentation to the Council, petitions in aid of a candidate for the position of vice-president or of member-at-large of the Council must have at least 50 valid signatures and must conform to several rules and operational considerations, which are described in the box.

The Nominating Committee for 1986

Four places on the Nominating Committee will be filled by election. There will be four continuing members of the Nominating Committee, namely

Vera S. Pless
Mary Ellen Rudin
Michael Shub
R. O. Wells, Jr.

The new members will be elected in a preferential ballot. The President will name six candidates for these four places. The names may be expected to appear in the June issue of the *Notices*. Nominations by petition, in the manner described in the box, will be accepted. Should the final number of candidates be less than eight, the President will bring it up to eight.

The name of a candidate for member of the Nominating Committee may be placed on the ballot by petition. The candidate's assent and petitions bearing at least 100 valid signatures are required for a name to be placed on the ballot. In addition, several other rules and operational considerations which are described in the box should be followed.

Rules and Procedures

Use separate copies of the form for each candidate for vice-president, member-at-large, or member of the Nominating Committee.

1. To be considered, petitions must be addressed to Everett Pitcher, Secretary, P.O. Box 6248, Providence, Rhode Island 02940, and must arrive by July 8, 1985.

2. The name of the candidate must be given as it appears in the *Combined Membership List*. If the name does not appear in the list, as in the case of a new member or by error, it must be as it appears in the mailing lists, for example on the mailing label of the *Notices*. If the name does not identify the candidate uniquely, append the member code, which may be obtained from the candidate's mailing label or the Providence office.

3. The petition for a single candidate may consist of several sheets each bearing the statement of the petition, including the name of the position, and signatures. The name of the candidate must be exactly the same on all sheets.

4. On the facing page is a sample form for petitions. Copies may be obtained from the Secretary; however, petitioners may make and use photocopies or reasonable facsimiles.

5. A signature is valid when it is clearly that of the member whose name and address is given in the left-hand column.

6. The signature may be in the style chosen by the signer. However, the printed name and address will be checked against the *Combined Membership List* and the mailing lists. No attempt will be made to match variants of names with the form of name in the CML. A name neither in the CML nor on the mailing lists is not that of a member. (Example: The name Everett Pitcher is that of a member. The name E. Pitcher appears not to be. Note that the mailing label of the *Notices* can be peeled off and affixed to the petition as a convenient way of presenting the printed name correctly.)

7. When a petition meeting these various requirements appears, the Secretary will ask the candidate whether he is willing to have his name on the ballot. Petitioners can facilitate the procedure by accompanying the petitions with a signed statement from the candidate giving his consent.

NOMINATION PETITION FOR 1985 ELECTION

The undersigned members of the American Mathematical Society propose the name of

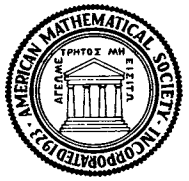
_____

as a candidate for the position of (check one):

- ☐ **Vice-President**
- ☐ **Member-at-Large of the Council**
- ☐ **Member of the Nominating Committee**

of the American Mathematical Society for a term beginning January 1, 1986.

Name and Address (printed or typed, or *Notices* mailing label)	Signature
	Signature
	Signature
	Signature
	Signature
	Signature



PROCEEDINGS OF THE STEKLOV INSTITUTE

(ISSN 0081-5438)

Theory and Applications of Differentiable Functions of Several Variables. VIII

S. M. Nikol'skiĭ, Editor

Abstract

In the papers of this collection, properties of differentiable functions of real variables are investigated, inequalities between integral norms of partial derivatives are established, boundary and approximation properties of functions are studied, generalized Riesz potentials and hypersingular integrals are investigated, and difference methods for approximate solution of Laplace's equation and approximate computation of integrals are proposed.

Contents

1980 *Mathematics Subject Classifications*: 26, 35, 41, 42, 45 and others

Proceedings of the Steklov Institute
Volume 156, x + 285 pages (soft cover)
List price $86, institutional member $69,
individual member $52
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Publication date: September 1983
To order, please specify STEKLO/156N

TRANSLATIONS OF MATHEMATICAL MONOGRAPHS

(ISSN 0065-9282)

Integral Representations and Residues in Multidimensional Complex Analysis

L. A. Aĭzenberg and A. P. Yuzhakov

Abstract

This book deals with integral representations of holomorphic functions of several complex variables, the multidimensional logarithmic residue, and the theory of multidimensional residues. Applications are given to implicit function theory, systems of nonlinear equations, computation of the multiplicity of a zero of a mapping, and computation of combinatorial sums in closed form. Certain applications in multidimensional complex analysis are considered.

The monograph is intended for specialists in theoretical and applied mathematics and theoretical physics, and for post graduate and graduate students interested in multidimensional complex analysis or its applications.

Contents

1980 *Mathematics Subject Classifications*: 32-02, 32A25, 32A27

Translations of Mathematical Monographs
Volume 58, x + 283 pages (hard cover)
List price $68, institutional member $54,
individual member $41
ISBN 0-8218-4511-X; LC 83-15549
Publication date: November 1983
To order, please specify MMONO/58N

Shipping/Handling: 1st book $2, each add'l $1, max. $25; by air 1st book $5, each add'l $3, max. $100
Prepayment is required. Order from American Mathematical Society, P.O. Box 1571, Annex Station, Providence, RI 02901-1571, or call toll free 800-556-7774 to charge with Visa or MasterCard.

Chicago, March 22–23, 1985, University of Illinois at Chicago

Program for the 817th meeting

The eight hundred and seventeenth meeting of the American Mathematical Society will be held at the University of Illinois, Chicago, Illinois, on Friday and Saturday, March 22 and 23, 1985. All sessions will be held in the Lecture Center on the University campus.

Invited Address

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

GRAHAM HIGMAN, University of Illinois, Urbana-Champaign, *Inflexions in characteristic 3*, 11:00 a.m. Saturday.

MICHAEL MARCUS, Texas A&M University, College Station, *Random Fourier series*, 1:30 p.m. Friday.

J. MARSHALL OSBORN, University of Wisconsin, Madison, *What are nonassociative algebras?*, 1:30 p.m. Saturday.

ROGER PENROSE, Mathematical Institute, Oxford, England, and Rice University, *Some results of twistor theory in general relativity*, 11:00 a.m. Friday.

Special Sessions

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

Plethysms, JOSEPH BRENNAN, Michigan State University. The speakers will be Joseph P. Brennan, Young-Ming Chen, Peter Hoffman, Tadeusz Józefiak, Philbert A. Morris, Jiri Patera, Ronald C. Read, Frank Servedio, Jacob Towber and Hiroshi Uehara.

Periodic and almost periodic solutions of differential equations, T. A. BURTON, Southern Illinois University, Carbondale. The speakers are Ovide Arino, Stephen R. Bernfeld, C. Corduneanu, A. M. Fink, J. Haddock, Muhammad N. Islam, Vadim Komkov, Carl E. Langenhop, Daniel S. Levine, W. S. Loud, W. E. Mahfoud, Stephen J. Merrill, Allan C. Peterson, James K. Peterson, Jane Cronin Scanlon, George Seifert, Lian Wang, Mu-Qui Wang, Jianhong Wu, Shunian Zhang, and Wang Zhicheng.

History of logic, THOMAS L. DRUCKER, University of Wisconsin Extension, Madison. The speakers are Irving H. Anellis, William Aspray, Alonzo Church, Joseph W. Dauben, Martin Davis, John W. Dawson, Jr., Judy Green, Nathan Houser, Steven C. Kleene, Jan Mycielski, Anil Nerode, Daniel J. O'Leary, Wim Ruitenburg, Dirk Siefkes, C. Smoryński, and Robert I. Soare.

K-theory, HENRI A. GILLET, University of Illinois at Chicago. The speakers will be A. J. Berrick, William G. Dwyer, Henri A. Gillet, Daniel R. Grayson, J. F. Jardine, Marc Levine, R. W. Thomason, and Charles A. Weibel.

Mathematical computer science, WOLFGANG MAASS, University of Illinois at Chicago. The speakers will be Eric Bach, Joel Berman, Andreas R. Blass, Allan B. Borodin, John Case, Deborah S. Franzblau, Harvey Friedman, Merrick L. Furst, Yuri Gurevich, Kenneth Kunen, Jeffery S. Leon, Angus MacIntyre, Glenn K. Manacher, Vera Pless, Franco P. Preparata, and Georg Schnitger.

Stochastic analysis and related topics, PHILIP PROTTER, Purdue University. The speakers are Klaus Bichteler, Donald L. Burkholder, Erhan Çinlar, R. Dante DeBlassie, Allan Gut, Wolfgang Kliemann, Joanna B. Mitro, P. Ney, Steven Orey, Mark Pinsky, Philip Protter, and Thomas S. Salisbury.

Borel structures and classical measure theory, K.P.S. BHASKARA RAO and RAE MICHAEL SHORTT, Michigan Technological University. The speakers are Thomas E. Armstrong, Wayne C. Bell, Jack B. Brown, Richard B. Darst, Nicolae Dinculeanu, R. M. Dudley, G. A. Edgar, Roy A. Johnson, Dan Mauldin, Arnold W. Miller, John C. Morgan, II, Washek F. Pfeffer, Karel Prikry, D. Ramachandran, S. Ramakrishnan, K.P.S. Bhaskara Rao, Rae Michael Shortt, C. E. Silva, A. H. Stone, and Dorothy Stone.

Groups and geometries, MARK A. RONAN and STEPHEN D. SMITH, University of Illinois at Chicago. The speakers will be Michael Aschbacher, Laszlo Babai, Alberto L. Delgado, Jonathan I. Hall, Chat Y. Ho, Robert A. Liebler, Geoffrey Mason, Stanley E. Payne, Sarah Rees, Ernest Shult, David B. Surowski, and Richard Weiss.

Contributed Papers

There will also be five sessions for contributed ten-minute papers.

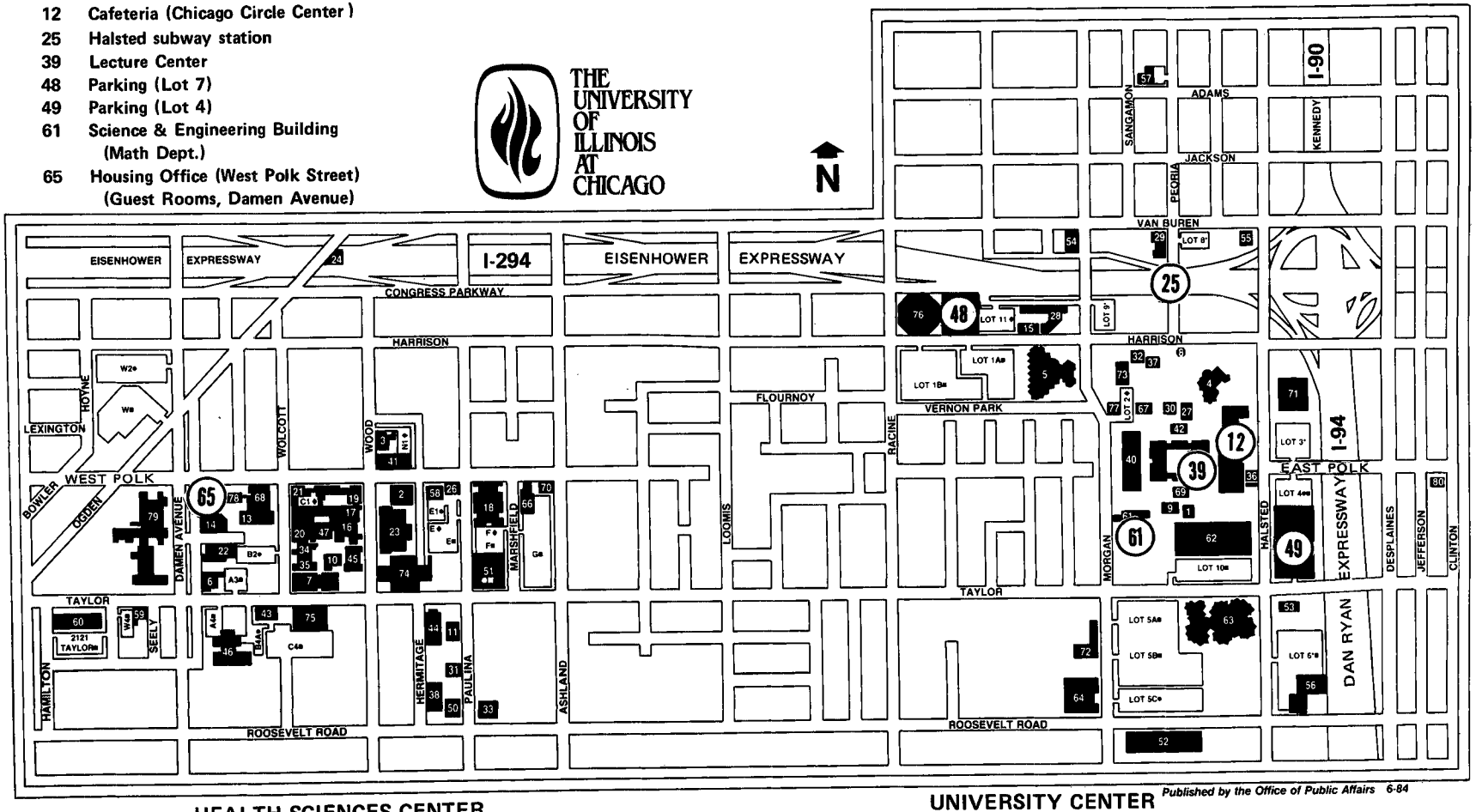
Registration

The meeting registration desk will be located in Room 120 Science and Engineering Offices Building. (Number 61 on the map.) The desk will be open from 8:30 a.m. to 3:30 p.m. on Friday, and from 8:30 a.m. to 11:00 a.m. on Saturday. The registration fees are $10 for members, $16 for nonmembers, and $5 for students or unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information can be found in a box on page 26 in the Anaheim meeting announcement in the January issue of the *Notices*.

12 Cafeteria (Chicago Circle Center)
25 Halsted subway station
39 Lecture Center
48 Parking (Lot 7)
49 Parking (Lot 4)
61 Science & Engineering Building (Math Dept.)
65 Housing Office (West Polk Street) (Guest Rooms, Damen Avenue)



Published by the Office of Public Affairs 6-84

Association for Women in Mathematics

The Association for Women in Mathematics (AWM) will have a luncheon meeting at 12:15 p.m. on Saturday at a restaurant in the University area. Information about the location and other details will be available at the AWM desk near the meeting registration desk in Room 120 Science and Engineering Offices Building.

Accommodations

A block of rooms is being held at the following location for participants attending the meeting. These rooms were to be held until February 21, after which reservations will be accepted on a space available basis. Participants should make their own arrangements directly with the hotel and be sure to mention the AMS meeting at UIC when making reservations. A daily buffet breakfast is complimentary for hotel guests; however, individuals are expected to pay the appropriate tax and gratuity.

Hyde Park Hilton
4900 S. Lake Shore Drive, Chicago 60615
Telephone: 312-288-5800

Single $40 Double $46

The Hilton is several miles from the campus; however, complimentary limousine service is provided to and from McCormick Place as well as to and from the UIC campus. Parking is complimentary for hotel guests.

Rooms have **not** been blocked at any of the following locations, and they are listed here for information purposes. Participants should make their own arrangements directly with the hotel or motel of their choice and identify themselves as attending the AMS meeting at the University of Illinois when making reservations.

Americana Congress
520 S. Michigan Avenue, Chicago 60605
Telephone: 312-427-3800

Single $40 Double $50

The Americana Congress is a mile and a half east of the campus.

Bismark Hotel
171 West Randolph, Chicago 60601
Telephone: 312-236-0123

Single $32 Double $40

The Bismark is on the north side of the Loop, about two miles from campus.

Blackstone Hotel
636 S. Michigan Avenue, Chicago 60605
Telephone: 312-427-4300

Single $42 Double $47

The Blackstone Hotel is about a mile and a half east of the campus.

Comfort Inn
506 W. Harrison Street, Chicago 60607
Telephone: 312-427-6969

Single $35 Double $45

Comfort Inn (formerly Ramada Inn) is five blocks east of campus and just south of the Eisenhower Expressway.

Quality Inn
1 S. Halsted Street, Chicago 60606
Telephone: 312-829-5000

Single $32 Double $38

Quality Inn (formerly Holiday Inn) is six blocks north of campus and just west of the Kennedy Expressway.

University of Illinois Housing Office
1933 West Polk Street, Chicago 60612
Telephone: 312-996-8100

Single $36–40 Double $42–46

Reservations for University Housing Service guest rooms are handled by the Housing Office (Number 65 on the map); both are located on the west end of the campus (Health Sciences Center), a mile west of the University Center end of campus where the scientific sessions will take place. Shuttle buses run a continuous circuit between the east and west campus about every 20 minutes.

Food Service

The cafeteria in the Chicago Circle Center (Number 12 on the map) will be open on Friday from 7:30 a.m. until 2:00 p.m., but will not be open on Saturday. A few blocks north of the campus (on Halsted Street) is Greek Town, where several Greek restaurants are located. Immediately to the west of the campus are numerous Italian restaurants. Participants who wish to go into the Loop to eat should note that bus and subway transfers (10 cents in addition to the base 90 cents fare) are good for one hour and can be used for the return trip from the Loop.

Travel

The University of Illinois at Chicago University Center is located just west and south of the junction of the three major expressways: the Kennedy (I-90), Eisenhower (I-294), and Dan Ryan (I-94). Arriving by car from the **north** take I-90 to I-294 westbound and keep to the right. Take the first exit (Morgan Street) from I-294 and go one block south to the campus. From the **south** take the Dan Ryan (I-94) and exit at 1200 South (Roosevelt Road) or 1000 South (Taylor Street); go west one block on either Roosevelt or Taylor to the campus. From the **west** take the Eisenhower Expressway (I-294) to the Racine Avenue exit; go one-half block south to Harrison Street, then east one block to the campus. From the **east** take Harrison Street west to the campus.

If coming to the campus by bus, participants should use any of the following: No. 60 Blue Island–26th St.; No. 8 Halsted Street; No. 7 Harrison St.; No. 12 Roosevelt Road; or No. 37 Taylor Street.

The Halsted/University of Illinois stop on the route of the Douglas-Milwaukee-Congress elevated-subway trains is at the north edge of the campus in the middle of the Eisenhower Expressway (Number 25 on the map). Both the A and B trains stop at Halsted, which is the first stop above ground after the

line leaves the subway heading west from the Loop. This line provides service all the way to O'Hare Airport; the trip from O'Hare to Halsted takes about 45 minutes. Information about the Chicago Transit Authority buses and trains can be obtained by calling 312-836-7000.

Trains of the Burlington Northern, Penn Central, Milwaukee Road and the Illinois Central Gulf railroads arrive at Chicago's Union Station, one mile north and east of the campus. Northwestern trains arrive at the Northwestern Station two blocks north of Union Station. From there take the No. 60 bus (Blue Island-26th Street) at Clinton and Madison, Adams or Jackson Streets. Some Illinois Central, and all South Shore trains, arrive at the IC Station at Randolph Street and Michigan Avenue. From the station walk three blocks west to Dearborn Street and take a westbound A or B train on the Douglas-Congress- Milwaukee subway to the Halsted/UIC station. Rock Island trains arrive at the LaSalle Street Station; take westbound subway at LaSalle and Congress to Halsted (second stop).

Elevated-subway trains run every 10 minutes from O'Hare Airport to the Loop, and the fare is 90 cents. Taxicabs charge about $20 for the trip from O'Hare to the Loop, and airport buses charge $6.75 for the same trip. C & W Limousine Service from O'Hare to the Hilton at Hyde Park is $7.50.

Parking

Visitors to the University may park in any one of the following cash lots; the fee is $3.

Lot 4: Garage on Halsted with entrances on Polk and Taylor Streets.

Lot 5C: Lot on Morgan Street near Roosevelt Road.

Lot 7: Garage between Morgan Street and Racine Avenue, with visitor's entrance on Harrison.

Participants driving to the campus should be aware that street parking in the residental area just west of the campus is restricted to area residents by special permit only.

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
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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 March 1985 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.

Friday, March 22, 1985, 8:00 a.m.

Special Session on Periodic and Almost Periodic Solutions to Differential Equations, I — Lecture Center D4

8:00– 8:20 (1) *Periodic solutions of neutral integrodifferential equations.* Preliminary report. WANG ZHICHENG, Hunan University, People's Republic of China (817-34-60) (Sponsored by T. A. Burton)

8:25– 8:45 (2) *Ω-limits in a multi-parameter model of the immune response.* Preliminary report. STEPHEN J. MERRILL, Marquette University (817-34-41) (Sponsored by T. A. Burton)

8:50– 9:10 (3) *Singular perturbations near the zero of a leading coefficient for periodic solutions of a nonlinear equation.* VADIM KOMKOV, Winthrop College (817-34-65)

9:15– 9:35 (4) *Nonlinear evolution equations with almost periodic time dependence.* GEORGE SEIFERT, Iowa State University (817-34-76)

9:40–10:00 (5) *Disconjugacy of periodic equations.* A. M. FINK*, Iowa State University and S. B. ELIASON, University of Oklahoma, Norman (817-34-66)

10:05–10:25 (6) *Periodic solutions of an integro-differential system.* Preliminary report. W. E. MAHFOUD, Murray State University (817-34-75)

10:30–10:50 (7) *Entrainment of frequency in singularly perturbed systems.* Preliminary report. JANE CRONIN SCANLON, Rutgers University, New Brunswick (817-34-148)

Friday, March 22, 1985, 8:15 a.m.

Session on Analysis — Lecture Center D2

8:15– 8:25 (8) *Newton's theorem, convolution, and log concave ratios.* JAMES R. KENEVAN, Illinois Institute of Technology (817-65-147) (Sponsored by Thom Grace)

8:30– 8:40 (9) *Uniqueness for some singular backward diffusion equations.* Preliminary report. ALAN V. LAIR, Air Force Institute of Technology (817-35-79)

8:45– 8:55 (10) *Random variables for which a given function of any of them has a given density.* Preliminary report. JAMES S. WEBER, Roosevelt University (817-60-130)

9:00– 9:10 (11) *Superlogic EXAM: Quantum-logic in superspace.* STEPHEN L. WEINBERG, Berkeley Academy of Artscience (817-81-88)

9:15– 9:25 (12) *Best L_1-approximation by convex functions.* ROBERT HUOTARI*, Indiana University-Purdue University, Fort Wayne, and AARON D. MEYEROWITZ, Ohio State University, Columbus (817-41-81)

9:30– 9:40 (13) *A symbolic method for Laplace's equation on polygonal domains with mixed boundary conditions.* HERBERT H. SNYDER, Southern Illinois University, Carbondale, and RALPH W. WILKERSON*, University of Missouri, Rolla (817-35-95)

9:45– 9:55 (14) *Mean and pointwise ergodic theorems for cosine operator functions.* SEN-YEN SHAW, National Central University, Taiwan, Republic of China (817-47-104)

10:00–10:10 (15) *Fubini theorem for the abstract Henstock integral.* KRZYSZTOF OSTASZEWSKI, University of Washington (817-28-127)

10:15–10:25 (16) *Abstract H^1 and BMO spaces.* Preliminary report. J. K. BROOKS* and NICOLAE DINCULEANU, University of Florida (817-60-108)

10:30–10:40 (17) *Some solutions of the two-dimensional Korteweg-deVries equations.* YUKAI CHEN and SHIH-LIANG WEN*, Ohio University, Athens (817-76-99)

10:45–10:55 (18) *On discretized iterative methods.* Preliminary report. GEORGE MIEL, University of Nevada, Las Vegas (817-65-138)

Friday, March 22, 1985, 8:30 a.m.

Special Session on Mathematical Computer Sciences, I — Lecture Center F3

8:30– 8:50 (19) *Henkin quantifiers and complete problems.* ANDREAS BLASS* and YURI GUREVICH, University of Michigan, Ann Arbor (817-68-144)

9:00– 9:20 (20) *Extensions of first-order logic by fixed point operators.* YURI GUREVICH, University of Michigan, Ann Arbor (817-68-125) (Sponsored by Wolfgang Maass)

9:30– 9:50 (21) *Computational complexity of real functions.* HARVEY FRIEDMAN, Ohio State University, Columbus (817-68-134)

10:00–10:20 (22) *Relative effectivity in the Siegel-Mahler Theorem.* Preliminary report. ANGUS MACINTYRE, Yale University and University of Illinois, Urbana-Champaign (817-03-103)

10:30–10:50 (23) *Quantifier elimination and automated deduction.* Preliminary report. KENNETH KUNEN, University of Wisconsin, Madison (817-68-135)

Friday, March 22, 1985, 8:30 a.m.

Special Session on Borel Structures and Classical Measure Theory, I — Lecture Center D5

8:30– 8:50 (24) *A review of the problems in 'Borel spaces'.* K. P. S. BHASKARA RAO*, Michigan Technological University, and B. V. RAO, Indian Statistical Institute, Calcutta (817-04-28) (Sponsored by Rae Michael Shortt)

9:00– 9:20 (25) *Countable Baire order and singular sets.* JACK B. BROWN, Auburn University, Auburn (817-28-04)

9:30– 9:50 (26) *Borel sets generated by open sets.* Preliminary report. A. H. STONE, University of Rochester (817-54-31)

10:00–10:20 (27) *Two remarks on Borel sets.* ARNOLD W. MILLER, University of Texas, Austin (817-04-25)

10:30–10:50 (28) *On the general theory of point sets,* II. JOHN C. MORGAN II, California Polytechnic University (817-28-09) (Sponsored by John R. Fisher)

Friday, March 22, 1985, 8:45 a.m.

Session on Set Theory — Lecture Center F4

8:45– 8:55 (29) *Heyting algebras with a dual lattice endomorphism.* HANAMANTAGOUDA P. SANKAPPANAVAR, State University of New York, New Paltz (817-03-139)

9:00– 9:10 (30) *Maximal p-subgroups and the axiom of choice.* Preliminary report. PAUL E. HOWARD and MARY F. YORKE*, Eastern Michigan University (817-03-01)

9:15– 9:25 (31) *Category and measure for classes of relational structures.* Preliminary report. PAUL BANKSTON, Marquette University (817-03-105)

9:30– 9:40 (32) *Measurability and the Baire property in higher levels.* M. SREBRNY, Polish Academy of Sciences, Warsaw (817-03-54) (Sponsored by A. S. Kechris)

9:45– 9:55 (33) *Buchi's axiomatic convexity theory.* Preliminary report. WILLIAM E. FENTON, Bellarmine College (817-05-42)

10:00–10:10 (34) *Existential definability in, and undecidable extensions of, the theory of concatenation.* Preliminary report. J. R. BUCHI, Purdue University, West Lafayette, and STEVEN SENGER*, University of Wisconsin, La Crosse (817-03-132)

10:15–10:25 (35) *The Tarski algorithm for* ORD. IRVING H. ANELLIS, University of Iowa (817-03-02)

Friday, March 22, 1985, 8:45 a.m.

Session on Algebra — Lecture Center F6

8:45– 8:55 (36) *Odd triperfect numbers are divisible by at least twelve distinct primes.* MASAO KISHORE, East Carolina University (817-11-89)

9:00– 9:10 (37) *Integer division.* SOO I. KANG, East Carolina University (817-11-131)

9:15– 9:25 (38) *Pythagorean triangles of equal area.* Preliminary report. MALVINA BAICA, University of Wisconsin, Whitewater (817-11-84)

9:30– 9:40 (39) *Combinatorial proofs of some enumeration identities.* A. K. AGARWAL, Pennsylvania State University, University Park (817-11-118) (Sponsored by George E. Andrews)

9:45– 9:55 (40) *Function fields of general type.* Preliminary report. JAMES K. DEVENEY, Virginia Commonwealth University (817-12-101)

10:00–10:10 (41) *The Kirillov correspondence for exponential solvable Lie groups: Application of Pedersen's character formula.* Preliminary report. BRADLEY CURREY, Purdue University, West Lafayette (817-22-120)

10:15–10:25 (42) *A note on quadratic subspaces.* S. D. PEDDADA, Central Michigan University (817-15-86) (Sponsored by Richard J. Fleming)

10:30–10:40 (43) *Serial rings with right Krull dimension one.* MARY H. UPHAM, Southern Illinois University, Carbondale (817-16-90)

Friday, March 22, 1985, 9:00 a.m.

Special Session on Stochastic Analysis and Related Topics, I — Lecture Center F1

9:00– 9:20 (44) *On non-euclidean harmonic measure.* MARK PINSKY, Northwestern University (817-60-80)

9:30– 9:50 (45) *Exit times from cones in* $\mathbf{R}^3$ *of Brownian motion.* R. DANTE DEBLASSIE, Texas A&M University, College Station (817-60-57)

10:00–10:20 (46) *Large deviations of Markov additive processes.* P. NEY*, University of Wisconsin, Madison, and E. NUMMELIN, University of Helsinki (817-60-100)

10:30–10:50 (47) *Getting to zero fast (or slowly).* STEVEN OREY, University of Minnesota, Minneapolis (817-60-137)

Friday, March 22, 1985, 9:30 a.m.

Session on Graph Theory — Lecture Center D1

9:30– 9:40 (48) *Biplanes and Singer groups.* Preliminary report. K. T. ARASU, Wright State University (817-05-106)

9:45– 9:55 (49) *On the euclidean dimensions of a wheel.* FRED BUCKLEY, Baruch College, City University of New York, and FRANK HARARY*, University of Michigan, Ann Arbor (817-05-119)

10:00–10:10 (50) *Association schemes on the flags of a symmetric design.* KEN W. SMITH, Central Michigan University (817-05-128)

Friday, March 22, 1985, 11:00 a.m.

Invited Address — Lecture Center F6

11:00–12:00 (51) *Some results of twistor theory in general relativity.* ROGER PENROSE, Mathematical Institute, Oxford, England, and Rice University (817-83-97)

Friday, March 22, 1985, 1:30 p.m.

Invited Address — Lecture Center F6

1:30– 2:30 (52) *Random Fourier series.* MICHAEL MARCUS, Texas A&M University, College Station (817-60-109)

Friday, March 22, 1985, 3:00 p.m.

Special Session on History of Logic, I — Lecture Center F4

3:00– 3:20 (53) *The reception of Gödel's incompleteness theorems.* JOHN W. DAWSON, JR., Pennsylvania State University, York (817-01-48)

3:30– 3:50 (54) *Oswald Veblen and the origins of mathematical logic in Princeton.* Preliminary report. WILLIAM ASPRAY, Charles Babbage Institute, Minneapolis (817-01-56) (Sponsored by Thomas L. Drucker)

4:00– 4:20 (55) *The development of self-reference.* Preliminary report. C. SMORYŃSKI, San Jose State University (817-03-55)

4:30– 4:50 (56) *Some aspects of changes in the use of intuitionistic logic.* Preliminary report. WIM RUITENBURG, Marquette University (817-03-116)

5:00– 5:20 (57) *Methods in recursion theory.* ROBERT I. SOARE, University of Chicago (817-03-70)

Friday, March 22, 1985, 3:00 p.m.

Special Session on Periodic and Almost Periodic Solutions of Differential Equations, II — Lecture Center D4

3:00– 3:20 (58) *Almost periodic solutions of linear integrodifferential systems.* Preliminary report. CARL E. LANGENHOP, Southern Illinois University, Carbondale (817-45-35)

3:25– 3:45 (59) *Periodic solutions of functional differential equations.* O. ARINO, University of Pau, France, T. A. BURTON, Southern Illinois University, Carbondale, and J. HADDOCK*, Memphis State University (817-34-82)

3:50– 4:10 (60) *Comparison theorems for difference equations.* Preliminary report. ALLAN C. PETERSON, University of Nebraska, Lincoln (817-34-49)

4:15– 4:35 (61) *Stable or semi-stable periodic solutions for a class of autonomous systems in* $\mathbf{R}^3$. Preliminary report. DANIEL S. LEVINE, University of Texas, Arlington (817-34-44)

4:40– 5:00 (62) *Periodic solutions of linear Volterra integral equations.* Preliminary report. MUHAMMAD N. ISLAM, Southern Illinois University, Carbondale (817-45-36)

5:05– 5:25 (63) *Positive periodic solutions to a class of action integrals.* Preliminary report. JAMES K. PETERSON, Michigan Technological University (817-34-68) (Sponsored by Rae Michael Shortt)

5:30– 5:50 (64) *On functional differential systems having as solutions sums of periodic functions with distinct periods.* OVIDE ARINO, Faculté des Sciences, Pau, France (817-34-27) (Sponsored by T. A. Burton)

Friday, March 22, 1985, 3:00 p.m.

Special Session on Groups and Geometries, I — Lecture Center F6

3:00– 3:20 (65) *Gamma-spaces whose planes are affine.* Preliminary report. ERNEST SHULT, Kansas State University (817-51-23) (Sponsored by Stephen D. Smith)

3:30– 3:50 (66) *The 27 dimensional module for E_6.* Preliminary report. MICHAEL ASCHBACHER, California Institute of Technology (817-20-14)

4:00– 4:20 (67) *Folding trees.* ALBERTO L. DELGADO, Kansas State University (817-99-150)

4:30– 4:50 (68) *Flag collineation groups and projective planes of square orders.* CHAT Y. HO, University of Toronto (817-99-152) (Sponsored by Mark A. Ronan)

Friday, March 22, 1985, 3:00 p.m.

Special Session on Mathematical Computer Sciences, II — Lecture Room F3

3:00– 3:20 (69) *Some open problems in computational geometry.* FRANCO P. PREPARATA, University of Illinois, Urbana-Champaign (817-68-142) (Sponsored by Wolfgang Maass)

3:30– 3:50 (70) *Decoding the Golay codes.* Preliminary report. VERA PLESS, University of Illinois, Chicago (817-68-83)

4:00– 4:20 (71) *Permutation group algorithms based on partitions.* Preliminary report. JEFFREY S. LEON, University of Illinois, Chicago (817-20-94) (Sponsored by Wolfgang Maass)

4:30– 4:50 (72) *Factoring with cyclotomic polynomials.* Preliminary report. ERIC BACH, University of Wisconsin, Madison (817-11-124) (Sponsored by Wolfgang Maass)

5:00– 5:20 (73) *An efficient average-case algorithm for finding a maximum clique of intersecting chords.* Preliminary report. GLENN K. MANACHER, University of Illinois, Chicago (817-68-136)

5:30– 5:50 (74) *Greedy algorithms for covering polygons with rectangles.* Preliminary report. DEBORAH S. FRANZBLAU, Massachusetts Institute of Technology (817-68-71)

Friday, March 22, 1985, 3:00 p.m.

Special Session on Borel Structures and Classical Measure Theory, II — Lecture Center D5

3:00– 3:20 (75) *Bayesian states on quantum logics.* THOMAS E. ARMSTRONG*, University of Maryland, Baltimore County, and University of Minnesota, Minneapolis, and STANLEY GUDDER, University of Denver (817-28-07)

3:30– 3:50 (76) *An exhaustive submeasure which dominates no nonzero measure.* ROY A. JOHNSON, Washington State University (817-28-24)

4:00– 4:20 (77) *Truncation and density for non-negative sequences.* Preliminary report. DOROTHY STONE, University of Rochester (817-28-32)

4:30– 4:50 (78) *Monotone L_1-approximation on the unit n-cube.* Preliminary report. RICHARD B. DARST*, Colorado State University, Fort Collins, and ROBERT HUOTARI, Indiana University-Purdue University, Fort Wayne (817-28-06)

5:00– 5:20 (79) *A Riemann integral and the divergence theorem.* WASHEK F. PFEFFER, University of California, Davis (817-28-33)

5:30– 5:50 (80) *Compact sets of measures.* Preliminary report. WAYNE C. BELL, University of Tennessee, Knoxville (817-28-87)

Friday, March 22, 1985, 3:00 p.m.

Special Session on Stochastic Analysis and Related Topics, II — Lecture Center F1

3:00– 3:20 (81) *A measure valued Markov process.* Preliminary report. ERHAN ÇINLAR, Northwestern University (817-60-73)

3:30– 3:50 (82) *A two-sided stochastic integral.* Preliminary report. ETIENNE PARDOUX, Université de Provence, France, and PHILIP PROTTER*, Purdue University, West Lafayette (817-60-63)

4:00– 4:20 (83) *Lyapunov exponents of linear stochastic systems.* WOLFGANG KLIEMANN, Iowa State University (817-60-102) (Sponsored by Philip Protter)

4:30– 4:50 (84) *Malliavin calculus with jumps.* KLAUS BICHTELER, University of Texas, Austin (817-60-145)

Friday, March 22, 1985, 3:00 p.m.

Special Session on K-theory, I — Lecture Center D1

3:00– 3:20 Problem Session

3:30– 3:50 (85) *Module structures on the K-theory of graded rings.* CHARLES A. WEIBEL, Rutgers University, New Brunswick (817-18-15)

4:00– 4:20 (86) *Localization sequences in algebraic K-theory.* MARC LEVINE, Northeastern University (817-14-51) (Sponsored by Henri Gillet)

4:30– 4:50 (87) *Applications of a Künneth formula trick to algebraic K-theory and homology of groups.* Preliminary report. A. J. BERRICK, National University of Singapore (817-55-77)

5:00– 5:20 (88) *Relative algebraic K-theory.* Preliminary report. HENRI A. GILLET, University of Illinois, Chicago (817-14-29)

5:30– 5:50 Problem Session

Friday, March 22, 1985, 3:00 p.m.

Session on Geometry Lecture Center D2

3:00– 3:10 (89) *Collinearity and correlation.* SEYMOUR KASS, University of Massachusetts, Boston (817-51-93)

3:15– 3:25 (90) *Euler characteristic.* C. C. HSIUNG, Lehigh University, and KEN SHISKOWSKI*, Eastern Michigan University (817-53-111)

3:30– 3:40 (91) *Flows on the torus.* C. J. GARDINER, Eastern Michigan University (817-58-113)

3:45– 3:55 (92) *A version of the generalized Jones polynomial which is positive for positive knots.* JAMES M. VAN BUSKIRK, University of Oregon, Eugene (817-57-121)

Saturday, March 23, 1985, 8:00 a.m.

Special Session on Periodic and Almost Periodic Solutions of Differential Equations, III Lecture Center D4

8:00– 8:20 (93) *On steady-state oscillation of linear periodic dissipative systems with time slowly varying coefficients.* Preliminary report. LIAN WANG* and MU-QIU WANG, Academia Sinica, People's Republic of China (817-34-52)

8:25– 8:45 (94) *On existence of periodic solution of large scale system.* Preliminary report. MU-QIU WANG* and LIAN WANG, Academia Sinica, People's Republic of China (817-34-53)

8:50– 9:10 (95) *On stability and boundedness of nonautonomous systems.* Preliminary report. LI SENLIN and JIANHONG WU*, Hunan University, People's Republic of China (817-34-59) (Sponsored by T. A. Burton)

9:15– 9:35 (96) *Periodic and almost periodic solutions to some nonconvolution integral equations.* Preliminary report. C. CORDUNEANU, University of Texas, Arlington (817-45-114)

9:40–10:00 (97) *Boundedness and periodicity in Volterra equations.* Preliminary report. T. A. BURTON, Southern Illinois University, Carbondale, and SHUNIAN ZHANG*, Anhui University, People's Republic of China and Southern Illinois University, Carbondale (817-45-112)

10:05–10:25 (98) *A generalized inverse procedure for bifurcation problems.* W. S. LOUD, University of Minnesota, Minneapolis (817-34-92)

10:30–10:50 (99) *Bifurcation to periodic orbits and tori for ordinary differential systems.* Preliminary report. STEPHEN R. BERNFELD* and LUIGI SALVADORI, University of Texas, Arlington (817-34-67)

Saturday, March 23, 1985, 8:30 a.m.

Special Session on Mathematical Computer Sciences, III Lecture Room F3

8:30– 8:50 (100) *Recursion theoretic learning theory.* Preliminary report. JOHN CASE, State University of New York, Buffalo (817-68-110) (Sponsored by Wolfgang Maas)

9:00– 9:20 (101) *Communication complexity: The many player case.* MERRICK L. FURST*, Carnegie-Mellon University, ASHOK CHANDRA, IBM, Yorktown Heights, and RICHARD LIPTON, Princeton University (817-05-126) (Sponsored by Wolfgang Maass)

9:30– 9:50 (102) *Overview of some open problems in algebraic and parallel complexity.* ALLAN B. BORODIN, University of Toronto (817-68-143) (Sponsored by Wolfgang Maass)

10:00–10:20 (103) *Generalized Boolean dependencies.* Preliminary report. JOEL BERMAN* and W. J. BLOK, University of Illinois, Chicago (817-68-91)

10:30–10:50 (104) *On some graphtheoretical problems arising in complexity theory.* GEORG SCHNITGER, Pennsylvania State University and University of Chicago (817-68-129) (Sponsored by Tom Leighton)

Saturday, March 23, 1985, 8:30 a.m.

Special Session on Borel Structures and Classical Measure Theory, III Lecture Center D5

8:30– 8:50 (105) *Notions of independence for random variables.* Preliminary report. R. M. SHORTT, Michigan Technological University (817-60-08)

9:00– 9:20 (106) *On independent complements.* D. RAMACHANDRAN, California State University, Sacramento (817-28-20)

9:30– 9:50 (107) *Disintegrations and perfect measures.* A. MAITRA, Indian Statistical Institute, Calcutta, and S. RAMAKRISHNAN*, University of Miami (817-28-05) (Sponsored by R. M. Shortt)

10:00–10:20 (108) *Perfect functions and Wichura's theorem.* Preliminary report. R. M. DUDLEY, Massachusetts Institute of Technology (817-60-12)

10:30–10:50 (109) *Another almost separable range theorem.* Preliminary report. KAREL PRIKRY, University of Minnesota, Minneapolis (817-28-17)

Saturday, March 23, 1985, 8:30 a.m.

Special Session on History of Logic, II — Lecture Center F4

8:30– 8:50 (110) *Peirce and the law of distribution.* NATHAN HOUSER, Indiana University-Purdue University, Indianapolis (817-01-62) (Sponsored by Thomas L. Drucker)

8:55– 9:15 (111) *The problem of elimination in the algebra of logic.* Preliminary report. JUDY GREEN, Rutgers University, Camden (817-01-122)

9:20– 9:40 (112) *The first Russell paradox.* IRVING H. ANELLIS, University of Iowa (817-01-37)

9:45–10:05 (113) *Principia mathematica and the development of automated theorem proving.* Preliminary report. DANIEL J. O'LEARY, General Electric Company, Syracuse (817-01-61)

10:10–10:30 (114) *Intuition versus computation in foundations of mathematics.* JAN MYCIELSKI, University of Colorado, Boulder (817-01-74)

10:35–10:55 (115) *Abraham Robinson and nonstandard analysis: Historical and philosophical implications.* Preliminary report. JOSEPH W. DAUBEN, Herbert H. Lehman College, City University of New York (817-01-115)

Saturday, March 23, 1985, 8:55 a.m.

Special Session on Plethysms, I — Lecture Center D2

8:55– 9:15 (116) *Multiplicities of $GL(V)$ in $S^t(S^r(V))$–Computation methods.* FRANK SERVEDIO, Montclair State College (817-20-123)

9:20– 9:40 (117) *λ-operations in the representation of finite classical groups.* HIROSHI UEHARA, Oklahoma State University, Stillwater (817-05-38)

9:45–10:05 (118) *The restriction of a plethysm to a Young subgroup.* JOSEPH P. BRENNAN, Michigan State University (817-20-133)

10:10–10:30 (119) *An algorithm for finding irreducible constituents of a symmetry class of tensors.* Preliminary report. JIRI PATERA, Université de Montréal (817-22-43)

10:35–10:55 (120) *Algorithms for plethysm.* YOUNG-MING CHEN*, Western Illinois University, and A. M. GARSIA and J. REMMEL, University of California at San Diego, La Jolla (817-99-151)

Saturday, March 23, 1985, 9:00 a.m.

Special Session on Groups and Geometries, II — Lecture Center F6

9:00– 9:20 (121) *Klein's correspondence and the ubiquity of translation planes.* GEOFFREY MASON, University of California, Santa Cruz (817-05-03) (Sponsored by Stephen D. Smith)

9:30– 9:50 (122) *On the nonexistence of certain geometries of hyperoctahedral type.* ROBERT A. LIEBLER, Colorado State University, Fort Collins (817-51-26)

10:00–10:20 (123) *The search for Tits geometries for the sporadic simple group M_{12}.* SARAH REES, University of Illinois, Chicago (817-20-40)

10:30–10:50 (124) *Transvection groups.* JONATHAN I. HALL, Michigan State University (817-20-107)

Saturday, March 23, 1985, 9:00 a.m.

Special Session on Stochastic Analysis and Related Topics, III — Lecture Center F1

9:00– 9:20 (125) *A central limit theorem for certain stopped sums and some applications.* ALLAN GUT, Uppsala University, Sweden, and Cornell University (817-60-50) (Sponsored by Philip Protter)

9:30– 9:50 (126) *An increasing diffusion.* THOMAS S. SALISBURY, Purdue University, West Lafayette (817-60-64)

10:00–10:20 (127) *A discontinuous time change for natural additive functionals which preserves duality.* JOANNA B. MITRO, University of Cincinnati (817-60-58)

10:30–10:50 (128) *Sharp inequalities for stochastic integrals and the optimal control of martingales.* DONALD L. BURKHOLDER, University of Illinois, Urbana-Champaign (817-60-96)

Saturday, March 23, 1985, 11:00 a.m.

Invited Address Lecture Center F6

11:00–12:00 (129) *Inflexions in characteristic* 3. GRAHAM HIGMAN, University of Illinois, Urbana-Champaign (817-20-149)

Saturday, March 23, 1985, 1:30 p.m.

Invited Address Lecture Center F6

1:30– 2:30 (130) *What are nonassociative algebras?* J. MARSHALL OSBORN, University of Wisconsin, Madison (817-17-30)

Saturday, March 23, 1985, 3:00 p.m.

Special Session on Borel Structures and Classical Measure Theory, IV Lecture Center D5

3:00– 3:20 (131) *A Radon-Nikodym theorem for vector valued processes with finite variation.* NICOLAE DINCULEANU, University of Florida (817-28-34)

3:30– 3:50 (132) *Complex Martingale convergence.* G. A. EDGAR, Ohio State University, Columbus (817-28-21)

4:00– 4:20 (133) *Radon-Nikodym derivatives and ergodic theorems.* C. E. SILVA, Williams College (817-28-13)

4:30– 4:50 (134) *Random constructions: asymptotic geometric and topological properties.* DAN MAULDIN*, North Texas State University, and STAN WILLIAMS, Utah State University (817-28-47)

5:00– 5:20 Problem Session

Saturday, March 23, 1985, 3:00 p.m.

Special Session on Plethysms, II Lecture Center, D2

3:00– 3:20 (135) *On calculating plethysms.* PHILBERT A. MORRIS, University of the West Indies, Trinidad (817-20-140) (Sponsored by Harold Ramkissoon)

3:30– 3:50 (136) *Plethysms in graphical enumeration.* RONALD C. READ, University of Waterloo (817-05-39) (Sponsored by J. A. Bondy)

4:00– 4:20 (137) *Shape-functors the plethysm S^nS^2, and James polynomials.* JACOB TOWBER, Depaul University (817-15-11) (Sponsored by Joseph P. Brannan)

4:30– 4:50 (138) *Symmetric functions and Koszul complexes.* Preliminary report. TADEUSZ JÓZEFIAK* and JERZY WEYMAN, Polish Academy of Sciences, Chopina (817-05-46)

5:00– 5:20 (139) *Adams operations on the projective representations of S_n and A_n.* Preliminary report. PETER HOFFMAN, University of Waterloo (817-20-141) (Sponsored by Joseph Brennan)

Saturday, March 23, 1985, 3:00 p.m.

Special Session on History of Logic, III Lecture Center F4

3:00– 3:20 (140) *Frege's distinction of sense and denotation of names and Russell's notion of proposition.* Preliminary report. ALONZO CHURCH, University of California, Los Angeles (817-01-117)

3:30– 3:50 (141) *Turing's work on computability and the history of computers.* MARTIN DAVIS, Courant Institute of Mathematical Sciences, New York University (817-01-98)

4:00– 4:20 (142) *The writing of "Introduction to Metamathematics".* STEPHEN C. KLEENE, University of Wisconsin, Madison (817-01-45)

4:30– 4:50 (143) *The work of J. Richard Büchi.* Preliminary report. DIRK SIEFKES, Technische Universität Berlin, Federal Republic of Germany (817-01-69) (Sponsored by Thomas L. Drucker)

5:00– 5:20 (144) *The finite injury method of recursion theory.* ANIL NERODE, Cornell University (817-01-146)

Saturday, March 23, 1985, 3:00 p.m.

Special Session on Groups and Geometries, III Lecture Center F6

3:00– 3:20 (145) *Distance-transitive graphs.* RICHARD WEISS, Tufts University (817-05-10)

3:30– 3:50 (146) *Coherent configurations and asymptotic group theory.* LÁSZLÓ BABAI, University of Chicago and Eötvös University, Budapest (817-05-78) (Sponsored by Mark A. Ronan)

4:00– 4:20 (147) *On a class of principal series unipotent representations of groups of type B_n.* DAVID B. SUROWSKI, Kansas State University (817-20-85)

4:30– 4:50 (148) *A new family of generalized quadrangles.* STANLEY E. PAYNE, University of Colorado, Denver (817-51-72)

Saturday, March 23, 1985, 3:00 p.m.

Special Session on K-theory, II Lecture Center D1

3:00– 3:20 (149) *Reduction theory for arithmetic subgroups of semisimple groups using semistability.* Preliminary report. DANIEL R. GRAYSON, University of Illinois, Urbana-Champaign (817-18-19)

3:30– 3:50 (150) *Cup products in sheaf cohomology.* Preliminary report. J. F. JARDINE, University of Western Ontario (817-18-22)

4:00– 4:20 (151) *Equivariant algebraic versus topological K-theory.* Preliminary report. R. W. THOMASON, Johns Hopkins University, Baltimore (817-14-16)

4:30– 4:50 (152) *Cyclic modules.* Preliminary report. WILLIAM G. DWYER, University of Notre Dame (817-18-18)

5:00– 6:00 Problem Session

Robert M. Fossum
Associate Secretary

Urbana, Illinois

Tucson, April 12–13, 1985, University of Arizona

Program for the 818th meeting

The eight hundred eighteenth meeting of the American Mathematical Society will be held at the University of Arizona, Tucson, on Friday and Saturday, April 12 and 13, 1985. This meeting will be held in conjunction with meetings of the Mathematical Association of America (MAA) and the Sociedad Matematica Mexicana (SMM).

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 and the titles of their talks are:

GEORGE M. BERGMAN, University of California, Berkeley, *Representable functors among categories of algebras.*

GREGORY BRUMFIEL, Stanford University, *Modern real algebra.*

Special Sessions

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

Abelian group theory, ROSS BEAUMONT, University of Washington. The speakers are Ulrich Albrecht, David M. Arnold, Doyle Cutler, Temple H. Fay, H. Pat Goeters, Alfred W. Hales, Paul Hill, Jutta Hausen, Roger Hunter, John Irwin, Patrick W. Keef, Mark Lane, Charles Megibben, Edwin P. Oxford, J. D. Reid, Alexander Soifer, C. Vinsonhaler, Robert B. Warfield, Jr., William Wickless, and George V. Wilson.

The arithmetic of algebraic function fields of one variable, DANIEL J. MADDEN, University of Arizona. The speakers are Michael D. Fried, Gerhard Frey, David M. Goss, David R. Hayes, Michael I. Rosen, Robert Alan Wake, and Horst H. Zimmer.

Galois module structure of algebraic number fields, ALBRECHT FRÖHLICH, King's College, University of London, England, and the University of Arizona. The speakers are Stephen U. Chase, Lindsay N. Childs, Ted Chinburg, Gary Cornell, Kurt Foster, Donald E. Maurer, Leon R. McCulloh, Olga Taussky-Todd, Martin Taylor, Stephen V. Ullom, and Stephen B. Watt.

New ideas in nonlinear science, ALAN C. NEWELL, University of Arizona. The speakers are Gregory Baker, J. Doyne Farmer, F. C. Hoppensteadt, Christopher Jones, and Maciej Wojtkowski.

Contributed Papers

There will also be a session for contributed ten-minute papers on Saturday morning.

MAA Program

The MAA Program will include two invited speakers. At the Friday evening banquet, IVAN NIVEN of the University of Oregon, President of the MAA, will deliver an address titled *Some observations on mathematics and mathematicians.* CONSTANCE REID, San Francisco, will deliver an address, the title of which will be announced at the meeting. In conjunction with the Sociedad Matematica Mexicana, a panel discussion on *The history of the mathematical relations between Mexico and the United States* will also take place.

Registration

The meeting registration desk will be located in Mathematics 402, and will be open from 9:00 a.m. to noon and 1:00 p.m. to 5:00 p.m. on Friday, and from 9:00 a.m. until noon on Saturday. The registration fees are $6 for members of the AMS, MAA, or SMM, $8 for nonmembers, and $2 for students or unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information about the petition table can be found in a box on page 26 in the Anaheim meeting announcement in the January issue of the *Notices.*

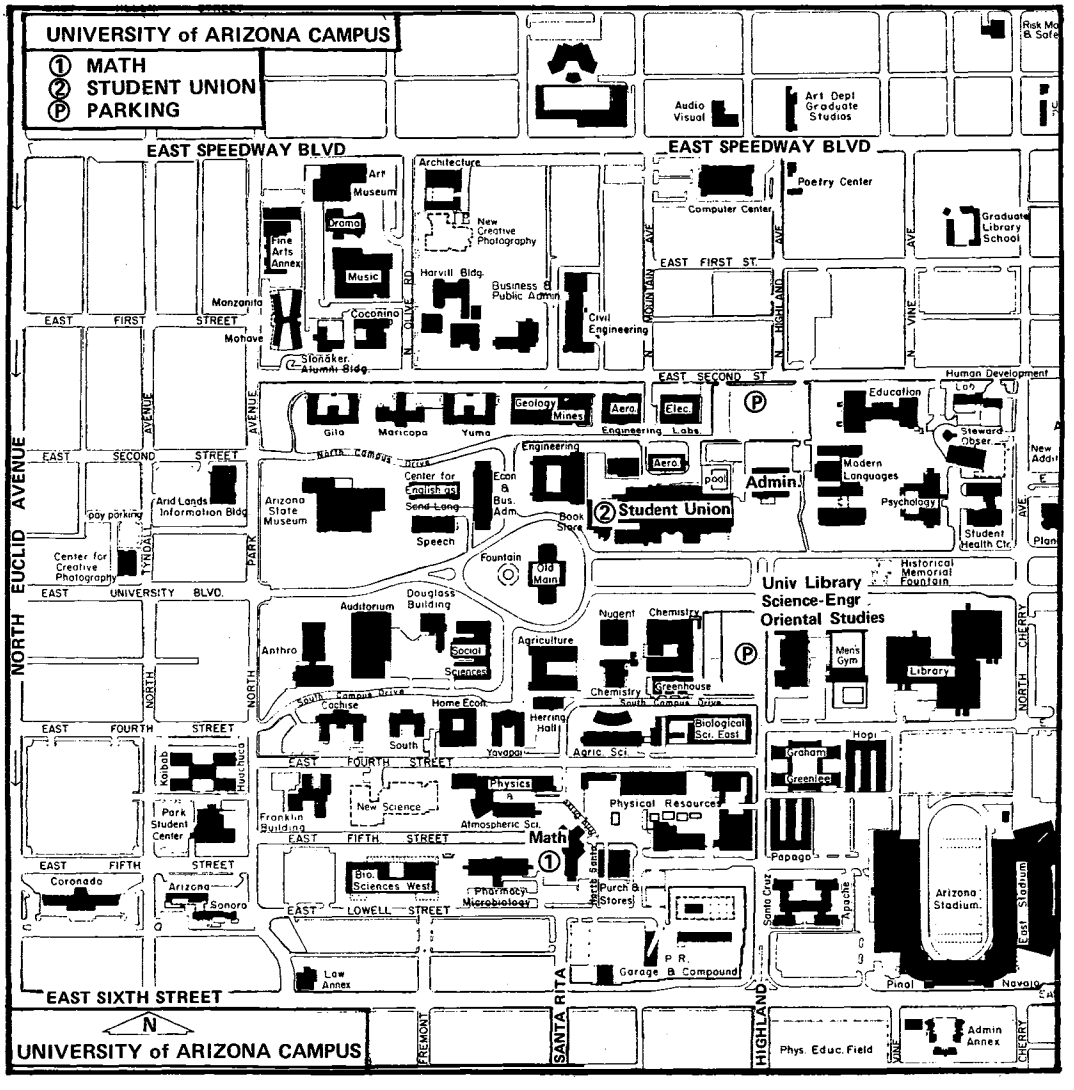
Accommodations

The following motels are located five miles or less from the campus. Participants should make their own reservations directly with the motel of their choice. Rates are subject to possible change, and do not include any applicable local taxes.

Arizona Inn (One mile from campus)
2200 East Elm Street 85719
Telephone: 602-325-1541
Toll free in Arizona: 800-421-1093
Single $75 and up Double $80 and up
Limousine fare from the airport to hotel is $5 per person.

Motel 6 (Five miles from campus)
960 South Freeway 85745
Telephone: 602-624-6345
Single $16.95 Double $20.95
Limousine fare from the airport to motel is approximately $5.25 per person.

Santa Rita Hotel and Conference Center
(Two miles from campus)
88 East Broadway 85701
Telephone: 602-791-7581 or toll free 800-528-3444
Toll free in Arizona: 800-362-3470
Single $34 Double $38
Complimentary limousine service from airport to the hotel. Limousine service also provided between hotel and campus; the fare is $1.50 per person. A welcome reception with complimentary margarita cocktails and dry snacks will be provided for hotel guests at


UNIVERSITY of ARIZONA CAMPUS
① MATH
② STUDENT UNION
Ⓟ PARKING
EAST SPEEDWAY BLVD
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NORTH EUCLID AVENUE
EAST UNIVERSITY BLVD.
EAST SIXTH STREET
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EAST SECOND STREET
EAST FOURTH STREET
EAST FIFTH STREET
EAST LOWELL STREET
EAST FIRST ST.
EAST SECOND ST
NORTH CAMPUS DRIVE
SOUTH CAMPUS DRIVE
Art Museum
Drama
Fine Arts Annex
Music
Architecture
New Creative Photography
Harvill Bldg.
Business & Public Admin.
Civil Engineering
Computer Center
Poetry Center
Graduate Library School
Audio Visual
Art Dept Graduate Studios
Risk Mgt. & Safety
Manzanita
Mohave
Coconino
Sloan Alumni Bldg.
Gila
Maricopa
Yuma
Geology
Mines
Aero. Engineering Labs
Elec.
Human Development
Education
Steward Observ.
Modern Languages
Psychology
Student Health Ctr.
Engineering
Aero.
pool
Admin
② Student Union
Book Store
Center for English as Second Lang. Speech
Econ & Bus. Adm.
Arizona State Museum
Arid Lands Information Bldg.
Gay parking
Center for Creative Photography
Tyndall
Park
Fountain
Old Main
Historical Memorial Fountain
Univ Library
Science-Engr
Oriental Studies
Men's Gym
Library
Auditorium
Douglass Building
Social Sciences
Anthro
Agriculture
Nugent
Chemistry
Greenhouse
Chemistry
Herring Hall
Agric. Sci.
Biological Sci. East
Cochise
Home Econ.
South
Yavapai
Graham
Greenlee
Hopi
Papago
Physics
New Science
Franklin Building
Atmospheric Sci.
Math
①
Physical Resources
Purch & Stores
Bio. Sciences West
Pharmacy
Microbiology
Santa Rita
Santa Cruz
Apache
Arizona Stadium
East Stadium
Pinal
Navajo
Koibab
Hualpai
Park Student Center
Coronado
Arizona
Sonora
Law Annex
P.R. Garage & Compound
Phys. Educ. Field
Admin Annex
N
UNIVERSITY of ARIZONA CAMPUS
FREMONT
SANTA RITA
HIGHLAND
VINE
CHERRY

poolside from 8:30 to 9:30 p.m. on Thursday, April 11.

Western 6 (Five miles from campus)
1338 West Grant Road 85745
Telephone: 602-622-4784

Single $21.95 Double $25.95

Limousine fare from airport to motel is $6.25 per person. Limousine service also available between motel and campus.

Food Service

Restaurants in the Student Union will be open during both days of the meeting. In addition, there are several restaurants within three blocks of the Mathematics Department.

Social

A banquet will be held at 7:00 p.m. on Friday in the Fiesta Room at the Santa Rita Hotel and Conference Center. The cost for the prime rib dinner will be $13 per person. Preceding the banquet there will be a no-host cash bar beginning at 6:00 p.m. Reservations and payment for the banquet should be sent by March 15 to William Y. Velez, Department of Mathematics, University of Arizona, Tucson, Arizona 85721.

Travel

Tucson is served by Greyhound and Trailways bus lines. The air carriers serving the Tucson Airport include Aero Mexico, Airways of New Mexico, American, American West, Eastern, Frontier, Northwest, PSA, Republic, Sun World, TWA, USAir, United, and Western Airlines. Arizona Stagecoach Limousine Service provides transportation between the airport and the university; the fare is approximately $5.25 per person. By reservation, Arizona Stagecoach will also transport participants from hotels to the university or back to the Tucson Airport. These reservations are required 24 hours in advance; the telephone number to call is 602-889-9681.

The University of Arizona campus is situated to the east of Interstate Route #10 (I-10), which runs from north to south. Drivers entering Tucson from either direction should take the Speedway Boulevard Exit and travel east for a distance of approximately two miles until reaching Euclid Avenue. Make a right turn onto Euclid Avenue; at the second traffic light turn left onto Sixth Street and proceed four blocks until reaching Santa Rita Avenue. A left turn at Santa Rita Avenue will lead directly to the Mathematics Building, a right turn will lead to the on-street parking, or drivers can continue on Sixth Street and make a left turn onto Highland Avenue. The latter will lead directly to the pay parking lot adjacent to the Science Library.

Parking

Free parking is available in the pay parking lots adjacent to the Science Library, or off Second Street north of the Administration Building. In order to obtain free parking, drivers must identify themselves to the attendants as participants at the AMS meeting. On-street parking is also available approximately three to four blocks directly south of the Mathematics Building.

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
•Invited one-hour lecturer *Special session speaker

*Albrecht, U., 27
*Arnold, D. M., 24
*Baker, G., 39
•Bergman, G. M., 47
•Brumfiel, G., 18
Carmichael, R. D., 40
*Chase, S. U., 30
*Childs, L. N., 29
*Chinburg, T., 28
Clay, J. R., 44
*Cornell, G., 34
*Cutler, D., 21
*Farmer, J. D., 35
*Fay, T. H., 13
*Foster, K., 31
*Frey, G., 2
*Fried, M. D., 1
*Goeters, H. P., 48
Goss, D. M., 5
*Hales, A. W., 17
Harary, F., 45
*Hausen, J., 20
*Hayes, D. R., 4
*Hill, P., 25
*Hoppensteadt, F. C., 36
*Hunter, R., 50
*Irwin, J., 15
*Jones, C., 37
*Keef, P. W., 19
Knoebel, A., 46
Kreith, K., 42
*Lane, M., 49
Lenihan, S. R., 41
*Maurer, D. E., 9
*McCulloh, L. R., 32
*Megibben, C., 26
O'Neill, J. D., 43
*Oxford, E. P., 16
*Reid, J. D., 52
*Rosen, M. I., 6
*Soifer, A., 12
*Taussky-Todd, O., 11
*Taylor, M., 8
*Ullom, S. V., 10
*Vinsonhaler, C., 23
*Wake, R. A., 3
*Warfield, R. B., Jr., 51
*Watt, S. B., 33
*Wickless, W., 14
*Wilson, G. V., 22
*Wojtkowski, M., 38
*Zimmer, H. G., 7

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 March 1985 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.

Friday, April 12, 1985, 8:30 a.m.

Special Session on the Arithmetic of Algebraic Function Fields of One Variable Mathematics 609

8:30– 8:50 (1) *A quantitative theory of "bad primes" for arithmetic statements based on Euler factors.* MICHAEL D. FRIED, University of California, Irvine (818-12-04)

9:00– 9:20 (2) *On the strong Lefschetz principle for function fields.* GERHARD FREY, Universität des Saarlandes, West Germany (818-14-21) (Sponsored by Daniel J. Madden)

9:30– 9:50 (3) *Global class field theory for function fields of characteristic zero.* ROBERT ALAN WAKE, University of California, Santa Cruz (818-12-35)

10:00–10:20 (4) *Special values of abelian L-functions in function fields.* Preliminary report. DAVID R. HAYES, University of Massachusetts, Amherst (818-12-26) (Sponsored by Daniel J. Madden)

10:30–10:50 (5) *P-class groups of curves in characteristic-p.* DAVID M. GOSS, Ohio State University, Columbus (818-12-51)

11:00–11:20 (6) *Fourier series and special values of L-functions.* BENEDICT H. GROSS and MICHAEL I. ROSEN*, Brown University (818-11-45)

11:30–11:50 (7) *Torsion groups of elliptic curves over quadratic fields.* Preliminary report. HANS H. MÜLLER and HORST G. ZIMMER*, University of the Saarland, West Germany (818-11-20) (Sponsored by Daniel J. Madden)

Friday, April 12, 1985, 12:30 p.m.

MAA Invited Address Mathematics 501

12:30– 1:30 Title to be announced. CONSTANCE REID, San Francisco, California

Friday, April 12, 1985, 1:40 p.m.

Special Session on Galois Module Structure of Algebraic Number Fields, I Mathematics 714

1:40– 2:10 (8) *Group laws and rings of integers.* MARTIN TAYLOR, Trinity College, United Kingdom (818-11-13) (Sponsored by Albrecht Frohlich)

2:20– 2:50 (9) *Stickelberger ideals and tame ramification.* Preliminary report. DONALD E. MAURER, Johns Hopkins University, Laurel (818-11-15)

3:00– 3:30 (10) *Multiplicator free groups.* Preliminary report. STEPHEN V. ULLOM, University of Illinois, Urbana-Champaign (818-12-19)

3:40– 4:10 (11) *Ideal matrices for normal fields.* OLGA TAUSSKY-TODD, California Institute of Technology (818-11-22)

Friday, April 12, 1985, 1:40 p.m.

Special Session on Abelian Group Theory, I Mathematics 609

1:40– 2:00 (12) *Countable $\aleph_0$-indecomposable mixed abelian groups of finite torsion-free rank.* SAHARON SHELAH, Hebrew University, Jerusalem, and ALEXANDER SOIFER*, University of Colorado, Colorado Springs (818-20-01)

2:05– 2:25 (13) *Generalized direct summands in an abelian category.* TEMPLE H. FAY*, University of Southern Mississippi, and MARIUS J. SCHOEMAN, University of Pretoria, Republic of South Africa (818-20-02)

2:30– 2:50 (14) *Irreducible groups, fields of definition and E-rings.* CHARLES VINSONHALER and WILLIAM WICKLESS*, University of Connecticut, Storrs (818-20-03)

2:55– 3:15 (15) *On essentially finitely indecomposable Abelian p-groups.* JOHN IRWIN*, Wayne State University, and DOYLE CUTLER, University of California, Davis (818-20-05) (Sponsored by Togo Nishiura)

3:20– 3:40 (16) *Cotorsion preradicals.* EDWIN P. OXFORD, Baylor University (818-20-06)

3:45– 4:05 (17) *Stable augmentation quotients of abelian groups.* ALFRED W. HALES, University of California, Los Angeles (818-20-07)

Friday, April 12, 1985, 4:20 p.m.

AMS Invited Address Mathematics 501

4:20– 5:20 (18) *Modern real algebra.* GREGORY BRUMFIEL, Stanford University (818-12-39)

Friday, April 13, 1985, 6:00 p.m.

Banquet and MAA Special Address Fiesta Room, Santa Rita Hotel and Conference Center

6:00– No host bar

7:00– Banquet

Some observations on mathematics and mathematicians, IVAN NIVEN, University of Oregon

Saturday, April 13, 1985, 8:00 a.m.

Special Session on Abelian Group Theory, II Biology West 210

8:00– 8:20 (19) *Immediate subgroups of totally projective Abelian groups.* PATRICK W. KEEF, Whitman College (818-20-08)

8:25– 8:45 (20) *Strongly homogeneous torsion-free abelian groups and generalizations.* JUTTA HAUSEN, University of Houston, University Park (818-20-09)

8:50– 9:10 (21) *Pure projective resolutions in the category of p-primary abelian groups.* DOYLE CUTLER, University of California, Davis (818-20-10)

9:15– 9:35 (22) *Modules with the summand intersection property.* GEORGE V. WILSON, University of Georgia (818-20-11)

9:40–10:00 (23) *Torsion-free E-modules.* C. VINSONHALER, University of Connecticut, Storrs (818-20-12)

10:05–10:25 (24) *Representing graphs for a class of torsion free Abelian groups.* Preliminary report. DAVID M. ARNOLD*, New Mexico State University, Las Cruces, and CHARLES I. VINSONHALER, University of Connecticut, Storrs (818-20-32)

10:30–10:50 (25) *Properties of IT-groups, pseudo d.s.c.'s, and the classification problem.* PAUL HILL*, Auburn University, Auburn, and CHARLES MEGIBBEN, Vanderbilt University (818-20-16) (Sponsored by Ross Beaumont)

10:55–11:15 (26) *On c-valuated groups and the equivalence of IT-groups.* PAUL HILL, Auburn University, Auburn, and CHARLES MEGIBBEN*, Vanderbilt University (818-20-18) (Sponsored by Ross Beaumont)

11:20–11:40 (27) *Endomorphism rings of abelian groups.* ULRICH ALBRECHT, Auburn University, Auburn (818-20-14)

Saturday, April 13, 1985, 8:00 a.m.

Special Session on the Galois Module Structure of Algebric Number Fields, II Biology West 212

8:00– 8:30 (28) *Root numbers and Galois module structure.* Preliminary report. TED CHINBURG, University of Pennsylvania (818-11-23)

8:35– 9:05 (29) *Tame Hopf objects and local normal bases.* LINDSAY N. CHILDS, State University of New York, Albany (818-13-24)

9:10– 9:40 (30) *Base-change formulae in Galois module structure and class field theory.* Preliminary report. STEPHEN U. CHASE, Cornell University (818-11-25) (Sponsored by Albrecht Fröhlich)

9:45–10:15 (31) *Distribution of Galois module classes.* Preliminary report. KURT FOSTER, University of Illinois, Urbana-Champaign (818-11-29)

10:20–10:50 (32) *Galois module structure of relative abelian extensions.* Preliminary report. LEON R. MCCULLOH, University of Illinois, Urbana-Champaign (818-11-30)

10:55–11:25 (33) *Relative genus theory and a class number problem for imaginary quadratic number fields.* STEPHEN B. WATT, University of Iowa (818-12-31)

11:30–12:00 (34) *Abelian p-extensions of Q.* GARY CORNELL*, University of Connecticut, Storrs, and MICHAEL ROSEN, Brown University (818-11-46)

Saturday, April 13, 1985, 8:40 a.m.

Special Session on New Ideas in Nonlinear Science Mathematics 714

8:40– 9:10 (35) *Sensitive dependence on parameters: Living with structurally unstable behavior.* Preliminary report. J. DOYNE FARMER, Los Alamos National Laboratories (818-34-53) (Sponsored by Alan C. Newell)

9:20– 9:50 (36) *A voltage-controlled oscillator neuron model.* F. C. HOPPENSTEADT, University of Utah (818-92-38)

10:00–10:30 (37) *The Maslov index and the nonlinear Schroedinger equation.* Preliminary report. CHRISTOPHER JONES, University of Arizona (818-35-48)

10:40–11:10 (38) *Principles for the design of billiards with nonvanishing Lyapunov exponents.* MACIEJ WOJTKOWSKI, University of Arizona (818-58-40)

11:20–11:50 (39) *Some aspects to the numerical solution of nonlinear boundary-value problems.* GREGORY BAKER, University of Arizona (818-65-47) (Sponsored by Alan C. Newell)

Saturday, April 13, 1985, 8:40 a.m.

Session for Contributed Papers Biology West 219

8:40– 8:50 (40) *Boundary values of generalizations of H^p functions in tubes.* Preliminary report. RICHARD D. CARMICHAEL, New Mexico State University, Las Cruces, and Wake Forest University (818-32-49)

9:00– 9:10 (41) *Comparison of convergence rates for Newton's method and power series solutions of Ricatti's equation.* Preliminary report. STANLEY R. LENIHAN, U.S. Army Yuma Proving Ground (818-34-37)

9:20– 9:30 (42) *Stability criteria for conjugate points of indefinite second order differential systems.* Preliminary report. KURT KREITH, University of California, Davis (818-34-41)

9:40– 9:50 (43) *On indecomposable projective modules.* JOHN D. O'NEILL, University of Detroit (818-16-42)

10:00–10:10 (44) *The d.g. near-ring generated by the endomorphisms of a one dimensional noncommutative formal group law.* Preliminary report. JAMES R. CLAY, University of Arizona (818-16-50) (Sponsored by Albrecht Fröhlich)

10:20–10:30 (45) *On graphs with signed inverses.* FRED BUCKLEY, Baruch College, City University of New York, and FRANK HARARY*, University of Michigan, Ann Arbor (818-05-43)

10:40–10:50 (46) *Symmetric media are embeddable in distributive lattices.* ARTHUR KNOEBEL, New Mexico State University, Las Cruces (818-06-44)

Saturday, April 13, 1985, 1:30 p.m.

AMS Invited Address Mathematics 501

1:30– 2:30 (47) *Representable functors among categories of algebras.* GEORGE M. BERGMAN, University of California, Berkeley (818-08-52)

Saturday, April 13, 1985, 2:40 p.m.

Special Session on Abelian Group Theory, III Biology West 210

2:40– 3:00 (48) *When two groups always have the same group of extensions.* Preliminary report. H. PAT GOETERS, Fairfield University (818-20-28) (Sponsored by William J. Wickless)

3:10– 3:30 (49) *Balanced projectives and axiom* 3. MARK LANE, Vanderbilt University (818-20-17) (Sponsored by Ross Beaumont)

3:35– 3:55 (50) *Simply presented valuated groups.* Preliminary report. ROGER HUNTER*, FRED RICHMAN and ELBERT WALKER, New Mexico State University, Las Cruces (818-20-33)

4:00– 4:20 (51) *One dimensional rings.* Preliminary report. ROBERT B. WARFIELD, JR., University of Washington (818-16-34)

4:25– 4:45 (52) *Some remarks on Warfield duality.* Preliminary report. J. D. REID, Wesleyan University (818-20-36)

Salt Lake City, Utah

Hugo Rossi
Associate Secretary

Worcester, April 20–21, 1985, College of the Holy Cross

Program for the 819th meeting

The eight hundred and nineteenth meeting of the American Mathematical Society will be held at the College of the Holy Cross in Worcester, Massachusetts, on Saturday and Sunday, April 20 and 21, 1985. The scientific sessions will be held in Haberlin Hall and in Swords Hall, the new science and mathematics complex at the College.

Invited Addresses

By invitation of the Committee to Select Hour Speakers for Central Sectional Meetings, there will be four invited one-hour addresses. These invited addresses will be presented in Room 103 Haberlin Hall. The speakers, their affiliations, the titles of their talks, and the scheduled times of presentation are as follows:

WILLIAM ABIKOFF, University of Connecticut, Storrs, *Kleinian groups–an invitation to mathematics*, 1:30 p.m. Saturday.

IRA M. GESSEL, Brandeis University, *Recent work in enumerative combinatorics*, 11:00 a.m. Sunday.

ROBERT W. THOMASON, Johns Hopkins University, *Algebraic and topological K-theory*, 1:30 p.m. Sunday.

STEPHEN S.-T. YAU, University of Illinois at Chicago and Yale University, *Isolated singularities and finite dimensional solvable Lie algebras*, 11:00 a.m. Saturday.

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, names of the organizers, and final lists of speakers, are as follows:

Geometric function theory, WILLIAM ABIKOFF and IRWIN KRA, SUNY at Stony Brook. The speakers will be William Abikoff, Lipman Bers, Clifford J. Earle, Frederick P. Gardiner, Frederick W. Gehring, Jane Gilman, Andrew Haas, Blaise Heltai, Eric Robert Jablow, Linda Keen, Irwin Kra, John Marafino, A. Marden, Bernard Maskit, Howard A. Masur, Robert F. Riley, Caroline Series, and Scott A. Wolpert.

Differential geometry of submanifolds, THOMAS E. CECIL, College of the Holy Cross and STEPHEN S.-T. YAU. The speakers will be Kinetsu Abe, Thomas F. Banchoff, David E. Blair, Carol Blomstrom, Thomas E. Cecil, Bang-Yen Chen, Richard H. Escobales, Jr., R. J. Fisher, Jr., Michael E. Gage, Detlef Gromoll, David A. Hoffman, Gerald Ludden, Martin Magid, Katsumi Nomizu, Patrick J. Ryan, and Chuu-Lian Terng.

Singularities and complex geometry, THOMAS E. CECIL and STEPHEN S.-T. YAU. The speakers will be Shreeram Abhyankar, Max Benson, Denis Blackmore, Alan Durfee, Robert Ephraim, Yih-Nan Gau, Anatoly S. Libgober, T. T. Moh, Peter Orlik, Donal B. O'Shea, Mark Spivakovsky, Alphonse T. Vasquez, and Bun Wong.

Enumerative combinatorics, IRA M. GESSEL. The speakers will be George E. Andrews, Anders Björner, D. M. Bressoud, D.I.A. Cohen, Paul H. Edelman, Ian P. Goulden, Gil Kalai, Gilbert Labelle, Pierre Leroux, S. G. Mohanty, Bruce Sagan, Louis Shapiro, Richard P. Stanley, D. Stanton, and Dennis White.

Fractal geometry, BENOIT B. MANDELBROT, IBM T. J. Watson Research Center and Harvard University. The speakers will be Michael Barnsley, Michael Benedicks, Daniel J. Bessis, Paul Blanchard, P. Cvitanovic, Robert L. Devaney, Adrien Douady, Serge Dubuc, William J. Gilbert, John H. Hubbard, Claude Itzykson, Benoit B. Mandelbrot, Richard P. McGehee, S. James Taylor, Nils Tongling, and Claude Tricot.

Methods of K-theory, ROBERT W. THOMASON. The speakers are Thomas Fischer, J. F. Jardine, Roy Joshua, Christian Kassel, Ronnie Lee, and Leonid Nison Vaserstein.

Contributed Papers

There will also be sessions for contributed ten-minute papers on Saturday afternoon and Sunday morning.

Council

The Council of the Society will meet at 1:00 p.m. on Friday, April 19, in Room A or B at the Howard Johnson's Motor Lodge which is adjacent to the Holy Cross campus.

Registration

The meeting registration desk will be located in Haberlin or Swords Hall, and signs will be posted directing participants to the registration area. The desk will be open from 8:00 a.m. until 3:00 p.m. on Saturday, and from 8:00 a.m. to 11:00 a.m. on Sunday. The registration fees are $10 for members, $16 for nonmembers, and $5 for students or unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information about the petition table can be found on page 26 in the Anaheim meeting announcement in the January issue of the *Notices*.

Accommodations

Rooms have been blocked at the Howard Johnson's Motor Lodge adjacent to the campus, and at the Quality Inn which is about a mile from the campus in downtown Worcester. Participants should make their own reservations directly with the motel of their choice and identify themselves as attending the meeting of the American Mathematical Society at

the College of the Holy Cross. The cutoff date for reservations at these two locations was **February 15**. The rates listed below are subject to change and do not include applicable taxes.

Howard Johnson's Motor Lodge
800 Southbridge Street
Worcester, MA 01610
Telephone: 617-791-5501
Single $41 Double $51

Quality Inn
70 Southbridge Street
Worcester, MA 01610
Telephone: 617-791-2291
Single $42 Double $48

The following motels are located between two and five miles from campus. Although rooms have not been blocked at any of these locations, they are included here for information purposes.

Best Western Centrum Inn
110 Summer Street
Worcester, MA 01610
Telephone: 617-757-0400
Single $45 Double $51

Days Lodge of Worcester
50 Oriol Drive
Worcester, MA 01610
Telephone: 617-852-2800
Single $42.88 Double $47.88

Howard Johnson's Motor Lodge
West Boylston Street
West Boylston, MA 01583
Telephone: 617-835-4456
Single $47 Double $54

Sheraton–Lincoln Inn
500 Lincoln Street
Worcester, MA 01610
Telephone: 617-852-4000
Single $67–$73 Double $76–$81

Worcester Marriott
10 Lincoln Square
Worcester, MA 01610
Telephone: 617-791-1600
Single $77 Double $89

Yankee Budget Motor Lodge
531 Lincoln Street
Worcester, MA 01610
Telephone: 617-852-5800
Single $26.96 Double $30.94

Yankee Drummer Inn
624 Southbridge Street
Auburn, MA 01501
Telephone: 617-832-3221
Single $49.90 Double $52.90

Food Service

A variety of options are available for luncheon in Hogan Center on Saturday and Sunday. A special section in the Center will be designated as the dining area for meeting participants, where meal service is cafeteria-style. Those who prefer to do so may wish to eat at Kimball Hall instead. Information about various restaurants in the Worcester area will be available at the meeting registration desk.

Social Event

A beer and pizza party will take place on Saturday evening in the atrium between Haberlin and Swords Halls. Although beer and soft drinks may be purchased on a cash basis during the party, participants must order and pay for their pizza at the meeting registration desk before 3:00 p.m. on Saturday.

Travel

The Worcester Airport is located about five miles from the Holy Cross campus. Airline service to Worcester is provided by Bar Harbor Airlines, with flights from Logan Airport in Boston and Laguardia Airport in New York. Tri State Airlines also provides service from Newark Airport, however, service on both of these carriers is very limited or nonexistent on Saturday and Sunday. Participants who fly to Logan Airport should make use of the Worcester Limousine Service, which will transport passengers directly to the campus or elsewhere in Worcester. The cost is $18 each way, but reduced rates usually apply when two or more passengers are transported to the same destination in Worcester. **Reservations are necessary** and may be obtained by calling 617-756-4834; at the same time information will be provided concerning passenger pickup at Logan.

Worcester is also served by both Greyhound and Trailways bus lines. The bus station is about one mile from the campus. Taxicab service is available from the bus station, and the cost for transportation to the campus is approximately $3.

Participants driving to the meeting should use Auburn Exit No. 10 from the Massachusetts Turnpike, then take Route 290 East to Worcester. The College Square Exit from Route 290 is a block from the campus.

Parking

Free parking is available at several lots located on the Holy Cross campus.

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 March 1985 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.

Saturday, April 20, 1985, 9:00 a.m.

Special Session on Geometric Function Theory, I — Haberlin Hall, Room 236

9:00– 9:20 (1) *Quadratic vector classes on Riemann surfaces.* ERIC ROBERT JABLOW, State University of New York, Stony Brook (819-30-22)

9:30– 9:50 (2) *Pointed families of Riemann surfaces and the Bers-Greenberg isomorphism theorem.* Preliminary report. CLIFFORD J. EARLE, Cornell University (819-32-33)

10:00–10:20 (3) *Accessory parameters for punctured spheres.* Preliminary report. IRWIN KRA, State University of New York, Stony Brook (819-30-39)

10:30–10:50 (4) *Schoenflies theorem for plane quasiisometries.* FREDERICK W. GEHRING, University of Michigan, Ann Arbor (819-30-19)

Saturday, April 20, 1985, 9:00 a.m.

Special Session on Differential Geometry of Submanifolds, I — Haberlin Hall, Room 412

9:00– 9:20 (5) *Isoparametric hypersurfaces.* Preliminary report. PATRICK J. RYAN, McMaster University (819-53-49)

9:30– 9:50 (6) *Topology of isoparametric submanifolds.* Preliminary report. WU-YI HSIANG, University of California, Berkeley, RICHARD S. PALAIS, Brandeis University, and CHUU-LIAN TERNG*, Northeastern University (819-53-62)

10:00–10:20 (7) *Dupin hypersurfaces.* THOMAS E. CECIL, College of the Holy Cross (819-53-52)

10:30–10:50 (8) *New tight polyhedra in 3-space.* THOMAS F. BANCHOFF, Brown University (819-53-84)

Saturday, April 20, 1985, 9:00 a.m.

Special Session on Singularities and Complex Geometry, I — Haberlin Hall, Room 408

9:00– 9:20 (9) *Topology of quasi-ordinary singularities.* YIH-NAN GAU, Rutgers University, New Brunswick (819-32-28)

9:30– 9:50 (10) *Mixed Hodge structure on certain homotopy groups.* Preliminary report. ANATOLY S. LIBGOBER, University of Illinois, Chicago (819-14-37)

10:00–10:20 (11) *The Betti numbers of an algebraic variety.* ALAN DURFEE, Mount Holyoke College (819-14-12)

10:30–10:50 (12) *Jacobian conjecture.* Preliminary report. T. T. MOH, Purdue University, West Lafayette (819-14-54)

Saturday, April 20, 1985, 9:00 a.m.

Special Session on Enumerative Combinatorics, I — Swords Hall, Room 312

9:00– 9:20 (13) *Independent sets in trees.* Preliminary report. BRUCE SAGAN, Middlebury College (819-05-01)

9:30– 9:50 (14) *On an inclusion-exclusion formula based on the reflection principle.* T. WATANABE, Gifu University, Japan, and S. G. MOHANTY*, McMaster University (819-05-86) (Sponsored by Ira M. Gessel)

10:00–10:20 (15) *Orthogonality in S_n.* Preliminary report. DENNIS WHITE, University of Minnesota, Minneapolis (819-05-20)

10:30–10:50 (16) *Supersolvable arrangements of hyperplanes.* Preliminary report. ANDERS BJÖRNER, Massachusetts Institute of Technology (819-05-69)

Saturday, April 20, 1985, 9:00 a.m.

Special Session on Fractal Geometry, I — Haberlin Hall, Room 237

9:00– 9:20 (17) *Fractals constructed from paths in directed graphs.* Preliminary report. WILLIAM J. GILBERT, University of Waterloo (819-51-07)

9:30– 9:50 (18) *Estimation of the fractal dimension by packing the complementary set.* Preliminary report. CLAUDE TRICOT, University of British Columbia (819-28-40) (Sponsored by Benoit B. Mandelbrot)

10:00–10:20 (19) *Multiple points of Brownian motion.* NILS TONGLING, Yale University (819-60-90) (Sponsored by Benoit B. Mandelbrot)

10:30–10:50 (20) *The use of packing measure to define a fractal index.* S. JAMES TAYLOR, University of Virginia (819-60-10)

Saturday, April 20, 1985, 11:00 a.m.

Invited Address Haberlin Hall, Room 103

11:00–12:00 (21) *Isolated singularities and finite dimensional solvable Lie algebras.* STEPHEN S.-T. YAU, Yale University and University of Illinois, Chicago (819-32-60)

Saturday, April 20, 1985, 1:30 p.m.

Invited Address Haberlin Hall, Room 103

1:30– 2:30 (22) *Kleinian groups—an invitation to mathematics.* WILLIAM ABIKOFF, University of Connecticut, Storrs (819-30-71)

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Geometric Function Theory, II Haberlin Hall, Room 236

2:45– 3:05 (23) *On Sullivan's proof of the finiteness theorem and the eventual periodicity theorem.* LIPMAN BERS, Columbia University and Graduate Center, City University of New York (819-30-09)

3:15– 3:35 (24) *A finiteness theorem for a dynamical class of entire functions.* LISA R. GOLDBERG, Brooklyn College, City University of New York, and LINDA KEEN*, Herbert H. Lehman College, City University of New York (819-30-34)

3:45– 4:05 (25) *Algebraic linearity for a surface diffeomorphism acting on simple curves.* Preliminary report. JOAN BIRMAN, Columbia University, and CAROLINE SERIES*, University of Pennsylvania (819-30-81) (Sponsored by William Abikoff)

4:15– 4:35 (26) *Diophantine approximation on hyperbolic surfaces.* ANDREW HAAS, University of Connecticut, Storrs (819-30-65)

4:45– 5:05 (27) *The dynamics of rational billiards.* HOWARD A. MASUR, Harvard University (819-32-66)

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Methods of *K*-theory, I Haberlin Hall, Room 414

2:45– 3:05 (28) *Cyclic homology and comodule structure.* CHRISTIAN KASSEL, Institute for Advanced Study (819-18-11)

3:15– 3:35 (29) *Becker-Gottlieb transfer in etale homotopy.* Preliminary report. ROY JOSHUA, Clark University (819-14-05)

3:45– 4:05 Problem Session

4:15– 4:35 (30) *Non-abelian cohomology of simplicial presheaves.* Preliminary report. J. F. JARDINE, University of Western Ontario (819-55-15)

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Differential Geometry of Submanifolds, II Haberlin Hall, Room 412

2:45– 3:05 (31) *2-type hypersurfaces and applications.* BANG-YEN CHEN, Michigan State University (819-53-03) (Sponsored by Thomas E. Cecil)

3:15– 3:35 (32) *Real Kaehler submanifolds and uniqueness of the Gauss map.* MARCOS DAJCZER, I. M. P. A., Rio de Janeiro, and DETLEF GROMOLL*, State University of New York, Stony Brook (819-53-83)

3:45– 4:35 (33) *Indefinite Riemannian geometry.* Preliminary report. KATSUMI NOMIZU*, Brown University, and MARTIN A. MAGID*, Wellesley College (819-53-51)

4:45– 5:05 (34) *Planar geodesic immersions in pseudo-Euclidean space.* CAROL BLOMSTROM, Wellesley College (819-53-63)

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Singularities and Complex Geometry, II Haberlin Hall, Room 408

2:45– 3:05 (35) *Singularities of basic invariants for reflection groups.* PETER ORLIK* and LOUIS SOLOMON, University of Wisconsin, Madison (819-14-27)

3:15– 3:35 (36) *On computing residues of certain meromorphic n-forms.* Preliminary report. MAX BENSON, University of Minnesota, Duluth (819-32-02)

3:45– 4:05 (37) *Characteristic pairs.* SHREERAM ABHYANKAR, Purdue University, West Lafayette (819-14-61)

4:15– 4:35 (38) *Iso-loci of coherent sheaves.* Preliminary report. ROBERT EPHRAIM, Bell Communications Research, Inc., Livingston, New Jersey (819-32-21)

4:45– 5:05 (39) *Some results and counterexamples in complex differential geometry.* BUN WONG, University of California, Riverside (819-32-70) (Sponsored by James Stafney)

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Fractal Geometry, II Haberlin Hall, Room 237

2:45– 3:05 (40) *Fractal interpolation.* Preliminary report. MICHAEL BARNSLEY, Georgia Institute of Techhnology (819-26-80) (Sponsored by Stephen Demko)

3:15– 3:35 (41) *Exploding Julia sets for entire functions.* ROBERT L. DEVANEY, Boston University (819-58-89)

3:45– 4:05 (42) *On Devaney hairs and the rays of the Mandelbrot set of* $z^2 + c$. JOHN H. HUBBARD, Cornell University (819-58-94) (Sponsored by Benoit B. Mandelbrot)

4:15– 4:35 (43) *On the size of the Mandelbrot elephants.* ADRIEN DOUADY, Université de Paris-Sud, France (819-58-93)

4:45– 5:05 Discussion

Saturday, April 20, 1985, 2:45 p.m.

Special Session on Enumerative Combinatorics, II Swords Hall, Room 312

2:45– 3:05 (44) *The seventh order mock theta functions.* GEORGE E. ANDREWS, Pennsylvania State University, University Park (819-05-43)

3:15– 3:35 (45) *Elementary polytopes.* GIL KALAI, Massachusetts Institute of Technology (819-52-85)

3:45– 4:05 (46) *Bijective proofs of basic hypergeometric series identities.* Preliminary report. J. JOICHI and D. STANTON*, University of Minnesota, Minneapolis (819-05-14)

4:15– 4:35 (47) *Constant term identities.* Preliminary report. D. M. BRESSOUD, Pennsylvania State University, University Park (819-05-53)

4:45– 5:05 Problem Session

Saturday, April 20, 1985, 2:45 p.m.

Session on Geometry and Topology Swords Hall, Room 314

2:45– 2:55 (48) *On the product of homogeneous spaces.* W. W. COMFORT*, Wesleyan University, and JAN VAN MILL, Vrije Universiteit, Amsterdam (819-54-08)

3:00– 3:10 (49) *An example concerning strong extreme points.* S. SWAMINATHAN, Dalhousie University (819-46-59)

3:15– 3:25 (50) *The Riemann-Christoffel tensors.* MICHAEL CAVAGNERO, TOM ROBERTS, RANDY SEMAGIN, DOMINA EBERLE SPENCER and SHAMA Y. UMA*, University of Connecticut, Storrs (819-53-79)

3:30– 3:40 (51) *Homeomorphic displacements and the infinitesimal pentagons.* DOMINA EBERLE SPENCER, University of Connecticut, Storrs (819-53-78)

3:45– 3:55 (52) *Geometric deformations of the evolution equations and Bäcklund transformations.* BOHUMIL CENKL, Northeastern University (819-53-77)

4:00– 4:10 (53) *Aspects of Morse theory.* DIANA KALISH, Fordham University (819-53-76)

Sunday, April 21, 1985, 8:30 a.m.

Special Session on Geometric Function Theory, III Haberlin Hall, Room 236

8:30– 8:50 (54) *Symmetric Riemann surfaces, torsion subgroups, and Schottky coverings.* BLAISE HELTAI, Indiana University, Bloomington (819-30-47)

9:00– 9:20 (55) *Holomorphic deformations of fuchsian groups by earthquaking/bending.* D. B. A. EPSTEIN, University of Warwick, England, and A. MARDEN*, University of Minnesota, Minneapolis (819-30-46)

9:30– 9:50 (56) *Iterates of Teichmüller modular transformations.* WILLIAM ABIKOFF, University of Connecticut, Storrs (819-30-82)

10:00–10:20 (57) *Some deformations in high codimension.* BERNARD MASKIT, State University of New York, Stony Brook (819-57-16)

10:30–10:50 (58) *Holomorphically parameterized families of groups in* $\mathrm{SL}(2, \mathbf{C})$. ROBERT F. RILEY, State University of New York, Binghamton (819-30-36) (Sponsored by William Abikoff)

Sunday, April 21, 1985, 8:30 a.m.

Special Session on Differential Geometry of Submanifolds, III — Haberlin Hall, Room 412

8:30– 8:50 (59) *Isometry groups of orthonormal frame bundles.* R. J. FISHER, JR.* and K. B. LEE, University of Oklahoma, Norman (819-53-103)

9:00– 9:20 (60) *When does inversion preserve convexity?* Preliminary report. DAVID E. BLAIR, Michigan State University (819-53-31)

9:30– 9:50 (61) *Hypersurfaces of complex hyperbolic space.* GERALD D. LUDDEN, Michigan State University (819-53-44)

10:00–10:20 (62) *Deforming convex plane curves with the heat equation.* MICHAEL E. GAGE*, University of Rochester, and RICHARD S. HAMILTON, University of California at San Diego, La Jolla (819-53-58)

10:30–10:50 (63) *The role of Riemannian submersions in differential geometry.* RICHARD H. ESCOBALES, JR., Canisius College (819-53-29)

Sunday, April 21, 1985, 8:30 a.m.

Special Session on Fractal Geometry, III — Haberlin Hall, Room 237

8:30– 8:50 (64) *Dyadic interpolation.* SERGE DUBUC, University of Montréal (819-26-55) (Sponsored by Aubert Daigneault)

9:00– 9:20 (65) *Symbols and the dynamics of polynomials.* Preliminary report. PAUL BLANCHARD, Boston University (819-58-101)

9:30– 9:50 (66) *Julia sets and localization properties of iterated families of algebraic integers.* DANIEL J. BESSIS* and JEFFREY S. GERONIMO, Georgia Institute of Technology, and PIERRE MOUSSA, Cen-Saclay, France (819-11-67)

10:00–10:20 (67) *Renormalization and fractal structure of singularities.* CLAUDE ITZYKSON, CEN-Saclay, France (819-58-92) (Sponsored by Benoit B. Mandelbrot)

10:30–10:50 (68) *Dynamics of rational maps after continuous-time interpolation and time reversal.* BENOIT B. MANDELBROT, IBM and Harvard University (819-58-91)

Sunday, April 21, 1985, 8:30 a.m.

Special Session on Enumerative Combinatorics, III — Swords Hall, Room 312

8:30– 8:50 Problem Session

9:00– 9:20 (69) *A combinatorial integral calculus.* Preliminary report. PIERRE LEROUX*, Université du Québec à Montréal, and GERARD X. VIENNOT, Université de Bordeaux, France (819-05-42)

9:30– 9:50 (70) *The cyclic type of combinatorial species.* Preliminary report. GILBERT LABELLE, Université du Québec à Montréal (819-05-41)

10:00–10:20 (71) *Continued fractions and Galois numbers.* LOUIS SHAPIRO, Howard University (819-05-96)

10:30–10:50 (72) *The Möbius function of the weak order of the symmetric group.* Preliminary report. PAUL H. EDELMAN, University of Pennsylvania (819-05-64)

Sunday, April 21, 1985, 9:00 a.m.

Special Session on Methods of K-theory, II — Haberlin Hall, Room 414

9:00– 9:20 (73) *Computation of K_1 via Mennicke symbols.* LEONID NISON VASERSTEIN, Pennsylvania State University, University Park (819-18-73)

9:30– 9:50 (74) *K-theory techniques in moduli spaces.* RONNIE LEE, Yale University (819-55-97)

10:00–10:20 (75) *On algebraic and topological K-theory with finite coefficients.* THOMAS FISCHER, University of Notre Dame (819-55-18)

Sunday, April 21, 1985, 9:00 a.m.

Special Session on Singularities and Complex Geometry, III — Haberlin Hall, Room 408

9:00– 9:20 (76) *Topological equivalence of real singularities.* DENIS BLACKMORE, New Jersey Institute of Technology (819-57-17)

9:30– 9:50 (77) *Sandwiched surface singularities and the Nash resolution problem.* Preliminary report. MARK SPIVAKOVSKY, Harvard University (819-14-50)

10:00–10:20 (78) *Limits of tangent spaces to singular points of complete intersections.* Preliminary report. DONAL B. O'SHEA, Mount Holyoke College and University of Massachusetts, Amherst (819-32-26)

10:30–10:50 (79) *Cusp singularities for Hilbet modular varieties for cyclic biquadratic fields.* ALPHONSE T. VASQUEZ, Graduate School and University Center, City University of New York (819-32-98)

Sunday, April 21, 1985, 9:05 a.m.

General Session Swords Hall, Room 314

9:05– 9:15 (80) *Socratic expert systems and the role of the university.* RICHARD P. HANEY, North Carolina State University (819-68-72)

9:20– 9:30 (81) *Holding sets for linear control systems.* Preliminary report. EMILIO O. ROXIN, University of Rhode Island (819-49-56)

9:35– 9:45 (82) *Reproducing kernels on the Euclidean group in three-space.* JUNG SIK RNO, University of Cincinnati (819-42-48)

9:50–10:00 (83) *Multiplicative cocycles under an irrational rotation.* LAWRENCE W. BAGGETT, University of Colorado, Boulder (819-42-57)

10:05–10:15 (84) *On normal subgroups of the general linear groups over Banach algebras and von Neumann regular rings.* LEONID NISON VASERSTEIN, Pennsylvania State University, University Park and Institute for Advanced Study (819-22-74)

10:20–10:30 (85) *Fermet's last theorem.* GERARD COUTU, Colchester, Connecticut (819-11-100)

Sunday, April 21, 1985, 11:00 a.m.

Invited Address Haberlin Hall, Room 103

11:00–12:00 (86) *Recent work in enumerative combinatorics* IRA M. GESSEL, Brandeis University (819-05-35)

Sunday, April 21, 1985, 1:30 p.m.

Invited Address Haberlin Hall, Room 103

1:30– 2:30 (87) *Algebraic and topological K-theory.* ROBERT W. THOMASON, Johns Hopkins University, Baltimore (819-14-04)

Sunday, April 21, 1985, 2:45 p.m.

Special Session on Geometric Function Theory, IV Haberlin Hall, Room 236

2:45– 3:05 (88) *A metric for Fricke space which is invariant under the modular group.* Preliminary report. LIPMAN BERS, Graduate Center, City University of New York, and FREDERICK P. GARDINER*, Brooklyn College, City University of New York (819-30-06)

3:15– 3:35 (89) *Constructing realizations of finite subgroups of the mapping class group.* JANE GILMAN, Rutgers University, Newark (819-30-45)

3:45– 4:05 (90) *Geometry of the geodesic length functions.* SCOTT A. WOLPERT, University of Maryland, College Park (819-30-13)

4:15– 4:35 (91) *Boundary behavior of a simply connected domain.* Preliminary report. JOHN MARAFINO, James Madison University (819-30-32)

Sunday, April 21, 1985, 2:45 p.m.

Special Session on Differential Geometry of Submanifolds, IV Haberlin Hall, Room 412

2:45– 3:05 (92) *New embedded minimal surfaces via symmetry function theory and computer graphics.* DAVID A. HOFFMAN, University of Massachusetts, Amherst (819-53-30)

3:15– 3:35 (93) *Relative nullity foliations and indefinite isometric immersions.* KINETSU ABE*, University of Connecticut, Storrs, and MARTIN MAGID, Wellesley College (819-53-38)

Sunday, April 21, 1985, 2:45 p.m.

Special Session on Fractal Geometry, IV Haberlin Hall, Room 237

2:45– 3:05 (94) *Universality for period N-couplings.* P. CVITANOVIC, University of Goteborg, Sweden (819-58-95) (Sponsored by Benoit B. Mandelbrot)

3:15– 3:35 (95) *Proof of the Mandelbrot N^2 conjecture.* JOHN GUCKENHEIMER, University of California, Santa Cruz, and RICHARD P. MCGEHEE*, University of Minnesota, Minneapolis (819-58-99)

3:45– 4:05 (96) *On absolutely continuous invariant measures for $x \to 1-ax^2$ on $(-1,1)$.* MICHAEL BENEDICKS*, Royal Institute of Technology, Stockholm, and LENNART CARLESON, Institut Mittag-Leffler, Djursholm (819-58-102)

Sunday, April 21, 1985, 2:45 p.m.

Special Session on Enumerative Combinatorics, IV Swords Hall, Room 312

2:45– 3:05 (97) *Properties of a popular partition tree.* D. I. A. COHEN, Hunter College, City University of New York (819-05-68)

3:15– 3:35 (98) *Labelled graphs with vertex degrees at least three.* IAN P. GOULDEN, University of Waterloo (819-05-87) (Sponsored by Ira M. Gessel)

3:45– 4:05 (99) *Self-complementary plane partitions.* RICHARD P. STANLEY, Massachusetts Institute of Technology (819-05-23)

Middletown, Connecticut

W. Wistar Comfort
Associate Secretary

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
•Invited one-hour lecturer *Special session speaker

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*Banchoff, T. F., 8
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*Bers, L., 23
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*Escobales, R. H., Jr., 63
*Fischer, T., 75
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*Gardiner, F. P., 88
*Gau, Y.-N., 9
*Gehring, F. W., 4
•Gessel, I. M., 86
*Gilbert, W. J., 17
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*Goulden, I. P., 98
*Gromoll, D., 32
*Haas, A., 26
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*Heltai, B., 54
*Hoffman, D. A., 92
*Hubbard, J. H., 42
*Itzykson, C., 67
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*Joshua, R., 29
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*Kassel, C., 28
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*Kra, I., 3
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*Lee, R., 74
*Leroux, P., 69
*Libgober, A. S., 10
*Ludden, G. D., 61
*Magid, M. A., 33
*Mandelbrot, B. B., 68
*Marafino, J., 91
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*Maskit, B., 57
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*McGehee, R. P., 95
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*Mohanty, S. G., 14
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*Orlik, P., 35
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*Riley, R. F., 58
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*Ryan, P. J., 5
*Sagan, B., 13
*Series, C., 25
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*Spivakovsky, M., 77
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*Taylor, S. J., 20
*Terng, C.-L., 6
•Thomason, R. W., 87
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*Tricot, C., 18
Uma, S. Y., 50
*Vaserstein, L. N., 73
Vaserstein, L. N., 84
*Vasquez, A. T., 79
*White, D., 15
*Wolpert, S. A., 90
*Wong, B., 39
•Yau, S. S.-T., 21

Mobile, May 3–4, 1985, University of South Alabama

Program for the 820th meeting

The eight hundred twentieth meeting of the American Mathematical Society will be held at the University of South Alabama Brookley Center in Mobile, Alabama, on Friday and Saturday, May 3 and 4, 1985. Sessions will be held at the Brookley Center, which also has guest rooms.

Invited Addresses

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

FRED F. R. COHEN, University of Kentucky, *Loop spaces and classical homotopy theory.*

DENNIS M. DETURCK, University of Pennsylvania, *Can you hear the shape of a manifold?.*

JOHN GILBERT, University of Texas, Austin, *Invariant differential operators in harmonic analysis.*

JEFFERY LAGARIAS, AT&T Bell Laboratories, *Short vectors in lattices and knapsack public key cryptosystems.*

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, names of the organizers, and final lists of speakers, are as follows:

Combinatorics and graph theory, THOMAS H. BRYLAWSKI, University of North Carolina, Chapel Hill, 1:15 p.m. Friday, 8:30 a.m. and 2:45 p.m. Saturday. The speakers will be Thomas H. Brylawski, Ying Cheng, Ralph Faudree, Robert L. Hemminger, Robert E. Jamison, Henry A. Kierstead, C. C. Lindner, James G. Oxley, Rhodes Peele, Michael D. Plummer, William T. Trotter, Jr., Michelle L. Wachs, and Neil White.

Nonlinear problems in geometry, DENNIS DETURCK, 1:30 p.m. Friday, 8:00 a.m. and 2:45 p.m. Saturday. The speakers are William K. Allard, Alfred Baldes, David E. Blair, Carolyn S. Gordon, R. J. Knill, Robert C. McOwen, Wei-Ming Ni, Vladimer Oliker, Jon Pitts, Al Vitter, Steven Wilkinson, and Deane Yang.

Analysis on homogeneous spaces, RAY KUNZE, University of Georgia, Athens, 1:15 p.m. Friday and 2:45 p.m. Saturday. The speakers are Brian Blank, Jean-Louis Clerc, R. Coifman, Roe Goodman, Alan Greenleaf, Kenneth I. Gross, Kenneth D. Johnson, Christopher Meaney, Donald St. P. Richards, and Ernest Thieleker.

Number theory and its applications, JEFFERY LAGARIAS, 8:30 a.m. and 2:45 p.m. Saturday. The speakers will be Ernest Brickell, Duncan A. Buell, Harvey Cohn, Alice A. Deanin, Michael Filaseta, Douglas Hensley, Richard H. Hudson, Helmut Maier, Charles F. Osgood, Carl Pomerance, David R. Richman, Randy Tuler, and Theresa P. Vaughan.

Algebraic topology, JOSEPH NEISENDORFER, Ohio State University, 1:15 p.m. Friday and 2:45 p.m. Saturday. The speakers are David J. Anick, H.E.A. Campbell, Paul G. Goerss, Hans-Werner Henn, J. F. Jardine, Haynes Miller, John C. Moore, Stewart B. Priddy, William Ralph, Paul Selick, Jeffrey H. Smith, Victor Snaith, and James Stasheff.

Symbolic dynamics and ergodic theory, SUSAN WILLIAMS, University of South Alabama, and BRUCE KITCHENS, IBM T. J. Watson Research Center, 1:15 p.m. Friday and 8:30 a.m. Saturday. The speakers will be Kirby A. Baker, Ethan M. Coven, Douglas Lind, N. Markley, Karl Petersen, V. S. Prasad, F. W. Roush, Daniel J. Rudolph, John Smillie, Paul Trow, William A. Veech, J. B. Wagoner, and Susan Williams.

Contributed Papers

There will also be sessions for contributed ten-minute papers.

Registration

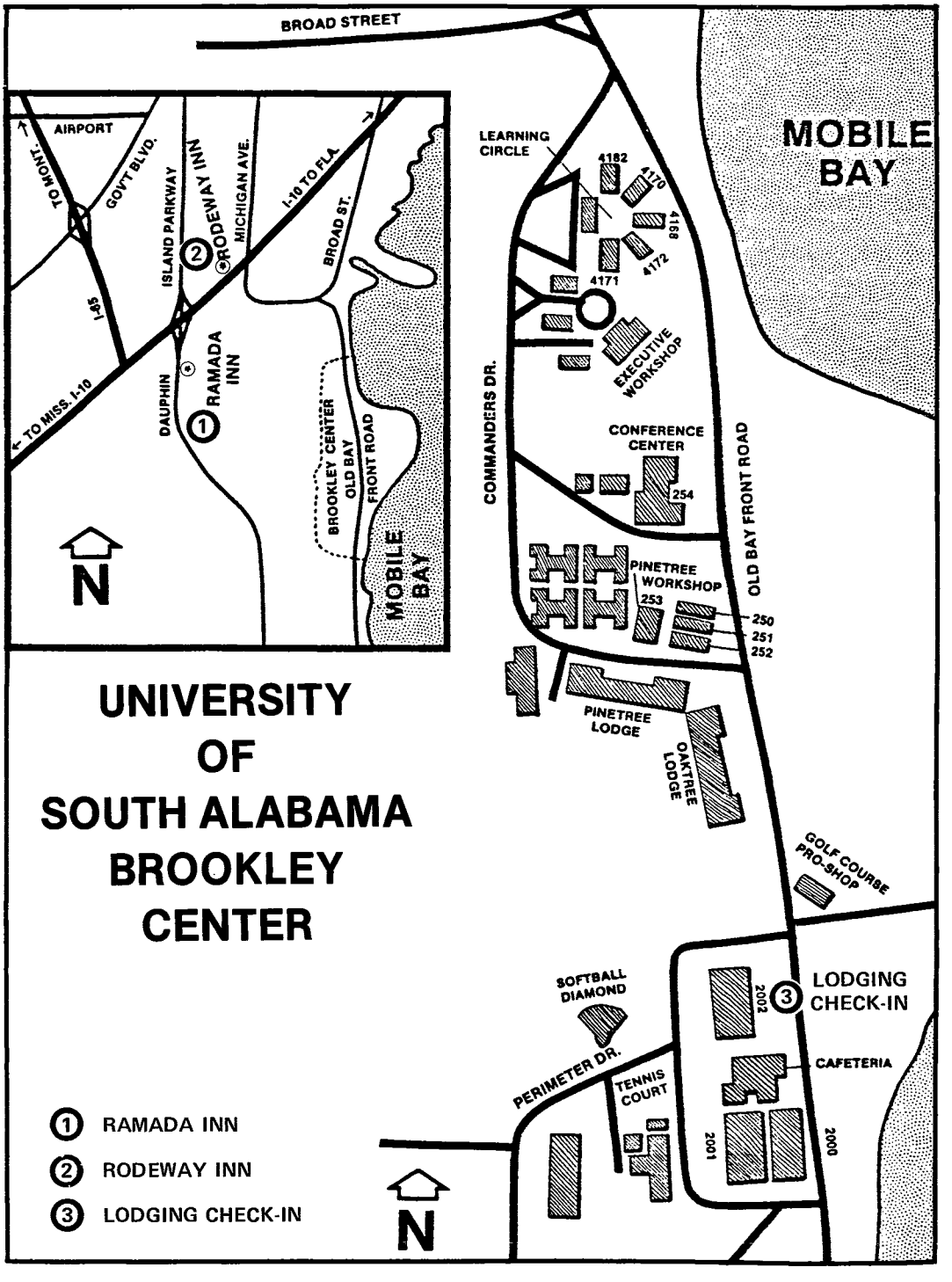
The meeting registration desk will be located in the lobby of Building 2002, and will be open from 8:00 a.m. to 5:00 p.m. on Friday, and from 8:00 a.m. until noon on Saturday. The registration fees are $10 for members, $16 for nonmembers, and $5 for students or unemployed mathematicians.

Petition Table

A petition table will be set up in the registration area. Additional information can be found in a box on page 26 in the Anaheim meeting announcement in the January issue of the *Notices.*

Accommodations

Rooms will be available for participants at Oak Tree Lodge, Pine Tree Lodge, and Building 2002 at Brookley Center. All are centrally located and within easy walking distance of the meeting activities. Private units at the lodges include one or two bedroom suites with living area, small kitchenette, and bath, while Building 2002 contains standard motel-style rooms. All accommodations have individually controlled heating and air conditioning, as well as closed circuit color television. Accommodations are available the nights of May 3 and 4; however, only a limited number of rooms will be available on May 2. The daily rates are $25, $30, $36, and $40 for single, double, triple, or quadruple occupancy, respectively, and are tax free. Participants should make their own reservations by writing to Ms. Sharon Davis, University of South Alabama Brookley Center, 2002 Old Bay Front Road, Mobile, AL 36615, or by telephoning her at 205-431-6410 (or 205-433-4966)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AIRPORT
TO MONT.
GOVT BLVD.
ISLAND PARKWAY
RODEWAY INN
MICHIGAN AVE.
I-10 TO FLA.
BROAD ST.
I-65
TO MISS. I-10
DAUPHIN
RAMADA INN
BROOKLEY CENTER
OLD BAY
FRONT ROAD
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COMMANDERS DR.
CONFERENCE CENTER
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OLD BAY FRONT ROAD
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PINETREE LODGE
OAKTREE LODGE
GOLF COURSE PRO-SHOP
SOFTBALL DIAMOND
LODGING CHECK-IN
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PERIMETER DR.
TENNIS COURT
CAFETERIA
2001
2000
UNIVERSITY OF SOUTH ALABAMA BROOKLEY CENTER
1 RAMADA INN
2 RODEWAY INN
3 LODGING CHECK-IN

between the hours of 8:00 a.m. and 4:00 p.m. Monday through Friday. The deadline for reservations is **April 15**.

The following accommodations are also available in the area of Brookley Center. The Ramada and Rodeway Inns are within two miles, while the Malaga Inn and Stouffer's Riverview Plaza are five miles or less from the Center. Rates quoted are subject to change, and do not include the additional 8 percent tax.

Malaga Inn
359 Church Street, Mobile 36602
Telephone: 205-438-4701
Single $38 or $44 Double $44 or $52

Ramada Inn
1705 Dauphin Island Parkway, Mobile 36605
Telephone: 205-471-6114
Single $32 Double $40

Rodeway Inn
1724 Michigan Avenue, Mobile 36605
Telephone: 205-478-3014
Single $25 Double $30

Stouffer's Riverview Plaza
64 South Water Street, Mobile 36602
Telephone: 205-438-4000
Single $49 Double $49

Food Service

The Brookley Center cafeteria will be serving breakfast from 7:00 a.m.–9:00 a.m., and lunch from 11:00 a.m.–1:00 p.m. on Thursday, Friday, and Saturday. The cafeteria is not open for dinner and is closed on Sunday. Many restaurants are located within five miles of the Center, and a restaurant guide will be available at the registration desk.

Social

A beer party will be held at the Conference Center (Building 254) on Friday evening. The cost for the party is $11.50 per person, and includes as hors d'oeuvres boiled shrimp, oysters on the half shell, chicken nuggets, creole meatballs, relish and cheese trays, and mini sandwiches, as well as beer and iced tea. Participants not residing at the Center should make their checks payable to the University of South Alabama Brookley Center and send them by April 15 to Ms. Sharon Davis. The mailing address is included in the section above titled **Accommodations**. Participants who will be lodging at Brookley Center can arrange to attend the beer party when making their room reservations.

Parking

There is ample free parking in lots at the Brookley Center, including the residence areas.

Travel

Mobile is served by several of the major airlines, including American, Delta, Eastern, and Republic. Bates Field, the Mobile municipal airport, is approximately sixteen miles from Brookley Center. Taxi and limousine service is available from the airport to Brookley Center. Car rental agencies also located at the airport include Avis, Budget, Dollar, Hertz, National, and Thrifty. Participants driving from Bates Field to the Center should take Airport Boulevard east for approximately eight miles until reaching Interstate 65 (I-65), then turn south on I-65 for approximately three miles to Interstate 10 (I-10). Take I-10 East toward Pensacola, Florida for approximately four miles and exit on Michigan Avenue. Go south on Michigan Avenue and take the first possible left turn, which will be onto Broad Street. Stay on Broad Street for approximately 6/10 of a mile until the road veers to the left and intersects Old Bay Front Road. Turn right onto Old Bay Front Road and continue to Brookley Center.

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 March 1985 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.

Friday, May 3, 1985, 12:00 p.m.

Invited Address Conference Center

12:00– 1:00 (1) *Can you hear the shape of a manifold?* DENNIS M. DETURCK, University of Pennsylvania (820-58-39)

Friday, May 3, 1985, 1:15 p.m.

Special Session on Combinatorics and Graph Theory, I Learning Circle #4182

1:15– 1:35 (2) *Matroid invariants and error-correcting codes.* Preliminary report. THOMAS H. BRYLAWSKI, University of North Carolina, Chapel Hill (820-05-67)

1:45– 2:05 (3) *A characterization of the ternary matroids with no $M(K_4)$-minor.* JAMES G. OXLEY, Louisiana State University, Baton Rouge (820-05-05)

2:15– 2:35 (4) *nth-line digraphs.* Preliminary report. ROBERT L. HEMMINGER, Vanderbilt University (820-05-08)

2:45– 3:05 (5) *Quasigroups and graphs.* C. C. LINDNER, Auburn University, Auburn (820-05-16)

3:15– 3:35 (6) *A reconstruction problem for matroids.* Preliminary report. RHODES PEELE, University of South Alabama (820-05-69)

Friday, May 3, 1985, 1:15 p.m.

Special Session on Analysis on Homogeneous Spaces, I Learning Circle #4172

1:15– 1:35 (7) *Reciprocity theorems and branching laws.* KENNETH I. GROSS, University of Wyoming (820-22-77)

1:45– 2:05 (8) *Addition and multiplication formulas for hypergeometric functions of matrix argument.* DONALD ST. P. RICHARDS, University of North Carolina, Chapel Hill (820-33-27)

2:15– 2:35 (9) *The inverse Abel transform on complex Grassmann manifolds.* CHRISTOPHER MEANEY, University of Texas, Austin (820-44-36)

2:45– 3:05 (10) *Nontangential convergence of Poisson integrals on compact groups.* Preliminary report. BRIAN BLANK, Washington University (820-22-76)

3:15– 3:35 (11) *Convolution operators with conical singularities.* ALLAN GREENLEAF, University of Rochester (820-42-14)

3:45– 4:05 Discussion

Friday, May 3, 1985, 1:15 p.m.

Special Session on Algebraic Topology, I Learning Circle #4171

1:15– 1:35 (12) *Upper triangular invariants.* H. E. A. CAMPBELL, Queen's University, Ontario (820-55-60)

1:45– 2:05 (13) *On the growth of homotopy groups.* HANS-WERNER HENN, Ohio State University, Columbus (820-55-28)

2:15– 2:35 (14) *Stable splittings of Stiefel manifolds.* HAYNES MILLER, University of Washington (820-55-22)

2:45– 3:05 (15) *Exponents in homotopy theory.* Preliminary report. JOHN C. MOORE, Princeton University (820-55-12)

3:15– 3:35 (16) *Bilinear forms versus Galois representations.* Preliminary report. VICTOR SNAITH, University of Western Ontario (820-55-01)

3:45– 4:05 (17) *Flabby simplicial presheaves.* Preliminary report. J. F. JARDINE, University of Western Ontario (820-55-06)

4:15– 4:35 (18) *Mappings of loop spaces of suspensions.* Preliminary report. PAUL SELICK* and F. R. COHEN, University of Toronto (820-55-78)

Friday, May 3, 1985, 1:15 p.m.

Special Session on Symbolic Dynamics and Ergodic Theory, I Learning Circle #4168A

1:15– 1:35 (19) *Dynamical systems on analytic manifolds of quadratic differentials.* WILLIAM A. VEECH, Rice University (820-58-59)

1:45– 2:05 (20) *Smale diffeomorphisms of surfaces.* Preliminary report. JOHN SMILLIE, Herbert H. Lehman College, City University of New York (820-58-80)

2:15– 2:35 (21) *Factor maps which commute with a power of the shift.* PAUL TROW, University of North Carolina, Chapel Hill (820-99-32) (Sponsored by Karl Petersen)

2:45– 3:05 (22) *Topological conjugacy and transitivity for a class of piecewise monotone maps of the interval.* LOUIS BLOCK, University of Florida, and ETHAN M. COVEN*, Wesleyan University (820-58-18)

3:15– 3:35 (23) *Coding with almost sofic systems* KARL PETERSEN, University of North Carolina, Chapel Hill (820-28-02)

3:45– 4:05 (24) *An analytic K-but not Bernoulli-map.* DANIEL J. RUDOLPH, University of Maryland, College Park (820-99-82)

4:15– 4:35 (25) *End behavior and ergodicity for homeomorphisms of manifolds with finitely many ends.* S. ALPERN, London School of Economics, and V. S. PRASAD*, York University (820-28-75)

Friday, May 3, 1985, 1:30 p.m.

Special Session on Nonlinear Problems in Geometry, I Learning Circle #4168B

1:30– 2:00 (26) *On the first variation of a varifold with respect to general integrands.* WILLIAM K. ALLARD, Duke University (820-49-46)

2:10– 2:40 (27) *Conformal deformations of complete Riemannian manifolds with negative curvature.* ROBERT C. MCOWEN, Northeastern University (820-58-31)

2:50– 3:20 (28) *Non-existence of Riemannian metrics with prescribed Ricci tensor.* Preliminary report. ALFRED BALDES, University of Pennsylvania (820-58-24) (Sponsored by Dennis DeTurck)

3:30– 4:00 (29) *Self-dual Einstein metrics.* Preliminary report. AL VITTER, Tulane University (820-53-53)

Friday, May 3, 1985, 4:45 p.m.

Invited Address Conference Center

4:45– 5:45 (30) *Short vectors in lattices and knapsack public key cryptosystems.* JEFFREY LAGARIAS, AT&T Bell Laboratories, Murray Hill (820-68-73)

Saturday, May 4, 1985, 8:00 a.m.

Special Session on Nonlinear Problems in Geometry, II Learning Circle #4168B

8:00– 8:30 (31) *Critical associated metrics on symplectic manifolds.* DAVID E. BLAIR*, Michigan State University, and STERE IANUS, University of Bucharest (820-53-09)

8:40– 9:10 (32) *A variational formulation and solution of the problem of existence of a closed convex hypersurface in R^{n+1} with prescribed Gaussian curvature.* Preliminary report. VLADIMIR OLIKER, Emory University (820-53-30)

9:20– 9:50 (33) *On the least growth of harmonic functions and the boundary behavior of Riemann mappings.* FANG-HUA LIN and WEI-MING NI*, University of Minnesota, Minneapolis (820-53-33)

10:00–10:30 (34) *Minimal surfaces of bounded topological type in three manifolds.* Preliminary report. JON PITTS*, Texas A&M University, College Station, and J. H. RUBINSTEIN, University of Melbourne, Australia (820-49-64)

10:40–11:10 (35) *Metrics with prescribed curvature tensors.* Preliminary report. DENNIS DETURCK, University of Pennsylvania, and DEANE YANG*, Rice University (820-53-58)

Saturday, May 4, 1985, 8:30 a.m.

Special Session on Number Theory and Its Applications, I Learning Circle #4172

8:30– 8:50 (36) *The crypt-analysis of iterated knapsack cryptosystems.* ERNEST BRICKELL, Sandia National Laboratories, Albuquerque (820-11-55)

9:00– 9:20 (37) *Periodicity of P-adic continued fraction expansions.* ALICE A. DEANIN, Villanova University (820-11-11)

9:30– 9:50 (38) *On the number of false witnesses for a composite number.* PAUL ERDŐS, Mathematical Institute of the Hungarian Academy of Sciences, and CARL POMERANCE*, University of Georgia, Athens, and Bell Communications Research (820-11-37)

10:00–10:20 (39) *Small differences between prime numbers.* Preliminary report. HELMUT MAIER, University of Georgia, Athens (820-11-52) (Sponsored by Jeffery Lagarias)

10:30–10:50 (40) *Convolution powers of the Dickman function and applications to number theory.* DOUGLAS HENSLEY, Texas A&M University, College Station (820-11-54)

11:00–11:20 (41) *Appproximation of values of E and G functions.* Preliminary report. CHARLES F. OSGOOD, Naval Research Laboratory (820-11-10)

Saturday, May 4, 1985, 8:30 a.m.

Special Session on Combinatorics and Graph Theory, II Learning Circle #4182

8:30– 8:50 (42) *The slope problem.* ROBERT E. JAMISON, Clemson University (820-05-25) (Sponsored by James A. Reneke)

9:00– 9:20 Discussion

9:30– 9:50 (43) *The maximum number of vertices in a regular graph not containing an induced* $2K_2$. Preliminary report. MADELEINE PAOLI and WILLIAM T. TROTTER, JR.*, University of South Carolina, Columbia, and G. W. PECK, Massachusetts Institute of Technology (820-05-84)

10:00–10:20 Discussion

10:30–10:50 (44) *Applications of edge colorings of multigraphs to vertex colorings of graphs.* Preliminary report. HENRY A. KIERSTEAD*, University of South Carolina, Columbia, and JAMES H. SCHMERL, University of Connecticut, Storrs (820-05-83)

Saturday, May 4, 1985, 8:30 a.m.

Special Session on Symbolic Dynamics and Ergodic Theory, II Learning Circle #4168A

8:30– 8:50 (45) *Markov partitions and* K_2. J. B. WAGONER, University of California, Berkeley (820-99-20)

9:00– 9:20 (46) *On strong shift equivalence over a Boolean algebra.* K. H. KIM and F. W. ROUSH*, Alabama State University (820-58-07)

9:30– 9:50 (47) *A progress report on sufficient conditions for strong shift equivalence of matrices.* KIRBY A. BAKER, University of California, Los Angeles (820-15-42)

10:00–10:20 (48) *Finite rank flows.* Preliminary report. J. AUSLANDER and N. MARKLEY*, University of Maryland, College Park (820-54-48)

10:30–10:50 (49) *Covers of sofic systems.* Preliminary report. SUSAN WILLIAMS, University of South Alabama (820-28-49)

11:00–11:20 (50) *The automorphism group of a subshift of finite type.* Preliminary report. DOUGLAS LIND, University of Washington (820-94-66)

Saturday, May 4, 1985, 9:30 a.m.

Session for Contributed Papers Learning Circle #4171

9:30– 9:40 (51) *Products with pseudo-arcs as factors.* Preliminary report. JUDY A. KENNEDY, Auburn University, Auburn (820-54-74)

9:45– 9:55 (52) *A characterization of spaces that are the continuous image of an arc.* L. B. TREYBIG, Texas A&M University, College Station (820-54-17)

10:00–10:10 (53) *Computability of homotopy groups of nilpotent complexes.* KATHRYN WELD, Baruch College, City University of New York (820-55-56)

10:15–10:25 (54) *On* w^**-continuous cosine operator functions.* SEN-YEN SHAW, National Central University, Chung-Li, Taiwan (820-47-21)

10:30–10:40 (55) *Regular involution groupoids.* Preliminary report. KRISHNAN V. SANKRITHI, Temple University (820-20-26)

10:45–10:55 (56) *Finding generators for numerical semigroup ring idelas.* Preliminary report. CHARLES G. FLEMING* and JUDY D. HALCHIN, Auburn University, Auburn (820-14-19)

Saturday, May 4, 1985, 11:30 a.m.

Invited Address Conference Center

11:30–12:30 (57) *Loop spaces and classical homotopy theory.* F. R. COHEN, University of Kentucky (820-55-71)

Saturday, May 4, 1985, 1:30 p.m.

Invited Address Conference Center

1:30– 2:30 (58) *Invariant differential operators in harmonic analysis.* JOHN GILBERT, University of Texas, Austin (820-42-40)

Saturday, May 4, 1985, 2:45 p.m.

Special Session on Analysis on Homogeneous Spaces, II — Learning Circle #4172

2:45– 3:05 (59) *Matrix coefficients of admissible representations.* Preliminary report. ERNEST THIELEKER, University of South Florida (820-22-41)

3:15– 3:35 (60) *A ring of highest weight vectors.* Preliminary report. KENNETH D. JOHNSON, University of Georgia, Athens (820-22-57)

3:45– 4:05 (61) *Joint eigenfunctions of some completely-integrable quantum-mechanical systems.* Preliminary report. ROE GOODMAN* and NOLAN R. WALLACH, Rutgers University, New Brunswick (820-35-44)

4:15– 4:35 (62) *Yang Mills hierarchies and* $\overline{\partial}$. Preliminary report. R. BEALS and R. COIFMAN*, Yale University (820-99-85)

4:45– 5:05 (63) *Fourier transform of orbital measures on the tangent space of a symmetric space.* JEAN-LOUIS CLERC, Washington University (820-99-81) (Sponsored by Guido L. Weiss)

Saturday, May 4, 1985, 2:45 p.m.

Special Session on Algebraic Topology, II — Learning Circle #4171

2:45– 3:05 (64) *Spliting the n-fold smash product.* Preliminary report. JEFFREY H. SMITH, Northwestern University (820-55-61)

3:15– 3:35 (65) *Unstable projectives and stable Ext: An application.* PAUL G. GOERSS, University of Chicago (820-55-29) (Sponsored by Joe Neisendorfer)

3:45– 4:05 (66) *Stable naturality of Dyer-Lashof structure maps.* STEWART B. PRIDDY, Northwestern University (820-55-45)

4:15– 4:35 (67) *Category and group rings in homotopy theory.* WILLIAM RALPH, University of Western Ontario (820-55-62)

4:45– 5:05 (68) *Diophantine equations and undecidable spaces.* DAVID J. ANICK, Massachusetts Institute of Technology (820-55-15)

5:15– 5:35 (69) *The bar construction in gauge field theory.* Preliminary report. JAMES STASHEFF, University of North Carolina, Chapel Hill (820-55-79)

Saturday, May 4, 1985, 2:45 p.m.

Special Session on Number Theory and Its Applications, II — Learning Circle #4168A

2:45– 3:05 (70) *Use of a computer scan to prove* $Q(2+2^{1/2})^{1/2}$ *and* $Q(3+2^{1/2})^{1/2}$ *are Euclidean.* HARVEY COHN*, City College, City University of New York, and JESSE DEUTSCH, Graduate School and University Center, City University of New York (820-12-03)

3:15– 3:35 (71) *On the construction of cyclic-8 class fields.* Preliminary report. THERESA P. VAUGHAN, University of North Carolina, Greensboro (820-11-63)

3:45– 4:05 (72) *A necessary condition for the integral equivalence of indefinite binary quadratic forms.* RANDY TULER, University of Georgia, Athens (820-11-43)

4:15– 4:35 (73) *The Waring problem for matrices.* Preliminary report. DAVID R. RICHMAN, University of South Carolina, Columbia (820-15-23)

4:45– 5:05 (74) *Running times of the Schnorr-Lenstra factoring method.* Preliminary report. DUNCAN A. BUELL, Louisiana State University, Baton Rouge (820-11-51)

5:15– 5:35 (75) *Irreducibility criteria for polynomials with non-negative coefficients.* MICHAEL FILASETA, University of South Carolina, Columbia (820-11-35)

5:45– 6:05 (76) *Phenomena related to the distribution of cubic and higher power residues.* RICHARD H. HUDSON, University of South Carolina, Columbia (820-11-34)

Saturday, May 4, 1985, 2:45 p.m.

Special Session on Combinatorics and Graph Theory, III — Learning Circle #4182

2:45– 3:05 (77) *Continuing development of the matching structure of graphs.* MICHAEL D. PLUMMER, Vanderbilt University (820-05-13)

3:15– 3:35 (78) *Flagged Schur functions, Schubert polynomials, and symmetrizing operators.* MICHELLE L. WACHS, University of Miami (820-05-70)

3:45– 4:05 (79) *A pruning theorem for the counting matroids.* NEIL WHITE, University of Florida (820-05-47)

4:15– 4:35 (80) *Bipartite graph-tree Ramsey numbers.* Preliminary report. PAUL ERDŐS, Hungarian Academy of Sciences, Budapest, and RALPH FAUDREE*, RICHARD SCHELP and CECIL ROUSSEAU, Memphis State University (820-05-68)

4:45– 5:05 (81) *On weakly symmetric graphs of order twice a prime.* YING CHENG* and JAMES OXLEY, Louisiana State University, Baton Rouge (820-05-04)

Saturday, May 4, 1985, 2:45 p.m.

Special Session on Nonlinear Problems in Geometry, III Learning Circle #4168B

2:45– 3:15 (82) *The Laplace spectra versus the legnth spectra of Riemannian manifolds.* Preliminary report. CAROLYN S. GORDON, Washington University (820-53-50)

3:25– 3:55 (83) *Superposition and decomposition of the solutions to field equations of gravitational potential tensors.* A. P. WHITMAN, Pontificia Universidade Catolica do Rio de Janeiro, R. J. KNILL*, Tulane University, and W. R. STOEGER, Specola Vaticana (820-53-65)

4:05– 4:35 (84) *Gauss maps for codimension two immersed manifolds.* Preliminary report. STEVEN WILKINSON, University of North Carolina, Chapel Hill (820-53-38)

4:45– 5:15 Discussion

Frank T. Birtel
Associate Secretary

New Orleans, Louisiana

Presenters of Papers

Numbers following the names indicate the speakers' positions on the program.
•Invited one-hour lecturer *Special session speaker

*Allard, W. K., 26
*Anick, D. J., 68
*Baker, K. A., 47
*Baldes, A., 28
*Blair, D. E., 31
*Blank, B., 10
*Brickell, E., 36
*Brylawski, T. H., 2
*Buell, D. A., 74
*Campbell, H. E. A., 12
*Cheng, Y., 81
*Clerc, J.-L., 63
•Cohen, F. R., 57
*Cohn, H., 70
*Coifman, R., 62
*Coven, E. M., 22
*Deanin, A. A., 37
•DeTurck, D. M., 1
*Faudree, R., 80
*Filaseta, M., 75
Fleming, C. G., 56
•Gilbert, J., 58
*Goerss, P. G., 65
*Goodman, R., 61
*Gordon, C. S., 82
*Greenleaf, A., 11
*Gross, K. I., 7
*Hemminger, R. L., 4
*Henn, H.-W., 13
*Hensley, D., 40
*Hudson, R. H., 76
*Jamison, R. E., 42
*Jardine, J. F., 17
*Johnson, K. D., 60
Kennedy, J. A., 51
*Kierstead, H. A., 44
*Knill, R. J., 83
•Lagarias, J., 30
*Lind, D., 50
*Lindner, C. C., 5
*Maier, H., 39
*Markley, N., 48
*McOwen, R. C., 27
*Meaney, C., 9
*Miller, H., 14
*Moore, J. C., 15
*Ni, W.-M., 33
*Oliker, V., 32
*Osgood, C. F., 41
*Oxley, J. G., 3
*Peele, R., 6
*Petersen, K., 23
*Pitts, J., 34
*Plummer, M. D., 77
*Pomerance, C., 38
*Prasad, V. S., 25
*Priddy, S. B., 66
*Ralph, W., 67
*Richards, D. St. P., 8
*Richman, D. R., 73
*Roush, F. W., 46
*Rudolph, D. J., 24
Sankrithi, K. V., 55
*Selick, P., 18
Shaw, S.-Y., 54
*Smillie, J., 20
*Smith, J. H., 64
*Snaith, V., 16
*Stasheff, J., 69
*Thieleker, E., 59
Treybig, L. B., 52
*Trotter, W. T., Jr., 43
*Trow, P., 21
*Tuler, R., 72
*Vaughan, T. P., 71
*Veech, W. A., 19
*Vitter, A., 29
*Wachs, M. L., 78
*Wagoner, J. B., 45
Weld, K., 53
*White, N., 79
*Wilkinson, S., 84
*Williams, S., 49
*Yang, D., 35

Laramie Meetings, August 10–15, 1985

Preliminary Announcement

The August 1985 Joint Mathematics Meetings, including the 89th Summer Meeting of the AMS, the 65th Summer Meeting of the Mathematical Association of America, and the 1985 Annual Meeting of Pi Mu Epsilon, will be held August 12–15, 1985 (Monday–Thursday), at the University of Wyoming, Laramie. The meetings will be preceded by the AMS Short Course on August 10 and 11 (Saturday and Sunday), 1985. Sessions will take place on the campus of the University of Wyoming, Laramie.

The members of the Local Arrangements Committee are Sandy H. Adams, Myron B. Allen (chairman), Lois Kline, William J. LeVeque (ex-officio), Melfried Olson (publicity director), and Kenneth A. Ross (ex-officio).

IMPORTANT DEADLINES

AMS Abstracts,	
For consideration for special sessions	**May 7**
Of contributed papers	**May 28**
MAA Abstracts,	
Of contributed papers	**May 28**
Joint Meeting Preregistration and Housing	**June 14**
MAA Minicourse Preregistration	**June 14**
Summer List of Applicants	**June 14**
Motions for AMS Business Meeting	**July 15**
Housing Cancellations (100% refund)	**July 25**
MAA Banquet (50% refund)	**July 25**
Preregistration cancellations (50% refund)	**August 9**
Dues credit for nonmembers/students	**September 15**

89th Summer Meeting of the AMS August 12–15, 1985

Colloquium Lectures

There will be a series of four Colloquium Lectures presented by KAREN K. UHLENBECK of the University of Chicago. The title of this lecture series is *Mathematical gauge field theory.* The lectures will be given at 1:00 p.m. daily, Monday–Thursday, August 12–15.

Prize Session

The 1985 LeRoy P. Steele Prizes and the Norbert Wiener Prize in Applied Mathematics will be awarded at a session at 4:30 p.m. on Wednesday, August 14.

Invited Addresses

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

STUART S. ANTMAN, University of Maryland, College Park, *Global bifurcation problems from mechanics*, 2:15 p.m. Wednesday;

RICHARD E. BLOCK, University of California, Riverside, *Simple Lie algebras of prime characteristic*, 3:30 p.m. Thursday;

ROBERT L. BRYANT, Rice University, *Surfaces in conformal geometry*, 8:30 a.m. Wednesday;

DAVID B. MACQUEEN, AT&T Bell Laboratories, *Theory of types in programming languages*, 8:30 a.m. Monday;

DENNIS W. STANTON, University of Minnesota, Minneapolis, *Orthogonal polynomials and association schemes*, 3:20 p.m. Tuesday;

RONALD J. STERN, University of Utah, *Gauge theories and the topology of 4-manifolds*, 11:00 a.m. Monday;

JERROLD B. TUNNELL, Rutgers University, *Elliptic curves and diophantine problems*, 2:15 p.m. Thursday; and,

LAI SANG YOUNG, Michigan State University, *Hyperbolicity in dynamical systems*, 3:20 p.m. Monday.

Special Sessions

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

Special functions and combinatorics, RICHARD A. ASKEY, University of Wisconsin, Madison, 1:00 p.m. Wednesday and 8:00 a.m. Thursday.

Dynamical systems and ergodic theory, MARCY BARGE, University of Wyoming and ROBERT F.

Preregistration and Housing

Preregistration. Preregistration for these meetings **must be completed by June 14, 1985.** All those wishing to preregister must complete the form which appears at the back of this issue and submit it along with the appropriate preregistration fee(s) to the Mathematics Meetings Housing Bureau in Providence by June 14.

Please provide your nickname if you wish this information to be printed on your badge.

Preregistration for the meeting and full payment of room/board charges is a requirement in order to obtain confirmed residence hall accommodations at Laramie through the Mathematics Meetings Housing Bureau.

Checks for preregistration fee(s), housing payments and fees for social events should be made payable to the AMS. Canadian checks must be marked for payment "in U.S. funds". Those who preregister for the AMS Short Course and/or Joint Mathematics Meetings pay fees which are 30 percent lower than those who register at the meetings. The preregistration fees are as follows:

AMS Short Course

Student/Unemployed	$ 5
All Others	$25

Joint Mathematics Meetings

Member of AMS, MAA, ΠME	$55
Emeritus Member of AMS, MAA	$14
Nonmember	$84
Student/Unemployed	$14

A $5 charge will be imposed for all invoices prepared when preregistration forms are submitted without accompanying check(s) for the preregistration fee(s) or are accompanied by an amount insufficient to cover the total payments due. Preregistration forms received well before the deadline of June 14 which are not accompanied by correct payment will be returned to the participant with a request for resubmission with full payment.

A 50 percent refund of the preregistration fee(s) will be made for all cancellations received in Providence no later than August 9, 1985. **No refunds will be granted for cancellations received after that date**, or to persons who do not attend the meetings.

The only exception to this rule is someone who preregisters for the Joint Mathematics Meetings only in order to attend an MAA Minicourse, and is too late to obtain a slot in the Minicourse. In this case, full refund will be made of the Joint Mathematics Meetings preregistration fee, **provided the preregistrant has checked the box** on the Minicourse Preregistration Form that this was his or her intent. Individuals who preregister for both the Joint Meetings and a Minicourse and who intend to attend the Joint Meetings, even if the Minicourse is not available, should, of course, **not** check the box on the Minicourse Preregistration Form. In this case, the Joint Meetings preregistration will be processed and will be subject to the 50 percent refund rule.

Full refunds will be made of MAA 25-Year Banquet tickets if notification of cancellation is received prior to July 25; after that date, a 50 percent refund will apply.

Housing. The use of the services offered by the Mathematics Meetings Housing Bureau requires preregistration for the meetings. Persons desiring confirmed residence hall accommodations should complete the preregistration/housing form, or a reasonable facsimile, and send it with payment in full to the Mathematics Meetings Housing Bureau, Post Office Box 6887, Providence, Rhode Island 02940-6887, **so that it will arrive no later than June 14, 1985.** (See Housing section of preregistration/housing form.)

Please read carefully the section on **University Housing** before completing the form. Forms sent to the wrong address and thus incurring delay in delivery to the Housing Bureau until after the deadline cannot be accepted. All residence halls reservations with **full prepayment** for room/board will be confirmed by the Housing Bureau. All reservation requests must be received in writing and be processed through the Housing Bureau in Providence. Please do not contact the university directly. Telephone requests will not be accepted.

Housing assignments are made on a first-come, first-served basis, so participants desiring specific types of accommodations are urged to get their housing requests in as early as possible. **Housing requests received after the deadline of June 14 most surely cannot be honored.**

Participants who are able to do so are urged to share a room whenever possible. This procedure can be economically beneficial. The housing form should be fully completed to ensure proper assignment of rooms. Participants planning to share accommodations should provide the name of the person with whom they plan to occupy a room. Each participant should, however, complete a separate preregistration/housing form. Parties planning to share rooms should send their forms together in the same envelope, if possible.

Changes/Cancellations

Please make all changes to or cancellations of residence hall reservations with the Housing Bureau in Providence **before July 25, 1985 in order to receive full refund of housing payment.** After that date, cancellations should be made with the Housing Bureau in Providence up until Friday, August 9, 1985, at which time a partial refund (amount paid minus one night's room/board) will be made and 50 percent of preregistration fee(s) will be allowed. No cancellations can be made between 5:00 p.m. on Friday, August 9, and 4:00 p.m. on Sunday, August 11, after which changes or cancellations may be called in to Mary Coccoli at the Telephone Message Center number in Laramie. Changes in reservations may be made at any time by notifying the Housing Bureau in Providence.

American Mathematical Society Short Course Series

Introductory Survey Lectures on

Actuarial Mathematics

Laramie, Wyoming, August 10–11, 1985

The American Mathematical Society, in conjunction with its eighty-ninth Summer Meeting, will present a one and one-half day short course entitled *Actuarial Mathematics* on Saturday and Sunday, August 10 and 11, at the University of Wyoming, Laramie. Cecil J. Nesbitt of the University of Michigan, James C. Hickman of the University of Wisconsin, and Elias Shiu of the University of Manitoba will serve as organizers of the course. Six lectures are planned, and it is anticipated that proceedings will be published in the series *Proceedings of Symposia in Applied Mathematics.*

A number of forces have been shaping actuarial mathematics in the latter part of the twentieth century. Clearly, the on-going developments of computers have had a major influence. At the same time, the clarification of concepts of probability and statistical theory have provided a much richer foundation for actuarial theory. These concepts apply in related fields such as biostatistics, demography, economics and reliability engineering. Life tables are no longer simply actuarial tools but have been explored and utilized in those other fields. The mathematical theory of risk has flourished with the concurrent development of stochastic processes. Still more recently, developments in the theory of finance may eventually be assimilated into actuarial mathematics.

A basic textbook in preparation for the Society of Actuaries co-ordinates risk theory and classical actuarial mathematics. J. C. Hickman will introduce the audience to some ideas from this book. H. H. Panjer will follow with a lecture on models in risk theory pertaining to aggregate insurance losses, while Stuart Klugman will discuss distributions of individual losses. Credibility theory is devoted to models for combining information from several sources in determining insurance premiums. P. M. Kahn, who has co-chaired two Berkeley conferences on credibility theory, will present a survey of that topic. Graduation, the process of constructing a smoothed version of data, is an important topic in actuarial mathematics. Reflecting the influence of the work of T. N. E. Greville, E. S. Shiu will give a survey of graduation theory. A new emphasis in actuarial practice is on actuarial projections of insurance and annuity funds. J. A. Beekman will address this topic by giving an overview of the array of processes used in actuarial projections for U.S. Social Security.

The course will conclude with a general discussion which may include comments by C. J. Nesbitt on the 1960-1982 experience under TIAA-CREF annuities and the studies being undertaken by the recently formed Commission on College Retirement. Synopses of the talks and accompanying reading lists appear in this issue of the *Notices.*

The mathematics involved will be at the undergraduate and early graduate level. Some background in probability, statistics and computing will be helpful. Actuarial mathematics deals with a wide diversity of complex applications and a short course thereon will necessarily be only an overview.

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 sections entitled **Preregistration, Housing,** and **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, Stefan A. Burr, Philip C. Curtis, Jr., Lisl Novak Gaal, Gerald J. Janusz, and Donald C. Rung (chairman). The short course series is under the direction of the CEEP Short Course Subcommittee, whose members are Stefan A. Burr (chairman), Lisl Novak Gaal, Gerald J. Janusz, Barbara L. Osofsky, and Philip D. Straffin, Jr..

WILLIAMS, Northwestern University, 8:00 a.m. and 2:15 p.m. Tuesday.

Commutative algebra and algebraic geometry, FRANK R. DE MEYER, Colorado State University and RICK MIRANDA, Bedford, Massachusetts, 2:15 p.m. Monday and 8:00 a.m. Tuesday.

The geometry of configurations, GEORGE B. PURDY, Texas A&M University, 2:15 p.m. Monday and 8:00 a.m. Tuesday.

Approximation theory and applications, V. M. SEGAL, University of Wyoming and S. P. SINGH, Memorial University of Newfoundland, 2:15 p.m. Tuesday and 1:00 p.m. Wednesday.

Mechanics and bifurcation theory, SCOTT J. SPECTOR, Southern Illinois University, Carbondale, 8:00 a.m. and 1:00 p.m. Thursday.

Analysis of one complex variable, CHUNG-CHUN YANG, Naval Research Laboratory, Washington, DC, 8:00 a.m. and 1:00 p.m. Thursday,

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 sessions should indicate this clearly on the abstract, **and should submit it by May 7, 1985, three weeks earlier than the normal deadline for contributed papers,** in order that it may be considered for inclusion. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics, and should be sent to Abstracts, Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940. Each abstract submitted must be accompanied by payment in the amount of $15 to cover processing costs. Please refer to the article on page 484 of the August 1984 issue of the *Notices.* In addition, a charge of $12 is imposed for retyping abstracts that are not in camera-ready form.

Contributed Papers

There will be sessions for contributed papers on Monday afternoon, Tuesday morning and afternoon, Wednesday afternoon, and Thursday morning and afternoon. Abstracts should be prepared on the standard AMS form available from the AMS office in Providence or in departments of mathematics, and should be sent to Abstracts, Editorial Department, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940, **so as to arrive by the abstract deadline of May 28, 1985.** These abstracts must also be accompanied by payment of the $15 processing charge and are also subject to the charge of $12 for retyping.

Late papers will not be accepted.

Other AMS Sessions

AMS Committee on Employment and Educational Policy

CEEP will sponsor a fact-finding panel discussion at 7:00 p.m. on Wednesday, August 14, moderated by DONALD C. RUNG, Pennsylvania State University on *Computer science in mathematics departments–What are the problems?* Opening remarks on *Forming a separate department of computer science* will be given by BARNET M. WEINSTOCK, University of North Carolina, Charlotte.

Council Meeting

The Council of the Society will meet at 5:00 p.m. on Sunday, August 11.

Business Meeting

The Business Meeting of the Society will take place immediately following the Steele and Wiener Prize Session at 4:30 p.m. on Wednesday, August 14. 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 box titled Committee on the Agenda for Business Meetings.

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 14, 1985, receive the service offered by the committee in the most effective manner, it should have been in the hands of the secretary by July 15, 1985.

Everett Pitcher, Secretary

65th Summer Meeting of the MAA August 12–15, 1985

Hedrick Lectures

The 34th Earle Raymond Hedrick Lectures will be given by ARTHUR M. JAFFE of Harvard University. These lectures will be given at 11:00 a.m. on Tuesday, Wednesday, and Thursday, August 13–15.

Invited Addresses

There will be invited fifty-minute addresses. A partial list of speakers and their affiliations follow:

JEANNE LADUKE, DePaul University;

HENRY P. MIRANDA, Colorado State University;

HUGH L. MONTGOMERY, University of Michigan;

MICHAEL SACHS, Bell Communications Research.

Minicourses

Five Minicourses are being offered by MAA. The names and affiliations of the organizers and the topics follow:

Minicourse #1: *Geometry for college teachers* is being organized by BRANKO GRÜNBAUM, University of Washington;

Minicourse #2: *Applied mathematics via classroom experiments* is being organized by HERBERT R. BAILEY, Rose-Hulman Institute of Technology;

Minicourse #3: *Teaching experiential applied mathematics*, (TEAM) is being organized by JAMES R. CHOIKE, Oklahoma State University;

Minicourse #4: *Computing in undergraduate linear algebra* is being organized by EUGENE A. HERMAN, Grinnell College;

Minicourse #5: *Microcomputer software in mathematics instruction* is being organized by ROY E. MYERS, Pennsylvania State University, Kensington.

Please note the new procedure for registering for Minicourses. Participants interested in attending any of the Minicourses should complete the Minicourse Preregistration Form located at the back of this issue **and send it directly to the MAA Office at the address given on the form so as arrive prior to the June 14 deadline. DO NOT SEND THIS FORM TO PROVIDENCE.**

Please note that prepayment is now required. Payment can be made by check payable to MAA (Canadian checks must be marked "in U.S. funds") or VISA or MASTERCARD credit cards.

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

If the only reason for registering for the Joint Meetings is to gain admission to a Minicourse, this should be indicated by checking the appropriate box on the Minicourse Preregistration Form. Then, if the Minicourse is fully subscribed, full refund can be made of the Joint Mathematics Meetings preregistration fee(s). Otherwise, the Joint Meetings preregistration will be processed, and then be subject to the 50 percent refund rule.

The registration fee for Minicourses #1, #2, and #3 is $25 each. The registration fee for Minicourses #4 and #5 is $35 each. This fee entitles the registrant to attend all sessions of the Minicourse for which he/she has registered. Participants are limited to two Minicourses each. It is advised that alternate choices be given in the event the first and/or second choice Minicourse(s) are full.

Contributed Papers

Papers are being accepted on four topics in collegiate mathematics for presentation in contributed paper sessions at the MAA Summer Meeting in Laramie. These sessions will be held on Monday morning and afternoon, and Tuesday and Wednesday mornings. The topics are:

- The role of the history of mathematics in the undergraduate curriculum (Duane D. Blumberg, University of Southwestern Louisiana)
- What's happening in college geometry courses? What should? (Lester H. Lange, San Jose State University)
- Experience with innovation in solving the discrete/continuous mathematics dilemma (Michael G. Murphy and Nancy T. Rich, University of Houston–Downtown)
- What's new in teaching statistics? (Ann E. Watkins, Los Angeles Pierce College)

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 in Laramie should send the following information to the MAA Washington office (1529 Eighteenth Street, NW, Washington, DC 20036) **before May 28.**

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., slide or film projector).

Late papers will not be accepted.

This information will be sent to session leaders who will arrange for refereeing. Selection of papers will be announced by June 15.

Other MAA Sessions

The MAA Film Program will take place on Monday, August 12 at 7:00 p.m.

Business Meeting

The Business Meeting of the MAA will take place at 4:35 p.m. on Tuesday, August 13 at which the 1985 Carl B. Allendoerfer, Lester R.

Ford, and George Pólya Awards for expository writing will be presented. Awards of Certificates for Meritorious Service will be announced. This meeting is open to all members of the Association.

Board of Governors

The MAA Board of Governors' will meet at 9:00 a.m. on Sunday, August 11. This meeting is open to all members of the Association.

Section Officers

There will be a Section Officers' Meeting at 3:30 p.m. on Monday, August 12.

Banquet for 25-year Members

The MAA is planning its tenth annual banquet for individuals who have been members of the Association for twenty-five years or more. The banquet will take place at 6:15 p.m. on Wednesday evening, August 14. Dinner will be served at 7:00 p.m. The menu includes fresh fruit cup, Western cut of prime rib of beef, salad, vegetable, potato, rolls, dessert, coffee, tea, Sanka, iced tea. Dinner will be preceded by a cash bar reception.

Please note that all tickets for this banquet must be purchased through preregistration, since a guarantee must be given to the caterer. Tickets (which include gratuities) are $17.25 each. For those who are residing in the residence halls and are subject to the three-meal plan, the price of the banquet ticket is an additional $12.75 since a credit of $4.50 will be allowed. Interested participants should complete the appropriate section of the preregistration form. In the event of cancellations, a full refund of the amount paid for the ticket will be refunded if notification is received in Providence prior to July 25. After that date, only a 50 percent refund will be given.

Joint AMS-MAA Sessions

By invitation of the AMS-MAA Joint Program Committee (Jeanne L. Agnew, George E. Andrews, Paul F. Baum, and William P. Ziemer), the following speakers will address the joint meeting of the AMS and MAA on the history and development of mathematics. The names of some of the speakers, their affiliations, and some of their titles are:

RICHARD A. ASKEY, University of Wisconsin, Madison, *The Bieberbach conjecture, now de Branges's theorem*;

SAUNDERS MAC LANE, University of Chicago.

ACTIVITIES OF OTHER ORGANIZATIONS

Association for Women in Mathematics (AWM). The AWM will sponsor a panel discussion on Tuesday, August 13 at 8:30 a.m. The AWM Membership Meeting will follow at 9:30 a.m. The AWM Open Dessert Party will follow the picnic on Tuesday evening, August 13.

Pi Mu Epsilon (ΠΜΕ) will hold its annual meeting on Tuesday and Wednesday, August 13 and 14. The J. Sutherland Frame Lecture will take place at 8:30 p.m., on Wednesday, August 14. There will also be sessions for contributed papers on Tuesday afternoon and Wednesday morning.

OTHER EVENTS OF INTEREST

National Meeting of Department Heads

The Joint Policy Board for Mathematics (JPBM) has created a new committee, the Committee for Mathematics Department Heads. This committee is organizing a National Meeting of Department Heads on Monday, August 12, at 7:00 p.m. There will be two one-hour sessions. The first is titled *Preliminary report from the* AMS-MAA-SIAM *Joint Committee on the Status of the Profession.* The second one-hour session is titled *On management and leadership in the mathematics department.*

Book Sales

Books published by the AMS and 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 will be open the same days and hours as the exhibits.

Exhibits

The book and educational media exhibits will be open from 1:00 to 5:00 p.m. on Monday, August 12 and from 8:30 a.m. to 4:30 p.m. on Tuesday and Wednesday, August 13 and 14. All participants are encouraged to visit the exhibits during the meeting.

MATHSCI

MATHSCI (formerly MATHFILE) will be demonstrated in the exhibit area during regular exhibit hours.

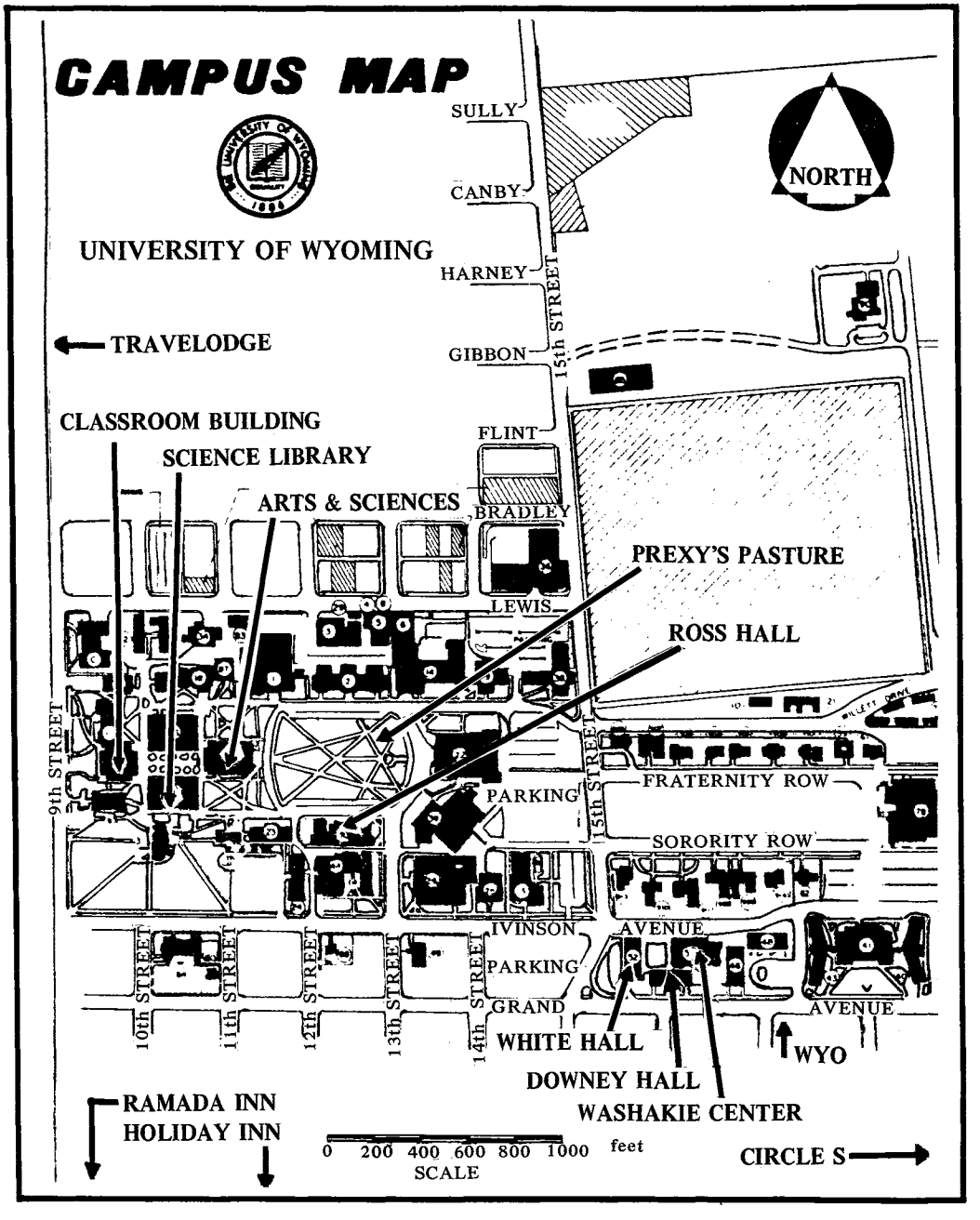
MATHSCI now contains three new components in addition to *Mathematical Reviews*: *Current Mathematical Publications* (CMP), *Current Index to Statistics* (CIS), and the *Tukey Index to Statistics and Probability.* The MR component of MATHSCI has also been increased with the addition of 200,000 author and title entries from MR 1959-72, bringing the size of MATHSCI to approximately 700,000 references.

CMP provides information on new articles and books within two months of their publication. The *Current Index to* Statistics, published jointly by the American Statistical Association and the Institute of Mathematical Statistics, brings to MATHSCI works which were not reviewed in MR. The *Tukey Index* covers the statistics literature from 1902 to 1968.

MATHSCI now makes it possible to search simultaneously four printed publications: MR (back to 1959), the current issues of CMP, CIS (back to 1975) and the *Tukey Index* (1902-1968).

Summer List of Applicants

At the direction of the AMS-MAA-SIAM Committee on Employment Opportunities, which


CAMPUS MAP
UNIVERSITY OF WYOMING
NORTH
SULLY
CANBY
HARNEY
GIBBON
FLINT
BRADLEY
LEWIS
15th STREET
TRAVELODGE
CLASSROOM BUILDING
SCIENCE LIBRARY
ARTS & SCIENCES
PREXY'S PASTURE
ROSS HALL
9th STREET
PARKING
FRATERNITY ROW
SORORITY ROW
IVINSON AVENUE
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GRAND AVENUE
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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 that 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 seven (7) days in advance of the meeting 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 the close of registration.**

is charged with operation of the Employment Register and with the publication of *Employment Information in the Mathematical Sciences*, the Society will publish a Summer List of mathematical scientists seeking employment for distribution at the Laramie meeting.

Copies of the 1985 summer list of applicants 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 is June 14. The applicant preregistration résumé and instructions on its completion can be found at the back of this issue.

Instead of an Employment Register at the Summer Meeting in Laramie, 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. No printed lists of employers or applicants who register at the meeting will be available after the meeting.

Accommodations

University Housing

Participants desiring confirmed reservations for on-campus housing **must preregister** and send payment in full for housing to the Mathematics Meetings Housing Bureau **prior to the June 14, 1985 deadline.** Participants in the Joint Mathematics Meetings may occupy residence hall rooms at the University of Wyoming during the period August 9 to August 16 only. **All must check out by August 16.** A limited number of rooms on campus will be available for those participants who do not preregister but plan on attending the Laramie meeting and registering on site. All rooms on campus are offered only through a **Room/Board Package that provides three meals.**

Participants requesting housing on the University of Wyoming campus during the meetings will be assigned to the Washakie Complex residence halls. (Please refer to the section below titled Room and Board Rates.)

Families with children will be allowed to stay in the dormitories. Sleeping bags for children of any age will not be permitted; however, parents can bring portacribs for infants and small children. All children (other than those in portacribs) must occupy a bed in a room with a parent and pay the same rate as an adult. (See section on **Motel Accommodations** below for alternate housing for families.)

Dormitories at the University of Wyoming are not air-conditioned and windows do not have screens. There are elevators in each of the residence halls. Sleeping rooms are good sized, very well maintained, and contain two single beds, desks, chairs, closets (with a limited number of hangers), and overhead lights. There are no reading lamps; however, a few lamps are available on request at the check-in desk. Rooms will be prepared for occupancy in advance. In addition to bed linen, pillow and blanket, participants will receive one wash cloth, towel, hand towel, ashtray, soap and drinking glass. These may be replaced on request at the check-in desk. There is no daily maid service in the sleeping rooms.

There are two bathrooms with showers on each floor; one for each gender. Walls separate shower stalls and curtains screen the interiors. Hooks are placed on the outside of stall dividers where robes

may be hung. A changing area is located several feet from the showers.

No pets are allowed in the residence halls. Alcoholic beverages are permitted provided the 21 year age limit is observed. There will be no telephone service in any of the university accommodations; however, there are pay telephones and campus phones in the public areas. Participants will be held responsible for any room damage incurred.

Smoking is permitted in dormitory rooms; however, there are areas where it is restricted. There are fire code approved doors in the residence halls which are unlocked until 2:00 a.m. The university is tied into the city alarm system in the event of fire.

Check-In Locations and Times

A check-in desk will be maintained in the lobby of each residence hall assigned for our use in the Washakie Center which is located on 15th Street and Grand Avenue. These desks will be staffed from 7:00 a.m. to 2:00 a.m. daily. The closest parking lot to Washakie Center is located across from the residence halls on 15th Street; another is adjacent to the Wyoming Union.

At the time of check-in, participants will be required to fill out a card for university records which will enable them to receive a room key. Spouses desiring a room key must follow this procedure also. **Please note that, although there is no deposit required for keys, a penalty of $20 will be imposed for each key lost or not returned.** It is the responsibility of the Mathematics Meetings Housing Bureau to collect this penalty. Therefore, it is requested that proper caution be exercised to avoid this charge. At checkout, all keys must be returned to the main desk in the lobby. Should the clerk not be present, please ensure that your name is left with the key.

A computerized meal card will be issued to each person who has paid the required room and board fee(s). This card will entitle holders to breakfast, lunch, and dinner each day in the Washakie Cafeteria. Meals start with breakfast on the day following receipt of meal card.

Room and Board Rates

The following rates apply for residence hall accommodations at the University of Wyoming. Please note that there is no room or food tax applicable to these rates.

Rates for adults and children (other than those occupying a portacrib); including three meals, are as follows:

	Singles	Doubles (two persons)
1 day	$ 25	$ 40
2 days	$ 50	$ 80
3 days	$ 75	$120
4 days	$ 90	$145
5 days	$104	$171
6 days	$117	$195
7 days	$130	$219

Food Services

All meals for those participants staying in the residence halls will be served in Washakie Cafeteria in Washakie Center. Dining hours are:

Breakfast	6:45 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.

Meals in the cafeteria are generous and well prepared. A typical breakfast would be fruit juices, fresh fruit, cold or hot cereals, eggs, sweet rolls, and assorted beverages. Lunch would be soup, a casserole, grilled sandwiches, salad bar with assorted dressings, desserts, fresh fruit and assorted beverages. Three entrees are offered for dinner together with vegetable, salad bar, fresh fruit, pies or cake, assorted rolls and beverages.

It will be possible for a limited number of participants not residing on campus to purchase a three-meal plan for $12.25 per day, if they wish. (This rate includes 3 percent tax.) These tickets may be purchased at the **Housing Desk at the Joint Meetings Registration Desk** in Washakie Center. In addition, tickets for individual meals in Washakie Cafeteria will be available for cash purchase at the Washakie Center Control Desk.

For those participants who wish to get their meals off-campus, please be advised that there are only a few restaurants within walking distance. Among these are a pizza parlor and a fast food place featuring hot dogs.

Motel Accommodations

Since most of the motels in Laramie are not within walking distance of the campus, it is recommended that participants planning to stay in a motel plan to provide their own transportation. There are fast food as well as other type restaurants in the motel areas.

The following is a partial list of motels and their approximate distance from the University of Wyoming campus. A 3 percent tax applies to room rates. Rates quoted are firm.

WYO Motel–5 blocks
1720 Grand Avenue
Laramie, Wyoming 82070
Telephone: 307-742-6633

Single	$22.50--1 bed
Double	$25.20--1 bed
Double	$27.70--2 beds
Triple	$31.50--2 beds

Children 12 and under are free

Airconditioned, outdoor pool. AE, VISA and MC accepted

Circle S–12 blocks
2440 Grand Avenue
Laramie, Wyoming 82070
Telephone: 307-745-4811

Single	$23.50--1 bed
Double	$28--1 bed
Double	$32--2 beds

Triple $36–2 beds

Children 12 and under are free

Airconditioned, outdoor pool. All major credit cards accepted.

TraveLodge–6 blocks
262 North Third Street
Laramie, Wyoming 82070
Telephone: 307-745-4853 or 800-255-3050

Single	$32–1 bed
Double	$37–1 bed
Double	$48–2 beds

Children 17 and under are free

Airconditioned, outdoor pool. AE, VISA, MC and Carte Blanche accepted.

Holiday Inn–2 miles
South Third Street
Laramie, Wyoming 82070
Telephone: 307-742-6611

Children 16 and under are free

Single	$38–(Double bed)
Double	$44–(Double bed)
Single	$42–(King bed)
Double	$46–(King bed)

Airconditioned, outdoor pool, restaurant, coffee shop, lounge. AE, VISA, MC, and Diner's Club accepted

Ramada–2 miles
421 Boswell
Laramie, Wyoming 82070
Telephone: 307-742-3721

Single	$36–1 bed
Double	$38–1 or 2 beds

Children 16 and under are free

Airconditioned, outdoor pool, coffee shop, dining room. AE, VISA, and MC accepted.

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. **Badges are required to obtain discounts at the AMS and MAA Book Sales, to cash a check with the meeting casher, and to attend sessions scheduled in Room 127 in the Arts and Sciences Building. (If a preregistrant should arrive too late in the day to pick up his/her badge, he/she may show the acknowledgment received from the Mathematics Meetings Housing Bureau as proof of registration.)** The fees for Joint Meetings registration at the meeting (listed below) are 30 percent more than the preregistration fees.

Joint Mathematics Meetings

Member of AMS, MAA, ΠΜΕ	$ 72
Emeritus Member of AMS, MAA	$ 18
Nonmember	$109
Student/Unemployed	$ 18

AMS Short Course

Student/Unemployed	$ 10
All Other Participants	$ 30

MAA Minicourses
(if openings available)

Minicourses #1, #2, and #3	$ 25 each
Minicourses #4 and #5	$ 35 each

U.S. Treasury regulation §1.162-5 allows an income tax deduction for education expenses (registration fees, cost of travel, meals, and lodging) incurred to (i) maintain or improve skills in one's employment or other trade or business or (ii) meet express requirements of an employer or a law imposed as a condition to retention of employment, job status, or rate of compensation. This is true even for education that leads to a degree.

Registration fees may be paid at the meetings in cash, by personal or traveler's checks, or by VISA or MASTERCARD credit card. Canadian checks must be marked for payment in U.S. funds.

There is 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 $109 nonmember registration fee are entitled to a discount of the difference between the member registration fee of $72 and the nonmember registration fee of $109 as a $37 credit against dues in either the AMS or MAA or both, provided they apply for membership before September 15, 1985.

Nonmember students who register at the meetings and pay the $18 registration fee are entitled to a discount of the difference between the student preregistration fee of $14 and the registration fee of $18 as a $4 credit against dues in either the AMS or MAA or both, provided they apply for membership before September 15, 1985.

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

Registration Dates, Locations, and Times

AMS Short Course
Outside Room 103, Classroom Building

Saturday, August 10 9:00 a.m. to 2:30 p.m.

Joint Mathematics Meetings
[and MAA Minicourses (until filled)]
Wyoming Room, Washakie Center

Sunday, August 11 4:00 p.m. to 8:00 p.m.
Monday, August 12 8:00 a.m. to 4:30 p.m.
Tuesday, August 13, and Wednesday, August 14 8:30 a.m. to 4:30 p.m.

Assistance and Information Desk
Outside Room 127, Arts & Sciences Building
Thursday, August 15 8:30 a.m. to 1:00 p.m.

Please note that the Joint Mathematics Meetings registration desk **will not be open on Thursday, August 15**, 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 outside Room 127 in the Arts & Sciences Building, 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 meeting 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 meeting 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 meetings director, who will try to assist them.

Audio-Visual Assistance

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

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.

Baggage and Coat Check

Provision will be made for participants checking out of the residence halls or motels early to leave baggage in the meeting registration area while it is open.

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. Due to the increased use of credit cards, cash availability may be lower than at other meetings. It is strongly advised that participants bring travelers' checks which are honored by banks and most restaurants. Canadian checks must be marked for payment in U.S. funds.

Local Information

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

Lost and Found

See the meeting cashier during the meeting. After the meeting, all lost articles not claimed will be turned over to the Department of Mathematics.

Information Table

The information table at Joint Meetings of the AMS and MAA is set up in the registration area for the dissemination of information of a nonmathematical nature of possible interest to the members. The administration of the information table is in the hands of the AMS-MAA Joint Meetings Committee, as are all arrangements for such joint meetings. The following rules and procedures apply.

1. Announcements submitted by participants should ordinarily be limited to a single sheet no more than $8\frac{1}{2}" \times 14"$.

2. A copy of any announcement proposed for the table is to be sent to: H. Hope Daly, American Mathematical Society, Post Office Box 6248, Providence, Rhode Island 02940 to arrive at least one week before the first day of the scientific sessions.

3. The judgment on the suitability of an announcement for display rests with the Joint Meetings Committee. It will make its judgements on a case by case basis to establish precedents.

4. Announcements of events competing in time or place with the scheduled scientific program will not be accepted.

5. Copies of an accepted announcement for the table are to be provided by the proponent. Announcements are not to be distributed in any other way at the meeting (for example, not by posting or personal distribution of handbills).

6. It may be necessary to limit the number of events or the quantity of announcements distributed at a meeting.

7. At the close of registration, the table will be swept clean. A proponent who wishes the return of extra copies should remove them.

Mail

All mail and telegrams for persons attending the meetings should be addressed to the participant, c/o Joint Mathematics Meetings, Department of Mathematics, University of Wyoming, Laramie, Wyoming 82071. Mail and telegrams so addressed may be picked up at the mailbox in the registration area during the hours the registration desk is open. U.S. 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 meeting 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 11 through 14 only, during the hours that the Joint Mathematics Meetings registration desk is open. 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 be not be available on Thursday, August 15.**

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

Half-Acre Gymnasium has lockers, weight-room, basketball courts, racquetball courts, and an indoor track. These will be open from 8:00 a.m. to 6:00 p.m. The university maintains quite a few tennis courts east of campus off of Willett Drive. Also east of campus are playing fields and a public golf course. Hours and access rules will be available before the meetings begin.

Participants and their families can use any of the athletic facilities provided they have a guest pass. This pass costs $2 per day or $10 per week, per person, including children. The pool will be open for public swimming from noon to 1:00 p.m. and from 4:00 p.m. to 6:00 p.m.

Book Store

The University of Wyoming Bookstore is located in the Wyoming Union. Business hours are Monday through Friday from 7:30 a.m. to 4:30 p.m. Other bookstores and novelty shops are located close to campus and downtown.

Camping and RV Facilities

K.O.A., Northwest of Laramie at Curtis and I-80 exit. 742-6553. Full hookups and other services available.

N & H Trailer Ranch, 1360 North Third Street, 742-3158.

Curt Gowdy State Park, approximately 25 miles east of Laramie off Happy Jack Road (take I-80 east from Laramie). There are several primitive campgrounds here, available for $2 per night on a first-come basis. For more information call the Wyoming Recreation Commission in Cheyenne. 307-777-7550.

U.S. Forest Camping Facilities, 7–8 miles east of Laramie off Happy Jack Road, Tie City, Pole Creek and Yellow Pines. All have drinking water and spaces for tents or small trailers. 71 spaces available. No reservations needed. There are also many campgrounds in the Medicine Bow National Forest roughly 30–40 miles west of Laramie. Maps and other information are available from the U.S. Forest Service, Skyline Drive, Laramie, WY 82070, 307-745-8971.

Child Care

There are several state-licensed day nurseries and child care facilities. Please make your own reservations by calling any of the following centers:

ABC, 620 E. Fremont, 742-7272
Basic Beginnings, 1474 North 19th, 745-5755
Creative Childcare, 710 Garfield, 742-7502
Kids Connection, 506 South 21st, 742-0127
Sonshine House, 416 Hancock, 745-7985

Crib Rental

Portacribs can usually be rented directly from Taylor Rental Center, 1015 South Second, 745-3889. Some motels have rollaways for customer use upon request. Please note that no cots or cribs other than portacribs are allowed in the university residence halls.

Handicapped

Most (not all) university facilities are accessible to the handicapped. People with special requirements for campus housing should make these clear when submitting preregistration forms. People with special questions regarding handicapped access should contact Myron B. Allen, Mathematics Department, University of Wyoming, at 307-766-4221.

Libraries

Science Library (including mathematics): Biological Sciences Building

TIMETABLE

The purpose of this timetable is to provide assistance to registrants in the selection of arrival and departure dates. The program, as outlined below, is based on information available at press time.

AMERICAN MATHEMATICAL SOCIETY SHORT COURSE SERIES

SATURDAY, August 10	ACTUARIAL MATHEMATICS
9:00 a.m. - 2:30 p.m.	REGISTRATION
2:00 p.m. - 3:15 p.m.	Updating actuarial mathematics James C. Hickman
3:45 p.m. - 5:00 p.m.	Models in risk theory Harry H. Panjer
SUNDAY, August 11	
9:00 a.m. - 10:15 a.m.	Loss distributions Stuart A. Klugman
10:45 a.m. - noon	Overview of credibility theory Paul M. Kahn
1:30 p.m. - 2:45 p.m.	A survey of graduation theory Elias S. Shiu
3:15 p.m. - 4:30 p.m.	Actuarial assumptions and models for social security projections John A. Beekman
4:30 p.m. - 5:15 p.m.	General Discussion

JOINT MATHEMATICS MEETINGS

SUNDAY, August 11	American Mathematical Society	Mathematical Association of America
9:00 a.m. - 4:00 p.m.		Board of Governors' Meeting
4:00 p.m. - 8:00 p.m.	REGISTRATION	
5:00 p.m. - 10:00 p.m.	Council Meeting	
MONDAY, August 12	**AMS**	**MAA and Other Organizations**
morning		MAA - Contributed Paper Sessions
morning		MAA - Minicourses
8:00 a.m. - 4:30 p.m.	REGISTRATION	
8:15 a.m. - 8:25 a.m.	WELCOME ADDRESS	
8:30 a.m. - 9:30 a.m.	INVITED ADDRESS Theory of types in programming languages David B. MacQueen	
9:45 a.m. - 10:45 a.m.	AMS-MAA INVITED ADDRESS	
11:00 a.m. - noon	INVITED ADDRESS Gauge theories and the topology of 4-manifolds Ronald J. Stern	
afternoon		MAA - Contributed Paper Sessions
afternoon		MAA - Minicourses
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE I Mathematical gauge field theory Karen K. Uhlenbeck	
afternoon	Sessions for Contributed Papers	
1:00 p.m. - 5:00 p.m.	EXHIBITS	
1:00 p.m. - 5:00 p.m.	AMS BOOK SALE	MAA BOOK SALE
	SPECIAL SESSIONS	
2:15 p.m.	Commutative algebra and algebraic geometry I	
2:15 p.m.	The geometry of configurations I	
2:15 p.m. - 3:05 p.m.		MAA - INVITED ADDRESS
3:20 p.m. - 4:20 p.m.	INVITED ADDRESS Hyperbolicity in dynamical systems Lai Sang Young	
3:30 p.m. - 5:30 p.m.		MAA - Section Officers' Meeting
evening		MAA - Minicourses
7:00 p.m. - 9:00 p.m.		MAA - Film Program

University Library: Coe Library
Geology Library: Knight Geology Building
Albany County Public Library: 310 S. 8th

Local Information

Laramie, with a population of about 25,000, is the third largest city (after Casper and Cheyenne) in Wyoming. Laramie sits at an elevation of 7,200 feet on a high, rolling prairie separating two mountain ranges. About 8–10 miles east of town are the Sherman Mountains of the Laramie Range, reaching 9,000 feet in elevation, and about 35 miles to the west rises the Snowy Range of the Medicine Bow Mountains, reaching 12,000 feet in elevation. The city began in 1868 when the first transcontinental railroad crossed the Laramie River, which afforded access to the railroad ties from forests in the Medicine Bow Mountains.

Because of its intermountain setting, Laramie is close to a wide range of outdoor activities. Within a 50-mile radius there is a remarkable variety of scenery: high, open plains; rocky, sage-covered foothills; densely forested mountains; alpine lakes, and many unusual geologic formations. The Happy Jack Road exit off I-80, about 10 miles east of Laramie, gives access to several hiking trails. Following Happy Jack Road about 12 miles leads to Curt Gowdy State Park, offering camping, hiking, and excellent fishing in Crystal and Granite Reservoirs. Further east along I-80, about 20 miles from Laramie, is the Vedawoo exit, giving access to Vedawoo Glen, a picnic area amidst huge, bizarre sub-rounded granite formations that challenge expert rock climbers. Across I-80 from Vedawoo is the Ames Monument, a stone pyramid commemorating the ghost town of Sherman, the highest point on the original transcontinental railroad.

West of Laramie, about 30 miles along Rte. 130, lies the small town of Centennial. Once a center for gold and platinum mining, Centennial today is largely a stopping place for hikers, fishermen, hunters, and skiers visiting the Medicine Bow Mountains. The hamlet boasts a small museum, several taverns, and a good restaurant (the Old Corral). Closer to Laramie along Rte. 130, near where it crosses the Little Laramie River, is the Vee-Bar Guest Ranch, offering horseback riding, ranch-style meals and accommodations. West of Centennial, Rte. 130 climbs into the Medicine Bow Mountains, giving access to several National Forest Service campgrounds, excellent hiking and fishing, and picnic grounds nestled among high mountain lakes beneath the sheer cliffs of the Snowy Range. Rte. 130 eventually leads to Saratoga, with its thermal springs.

North of Laramie, Route 287 leads about 40 miles to Como Bluffs, site of a large fossil bed that has yielded thousands of dinosaur bones. About 10 miles further along Rte. 287 is the town of Medicine Bow, setting for Owen Wister's novel, *The Virginian.* Today Medicine Bow is home of the Virginian Hotel, with its remarkable period furniture, and large wind turbines used to generate electricity. About 18 miles north of Laramie on Rte. 287 is the junction with Rte. 34, a cutoff leading northeast through Morton Pass and the rugged Sybille Canyon. About 40 miles from town is Wyoming's Game and Fish Experimental Station, where visitors can see elk, deer, moose, and bighorn sheep. Sharp navigators can find their way to Johnson Reservoir, north of Rte. 34 via dirt road, where there are campsites, fishing, and picnicking among the Laramie Hills.

To the south, about two-and-one-half hours' drive from Laramie, is Rocky Mountain National Park, some of whose peaks are visible from Laramie on clear days.

Within Laramie's city limits there are also many attractions. The block of Ivinson Avenue between First and Second Streets is a refurbished district with several specialty shops, a couple of restaurants, and a saloon. Further east on Ivinson Avenue is the Laramie Plains Museum, located in the home of one of Laramie's more prosperous early citizens. Upstairs in the museum is the Overland Trail Art Gallery. The university campus itself offers Geology, Anthropology, and Art Museums, along with the American Heritage Center, The Rocky Mountain Herbarium, containing over 300,000 plant specimens, and a planetarium.

Laramie has a public golf course, the Red Jacoby course on Willett at the eastern edge of town. There are 23 public tennis courts maintained by the university. There are several public parks, including Washington Park, three blocks south of campus off 15th; La Bonte Park, five blocks north of campus off of 9th, and Undine Park, 8 blocks southwest of campus off of 7th.

For further information about Laramie and environs, write to the Laramie Chamber of Commerce, 312 West Grand Avenue, Laramie, Wyoming 82070, or call 307-745-7339. For general information about Wyoming, write the Wyoming Travel Commission, I-25 at College Drive, Cheyenne, Wyoming 82002-0660, or call 307-777-7777. Further information on Laramie and surrounding areas will be available at the Local Information Section of the meeting registration desk.

Medical Services

Ivinson Memorial Hospital is located east of campus at 255 N. 30th; its telephone number is 742-2141.

Parking

The parking lot closest to Washakie Center is on 15th Street opposite the residence halls. There is additional parking adjacent to the Wyoming Union. Parking in these lots is free. No stickers are required.

Social Event

Plans are being made for a picnic on Tuesday evening, August 13. Further information will be available later.

TIMETABLE

MONDAY, August 12	American Mathematical Society	Mathematical Association of America and Other Organizations
7:00 p.m. - 9:00 p.m.	NATIONAL MEETING OF DEPARTMENT HEADS Preliminary report from the AMS-MAA-SIAM Joint Committee on the Status of the Profession On management and leadership in the mathematics department	
7:00 p.m. - 10:00 p.m.		Pi Mu Epsilon - Reception

TUESDAY, August 13	AMS	MAA and Other Organizations
morning	Sessions for Contributed Papers	
morning		MAA - Minicourses
morning		MAA - Contributed Paper Sessions
	SPECIAL SESSIONS	
8:00 a.m.	Dynamical systems and ergodic theory I	
8:00 a.m.	Commutative algebra and algebraic geometry II	
8:00 a.m.	The geometry of configurations II	
8:30 a.m. - 4:30 p.m.	REGISTRATION	
8:30 a.m. - 4:30 p.m.	AMS BOOK SALE	MAA BOOK SALE
8:30 a.m. - 4:30 p.m.	EXHIBITS	
8:30 a.m. - 9:30 a.m.		Association for Women in Mathematics Panel Discussion
8:40 a.m. - 9:30 a.m.		MAA - INVITED ADDRESS
9:30 a.m. - 10:00 a.m.		AWM - Membership Meeting
9:45 a.m. - 10:45 a.m.	AMS-MAA INVITED ADDRESS	
11:00 a.m. - noon		MAA - HEDRICK LECTURE I Title to be announced Arthur M. Jaffe
noon - 1:00 p.m.		IIME - Council Meeting
afternoon		IIME - Contributed Paper Session
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE II Mathematical gauge field theory Karen K. Uhlenbeck	
afternoon	Sessions for Contributed Papers	
	SPECIAL SESSIONS	
2:15 p.m.	Dynamical systems and ergodic theory II	
2:15 p.m.	Approximation theory and applications I	
2:15 p.m. - 3:05 p.m.		MAA - INVITED ADDRESS
3:20 p.m. - 4:20 p.m.	INVITED ADDRESS Orthogonal polynomials and association schemes Dennis W. Stanton	
4:35 p.m. - 5:35 p.m.		MAA - BUSINESS MEETING
evening	SOCIAL EVENT	
8:30 p.m. - 10:30 p.m.		AWM - Party
evening		MAA - Minicourses

WEDNESDAY, August 14	AMS	MAA and Other Organizations
morning		IIME - Contributed Paper Session
morning		MAA - Minicourses
morning		MAA - Contributed Paper Sessions
8:00 a.m. - 9:00 a.m.		IIME - Dutch Treat Breakfast
8:30 a.m. - 4:30 p.m.	REGISTRATION	
8:30 a.m. - 4:30 p.m.	AMS BOOK SALE	MAA BOOK SALE
8:30 a.m. - 4:30 p.m.	EXHIBITS	
8:30 a.m. - 9:30 a.m.	INVITED ADDRESS Surfaces in conformal geometry Robert L. Bryant	
9:45 a.m. - 10:45 a.m.	AMS-MAA INVITED ADDRESS	

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TIMETABLE

WEDNESDAY, August 14	American Mathematical Society	Mathematical Association of America and Other Organizations
11:00 a.m. - noon		MAA - HEDRICK LECTURE II Title to be announced Arthur M. Jaffe
afternoon	Session for Contributed Papers	
	SPECIAL SESSIONS	
1:00 p.m.	Approximation theory and applications II	
1:00 p.m.	Special functions and combinatorics I	
1:00 p.m. - 1:50 p.m.		MAA - INVITED ADDRESS
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE III Mathematical gauge field theory Karen K. Uhlenbeck	
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS Global bifurcation problems from mechanics Stuart S. Antman	
2:15 p.m. - 3:05 p.m.		MAA - INVITED ADDRESS
3:20 p.m. - 4:10 p.m.		MAA - INVITED ADDRESS
4:30 p.m. - 6:00 p.m.	PRIZE SESSION AND BUSINESS MEETING	
6:15 p.m.		MAA - Banquet for 25-Year Members
6:30 p.m. - 8:15 p.m.		IIME - Banquet
7:00 p.m.	Committee on Employment and Educational Policy - PANEL DISCUSSION: Computer science in mathematics departments - What are the problems? Donald C. Rung (moderator)	
	Forming a separate department of computer science Barnet M. Weinstock	
8:30 p.m. - 9:30 p.m.		IIME - J. Sutherland Frame Lecture
evening		MAA - Minicourses

THURSDAY, August 15	AMS	MAA
morning	Sessions for Contributed Papers	
	SPECIAL SESSIONS	
8:00 a.m.	Mechanics and bifurcation theory I	
8:00 a.m.	Analysis of one complex variable I	
8:00 a.m.	Special functions and combinatorics II	
8:30 a.m. - 1:00 p.m.	ASSISTANCE & INFORMATION DESK	
8:40 a.m. - 9:30 a.m.		MAA - INVITED ADDRESS
9:45 a.m. - 10:45 a.m.	AMS-MAA INVITED ADDRESS	
11:00 a.m. - noon		MAA - HEDRICK LECTURE III Title to be announced Arthur M. Jaffe
afternoon	Sessions for Contributed Papers	
	SPECIAL SESSIONS	
1:00 p.m.	Mechanics and bifurcation theory II	
1:00 p.m.	Analysis of one complex variable II	
1:00 p.m. - 1:50 p.m.		MAA - INVITED ADDRESS
1:00 p.m. - 2:00 p.m.	COLLOQUIUM LECTURE IV Mathematical gauge field theory Karen K. Uhlenbeck	
2:15 p.m. - 3:15 p.m.	INVITED ADDRESS Elliptic curves and diophantine problems Jerrold B. Tunnell	
3:30 p.m. - 4:30 p.m.	INVITED ADDRESS Simple Lie algebras of prime characteristic Richard E. Block	

Travel

In August, Laramie is on Mountain Daylight Saving Time.

The local airport, Brees Field, is four miles west of the campus. At the moment, only Centennial Airlines offers jet service connecting Laramie to Denver's Stapleton International Airport. (It is hoped that by the time of the meeting that another carrier will pick up the service recently eliminated when Frontier Airlines dropped their regularly scheduled flights.) There are, however, a very limited number of seats available on Centennial, and participants are urged to consider other means of transportation from Stapleton to Laramie, as outlined below.

If, however, one is fortunate enough to obtain a seat on Centennial, there is taxi service available at Brees Field. Also, Avis and National maintain car rental desks at the airport in Laramie.

There are several types of ground transportation available at Stapleton International Airport which will take one to Laramie, approximately 120 miles to the northwest. Participants should consider sharing a rental car. This is probably the most advantageous form of transportation since it will be available to the renters throughout the entire meeting period. (It is worth mentioning that many scenic attractions in the Laramie area require travel by car.) Avis, National, and Dollar maintain desks at Stapleton. Current rates being quoted for compact cars range from $139 to $235/week. However, Alamo Rent A Car is making a special offer to participants at the Laramie meeting where they will provide an economy-sized car for $21/day or $89/week. This includes unlimited mileage; there is an additional charge of $7.95 for insurance. Since Alamo does not have an office in Laramie, you must return the car to the Denver office. There is a courtesy van which will take one to and from Alamo's Denver office and Stapleton. In order to take advantage of these special rates, participants must request Group Number 14651, and Plan Code G9 when making reservations. Reservations may be made by calling 800-732-3232, toll-free.

The shortest and most scenic route is I-25 north to Fort Collins, then Colorado 24 west to Route 287, which runs north alongside the Rockies into Laramie. Driving time is approximately two-and-one-half hours.

One can also take the Front Range Airporter (pickup in baggage area at airport) from Stapleton to Fort Collins, and connect with the Laramie Cab Corporation's limousine service from there to Laramie. Passengers can request to be dropped off at their accommodations, whether on campus or in a nearby motel. The total cost is $36 one way, and reservations **MUST** be made in advance. Reservations for the entire trip can be made by calling Laramie Cab Corporation at 307-745-4840. The trip takes about three hours, and service is available from Stapleton at 9:30 a.m., 3:30 p.m., and 7:30 p.m. daily. Return service from Laramie is at 6:00 a.m., 10:00 a.m., and 4:00 p.m. Laramie Cab will pick participants up at their accommodations early enough to be on the road to Fort Collins at 6:00 a.m. Again, reservations are a must.

Greyhound offers four buses daily. The trip takes about two-and-one-half hours, and the present fare is $24 one way or $45.60 round trip.

Weather

In August, Laramie's daytime highs average around 80°F; the average nighttime low is around 48°F. Laramie's altitude (7,200 feet above sea level) makes hot weather fairly rare. Humidity is generally quite low; however, afternoon thundershowers are common throughout the summer.

Robert M. Fossum
Urbana, Illinois — Associate Secretary

Actuarial Mathematics (August 10-11, 1985)

Synopses and Reading Lists

Actuarial Assumptions and Models for Social Security Projections (John A. Beekman). The lecture consists of seven sections. In the first section, population projections are considered. A social security area population projection starts with an estimate of the current population by age, sex, and marital status, and carries the estimate forward as far as 2080. A deterministic model, and a stochastic model for population projections will be presented.

The second section is concerned with projected life tables. This will include a discussion of life table functions, an analysis of mortality experience by cause of death as well as by age and sex, postulated annual improvement rates in mortality, and the estimation of probabilities of death.

Dependency ratios are described in the third section. These are ratios of retired versus working populations, youth versus working populations and youth plus retired versus working populations. This will include a discussion of the financial burden of a social security pension scheme in a country with a stationary population versus the financial burden in a country with a stable population with a specified growth rate.

In section four, the basic economic assumptions which the Office of the Actuary, Social Security Administration must make are described. These assumptions are made in order to examine the financial status of the Old-Age, Survivors and Disability Insurance (OASDI) system for various periods of time.

Several mathematical models used by the Office of the Actuary are included in section five. These involve linkages between productivity and average wages, increases in average wages as related to increases in productivity and other factors, and labor force participation rates by sex and age. These rates were projected to the year 2060, under four alternative sets of assumptions. Short-range projected GNP, including the concept of potential GNP, with mathematical models for potential GNP are considered.

Further actuarial assumptions and models are presented in section six. These include regression equations for covered worker rates, projected covered populations to the year 2060, relations between effective taxable payroll (ETP) and GNP, and historical analysis of linkages between ETP and GNP, with projections to 2060. Further topics which will be presented are disability incidence and termination rates, probabilities of death, recovery for disabled people, expected average duration of disability entitlement, and actuarial present values of monthly annuities payable to disabled workers.

The seventh section is concerned with long-range cost estimates for the OASDI system. This involves four ideas. The first is primary insurance amounts (PIA) and benefits (expressed through PIA) for various classes of beneficiaries through 2060. The second is the actuarial balance of the system. The third involves sensitivity analyses of actuarial balances as demographic, economic, and programmatic assumptions are varied. The fourth concept is that of projected average OASDI cost rates, income rates, and actuarial balances based on alternative sets of assumptions through 2060.

1. John A. Beekman, *Demography for actuarial students*, Insurance: Mathematics and Economics **3** (1984), 271–277.

2. Robert L. Brown, *Actuarial aspects of the changing Canadian demographic profile*, Trans. Soc. Actuaries **34** (1982), 13–30.

3. J. C. Faber and J. C. Wilkin, *Social security area population projections, 1981*, Actuarial Study No. 85, Social Security Administration, Baltimore, Md., July 1981.

4. Stephen C. Goss, *Long-range estimates of the financial status of the old-age, survivors, and disability insurance program, 1983*, Actuarial Study No. 91, Social Security Administration, Baltimore, Md., April 1984.

5. N. Keyfitz and J. A. Beekman, *Demography through problems*, Springer-Verlag, New York, 1984.

6. Bruce D. Schobel, *Experience of disabled-worker benefits under OASDI, 1974–78*, Actuarial Study No. 81, Social Security Administration, Baltimore, Md., April 1980.

7. John C. Wilkin, Milton P. Glanz, Ronald V. Gresch, and Seung H. An, *Economic projections for OASDI cost estimates, 1983*, Actuarial Study No. 90, Social Security Administration, Baltimore, Md., February 1984.

Updating Actuarial Mathematics (James C. Hickman). Actuarial mathematics is a collection of mathematical ideas found useful in designing and managing financial security systems. The basic mathematical model for life insurance and annuity systems is based on the assumption that time until death is a random variable with a distribution that depends only on the factors of time already lived and the growth of financial capital. The distribution of time until death for use in model building is fixed by selecting an appropriate life table. Choosing an interest rate completes the specification of the

foundations of the model. The study of the basic model for life insurance and annuities has been called the mathematics of life contingencies.

Constructing a basic model for a life insurance or annuity system, based on separate contracts with individuals, is a four step process. (1) A loss variable, $L =$ (Present value of benefit payments) $-$ (Present value of premium income), a function of time until death, is formulated. (2) The premium is determined by requiring that the expected value of L be zero. (3) Reserves, liabilities of the insurance or annuity system, are defined as the expected value of the loss variable given survival to the time the liabilities are measured. (4) The variances of the loss variable provide a measure of the mortality risk assumed by the issuing organization. The variance of losses on individual policies can be used for making approximate probability statements about the present value of future losses for collections of policies. Earlier expositions of life contingencies omitted step (4) and stressed steps (2) and (3), premiums and reserves as expected values.

More elaborate versions of the basic model are made necessary by business practice and economic reality. Five of these extensions will be discussed. (1) Expenses and expense loadings on the premiums may be added to the loss variable. That is, $L =$ (Present value of benefits and expenses) $-$ (Present value of expense loaded premiums). (2) Different benefits may be paid, depending on the cause of decrement from the group of insured lives. For example, deaths due to accidental means may result in a larger benefit payment. In the U.S. the law specifies a minimum benefit for policy holders terminating voluntarily. These benefits require a multiple decrement model where both the time and cause of decrement are random variables. (3) The payment of benefits and premiums may depend on two or more time until death random variables. For example, a pension may be paid until the death of the last survivor of two lives. These extensions are called multiple life models. (4) Benefit amounts may depend on other economic variables. For example, pension benefits may depend in part on an individual's salary record. Variable life insurance and annuities may pay benefits related to the value of an investment portfolio or a price index. In such cases it may be necessary to augment the basic model with a component submodel for the economic variables that determine benefit amounts. (5) The assumption of a fixed interest rate may be dropped. A stochastic model for future interest rates can be added to the model. As an alternative, interest rate paths deemed to be relatively extreme can be used in addition to a central set of rates to determine the sensitivity of premium and reserve values to interest rate variation.

In the lecture the basic model will be developed and the five extensions reviewed.

Most of these ideas are covered in the following study note: N. L. Bowers, H. U. Gerber, J. C. Hickman, D. A. Jones, C. J. Nesbitt, *Actuarial mathematics*, Chapters 3–10, 14-15, available from Society of Actuaries, 500 Park Blvd., Itasca, Ill. 60143.

Overview of Credibility Theory (Paul M. Kahn). Synopsis and Reading List not available at time of publication.

Loss Distributions (Stuart Klugman). The risks assumed under an insurance contract center on three facets of a specified event. The first is whether or not the event takes place. If it does occur, the remaining two are the time of the occurrence and the amount of money paid under the insurance contract. In life insurance only the time is of interest, as death is certain, and the benefit is fixed. In property and liability insurances the time is usually short, but the other two factors are crucial. For this lecture, the emphasis will be on the amount of payment, given that one is to be made. Examples include the cost of repairing an automobile after an accident, and the settlement in a medical malpractice lawsuit.

The actuary's objective is to find a probability model that adequately describes the distribution of losses. It is not sufficient to determine only the expected value. Questions such as the effects of inflation or a change in the deductible can only be answered if the complete distribution is known. We prefer parametric models, as the parameters often assist in making comparisons. We also prefer smooth models, as they avoid inconsistencies.

The first step in such an analysis is to acquire an inventory of parametric distributions. For actuarial applications, we prefer that all positive real numbers be possible outcomes, and that the right tail of the distribution be heavy. Such an inventory will be provided, along with three general techniques for creating heavy tailed distributions.

The second step is to estimate the parameters. Five methods will be presented, ranging from percentile matching (usually easy but unreliable), to maximum likelihood (often requires a computer but is optimal in some senses). Some algorithms will be given, along with asymptotic theory for maximum likelihood estimators.

The final step is to use the fitted model to answer specific questions. A few of these will be discussed, including the effect of inflation on premiums in the presence of a deductible and the expected time between hurricanes that produce in excess of $1 billion in damages.

All of the above procedures will be illustrated with examples drawn from insurance company experience.

1. R. V. Hogg and S. A. Klugman, *Loss distributions*, Wiley, New York, 1984.

2. R. V. Hogg and S. A. Klugman, *On the estimation of long tailed skewed distributions with actuarial applications*, J. Econometrics **23** (1983), 91–102.

Models in Risk Theory (Harry H. Panjer). In many insurance contexts, the insurer is interested in modeling the effect of the total claims in the company or in some subset of the company. The modeling

of claims for an aggregate of risks will be reviewed in this lecture. Theoretical justification for the choice of models using concepts of mixed (compound) distributions and infinite divisibility. Numerical procedures for the evaluation of the distribution of total claims and related quantities, such as stop-loss premiums will be emphasized.

The lecture will reflect the author's own research interests. A forthcoming book by the author may be available in draft form at the time of the short course. Other references, readily available in most libraries are:

1. R. E. Beard, T. Pentikäinen and E. Pesonen, *Risk theory: The stochastic basis of insurance*, (3rd edition), Chapman and Hall, London, 1984.

2. H. U. Gerber, *An introduction to mathematical risk theory*, Irwin, Homewood, Ill., 1979.

A Survey of Graduation Theory (Elias S. Shiu). The actuary is concerned with the contingencies of events such as death, disability, retirement, sickness or marriage. He must know the probabilities of such events in order to predict their future occurrence and to calculate premiums, reserves, annuities, etc., for insurance operations. Tables of these probabilities have to be constructed. Graduation is a key step in constructing such tables.

A set of observed mortality probabilities usually contains irregularities which we do not believe to be a feature of the true, underlying mortality probabilities. Graduation is the process of obtaining, from an irregular set of observed values, a corresponding smooth set of values consistent in a general way with the observed values. The purpose of this talk is to give a survey of various graduation methods used by actuaries. An excellent introduction to this subject is the article *Graduation*, written by T.N.E. Greville in Encyclopedia of Statistical Sciences, vol. 3 (1983), edited by S. Kotz and N. L. Johnson, and published by J. Wiley and Sons.

On Some Mathematical Questions in Biology
Plant Biology

1985 Symposium, Los Angeles, California, May 27, 1985

The nineteenth annual Symposium on Some Mathematical Questions in Biology will be held on Monday, May 27, 1985, in the Garden East Room of the Los Angeles Hilton Hotel, in conjunction with the annual meeting of the American Association for the Advancement of Science. The symposium is sponsored by the American Mathematical Society, the Society for Industrial and Applied Mathematics, and Section A (Mathematics) of the American Association for the Advancement of Science. Cosponsors: Sections G (Biological Sciences) and O (Agriculture).

Details regarding registration, local arrangements, and program information for the AAAS meeting will appear in the March 8, 22 and April 5 issues of *Science.*

The program has been arranged by an Organizing Committee consisting of H. Thomas Banks (Brown University); Gail A. Carpenter, (Northeastern University); Joel E. Cohen (Rockefeller University); Joseph B. Keller (Stanford University); Robert M. Miura (University of British Columbia), chairman; Garrett M. Odell (Rensselaer Polytechnic Institute); Charles S. Peskin (Courant Institute, New York University); and John Rinzel (National Institutes of Health).

The theme of the symposium is Plant Biology. There will be two half-day sessions, each including three one-hour lectures.

PROGRAM

Chairman: Robert M. Miura

9:00 a.m. **Some Mathematical Questions in Biology—Plant Biology**
Presiding: LOUIS J. GROSS, University of Tennessee, Knoxville

Computer simulations of branching-patterns and their implications on the evolution of plants. KARL J. NIKLAS, Cornell University

Dynamics of stomate fields in leaves. RICHARD H. RAND, Cornell University

Modelling plant processes and crop growth. JOHN H. M. THORNLEY, Grassland Research Institute

2:30 p.m. **Some Mathematical Questions in Biology—Plant Biology**
Presiding: RICHARD H. RAND, Cornell University

Photosynthetic dynamics and plant adaptation to environmental variability. LOUIS J. GROSS, University of Tennessee, Knoxville

Life cycle models for plants. HAL CASWELL, Woods Hole Oceanographic Institution

Models of population processes for plants. JONATHAN ROUGHGARDEN, Stanford University

1985 Summer Seminar In Applied Mathematics, June 30–July 13

Reacting Flows: Combustion and Chemical Reactors

The seventeenth AMS-SIAM Summer Seminar in Applied Mathematics will be held June 30–July 13, 1985, at Cornell University, Ithaca, New York. The seminar will be sponsored jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. It is anticipated that it will be supported by a grant from a federal agency. The topic *Reacting Flows: Combustion and Chemical Reactors* was selected by the AMS-SIAM Committee on Applied Mathematics whose members at the time were Roger W. Brockett, C. K. Chu, A. K. Konheim, Alan C. Newell (chairman), George C. Papanicolaou, and Robert F. Warming. The proceedings of the seminar will be published by the Society in the series *Lectures in Applied Mathematics.*

The seminar is the culmination of the Special Year 1984–85 on the same subject held at the Center for Applied Mathematics of Cornell University. The theory of reacting flows has finally blossomed as a mathematical science in the last decade, and an attempt will be made to synthesize it into a firm foundation for future large-scale computing. The seminar will not, however, be aimed at computational fluid mechanics as a whole, but only those parts peculiar to reacting flows.

A series of five lectures each will be given by Rutherford Aris (University of Minnesota, Minneapolis), G. S. S. Ludford (Cornell University), and Andrew Majda (University of California, Berkeley); shorter series will be presented by Harry Dwyer (University of California, Davis), and A. F. Ghoniem (Massachusetts Institute of Technology). There will also be lectures by John D. Buckmaster (University of Illinois, Urbana), Donald Cohen (California Institute of Technology), John Guckenheimer (University of California, Santa Cruz), Ingo Müller (Berlin), Basil Nicolaenko (Los Alamos National Laboratory), Herschel Rabitz (Princeton University), and Forman A. Williams (Princeton University). Together, these lectures will summarize the Cornell Special Year and sharpen the focus onto computational questions.

The remaining speakers will be selected by the Organizing and Advisory Committees on the basis of abstracts submitted and commitments to a timely written version. The Organizing Committee consists of Donald Cohen, G. S. S. Ludford, (chairman), Andrew Majda, and Forman A. Williams; the members of the Advisory Committee are Rutherford Aris, John D. Buckmaster, H. Dwyer, John Guckenheimer, Ingo Müller, Basil Nicolaenko, and Herschel Rabitz. A list of topics at which abstracts should be aimed can be obtained from: Professor G. S. S. Ludford, Theoretical & Applied Mechanics, Thurston Hall, Cornell University, Ithaca, New York 14853.

In the early spring a brochure will be available from the AMS office which will include a description of the scientific program, information on the residence and dining hall facilities, firm room and board rates, local information, and a reservation form to be used to obtain accommodations on campus. Each participant will pay a social fee to cover the cost of refreshments served at breaks and for social events. There will also be a meeting registration fee. A copy of the proceedings will be available to registered participants as a privilege of participation in the seminar.

Application blanks for admission and/or financial assistance can be obtained from the Meetings Department, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940. An applicant should have completed at least one year of graduate school and will be asked to indicate his or her scientific background and interest. A graduate student's application must be accompanied by a letter from his or her faculty advisor concerning the applicant's ability and promise. Those who wish to apply for a grant-in-aid should so indicate; however, funds available for the seminar are limited and individuals who can obtain support from other sources should do so.

Topics for AMS/SIAM Summer Seminar
(Reviews preferred)

Laminar Combustion
- Diffusion flame structure, extinction and spread
- Deflagration structure, stability and extinction
- Ignition and explosion development
- Detonation structure, initiation and failure
- Deflagration-to-detonation transition
- Multiple-step kinetics
- Fluid-dynamical effects

Turbulent Combustion

Reactors (stirred tank, tubular, countercurrent, two-phase)
- Fluidized and packed beds
- Control, multiplicity of states, oscillations, stability

Pyrolysis and Gasification
- Gas-solid reactions, autocatalysis, catalyst preparation
- Polymerization, mass-action kinetics

Mathematical Questions
- Existence, uniqueness and stability of combustion structures
- Ignition modeling
- Analysis of complex reactions
- Governing equations of reacting flows
- Sensitivity analysis
- Qualitative methods and transition to chaos in reactive systems

Computational Questions
- Laminar-flame structure
- Detonation-wave structure
- Transition to detonation
- Statistical calculations of turbulent flames
- Large-eddy simulations (vortex dynamics)
- Adaptive-mesh techniques
- Elliptic free-boundary problems
- Numerical bifurcation and instability in reactors and combustion
- Sensitivity analysis

1985 Summer Research Institute, July 8–26

Algebraic Geometry

The thirty-third Summer Research Institute sponsored by the American Mathematical Society will be devoted to algebraic geometry, and will take place at Bowdoin College in Brunswick, Maine, from July 8 to 26, 1985. Members of the Organizing Committee include Spencer Bloch, David Eisenbud (chairman), William Fulton, David Gieseker, Joe Harris, Robin Hartshorne, and Shigefumi Mori. It is anticipated that the institute will be partially supported by a grant from the National Science Foundation. Proceedings of the institute will be published in the AMS series *Proceedings of Symposia in Pure Mathematics.*

The topic was selected by the 1983 Committee on Summer Institutes, whose members were Michael Artin, Thomas H. Brylawski, Robert Osserman (chairman), George C. Papanicolaou, Harold M. Stark, and Stephen Wainger.

The field of algebraic geometry has undergone very intense development since the AMS Summer Research Institute took place in 1974. Since that time there has been a very substantial return to the hard special problems at the base of algebraic geometry and a corresponding wealth of special results and examples. It is anticipated that the institute will have a broad enough scope to encompass the important developments in recent years in what might be called "classical" algebraic geometry, centered around projective varieties in characteristic 0, allowing leeway for the representation of the most exciting new results from the whole field. Algebraic geometry has changed considerably in its emphasis and practices in the last ten years, and an amazing number of classical conjectures have been settled. The demography of the field has also changed substantially; many more algebraic geometers now work outside the great centers. For these reasons, an institute in which at least the classical side of algebraic geometry is "pulled together" is extremely desirable at this time.

It is anticipated that there will be a number of lecture series presenting topics from classical algebraic geometry such as enumerative geometry, moduli of curves, classification of varieties, and arithmetic theory, which have undergone very extensive recent development. There will also be a number of research level seminars on these and other topics which seem likely to play a major role in the subject in the years ahead.

Housing accommodations will be available in the campus residence halls for participants and their families, and cafeteria-style meals will be served daily in the adjacent dining hall. Residence and dining facilities, as well as rooms used for the scientific sessions at Bowdoin College, are accessible to the handicapped.

In the spring a brochure will be sent to all who are invited to attend the institute. It will include information about the scientific program, the residence and dining facilities, room and board rates, travel and local information, and a reservation form for on-campus housing accommodations. Each participant will pay a social fee of $25 to cover the cost of social events and refreshments served at breaks. There will also be a meeting registration fee. A copy of the proceedings will be available to registered participants as a privilege of participation in the institute. Unfortunately, funds for financial assistance will be limited and, therefore, it will be necessary for many participants to obtain their own funds. Anyone who wishes to receive an invitation to participate in the institute and/or be considered for financial assistance should write to Mrs. Dorothy Smith, American Mathematical Society, P. O. Box 6248, Providence, Rhode Island 02940 prior to **April 12, 1985**. The Organizing Committee will subsequently consider those requests and applicants will be informed at a later date if funds are granted to provide support.

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.

Laramie, August 1985

Stuart S. Antman
Richard E. Block
Robert L. Bryant
David B. MacQueen
Dennis Stanton
Ronald J. Stern
Jerrold Tunnell
Karen K. Uhlenbeck
(Colloquium Lecturer)
Lai-Sang Young

Amherst, October 1985

Vaughan F. R. Jones
Andre Joyal
Ngaiming Mok
Robert T. Seeley

Columbia, November 1985

Eric Friedlander
Carlos Kenig
M. Talagrand

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.

August 1985 Meeting in Laramie

Associate Secretary: Robert M. Fossum

Deadline for organizers: Expired
Deadline for consideration: May 7, 1985

Richard A. Askey, *Special Functions and combinatorics*

Marcy Barge and Robert F. Williams, *Dynamical systems and ergodic theory*

Frank R. DeMeyer and Rick Miranda, *Commutative algebra and algebraic geometry*

George B. Purdy, *The geometry of configurations*

V. M. Segal and S. P. Singh, *Approximation theory and applications*

Scott J. Spector, *Mechanics and bifurcation theory*

Chung-Chun Yang, *Analysis of one complex variable*

October 1985 Meeting in Amherst

Eastern Section

Deadline for organizers: April 15, 1985
Deadline for consideration: July 29, 1985

November 1985 Meeting in Columbia

Central Section

Deadline for organizers: April 15, 1985
Deadline for consideration: July 31, 1985

November 1985 Meeting in Claremont

Far Western Section

Deadline for organizers: April 15, 1985
Deadline for consideration: August 5, 1985

Fall 1985 Meeting

Southeastern Section

No meeting will be held

January 1986 Meeting in New Orleans

Associate Secretary: Frank T. Birtel

Deadline for organizers: April 15, 1985
Deadline for consideration: September 25, 1985

Spring 1986 Meeting

Eastern Section

Deadline for organizers: October 15, 1986
Deadline for consideration: To be announced

Spring 1986 Meeting

Central Section

Deadline for organizers: October 15, 1986
Deadline for consideration: To be announced

Spring 1986 Meeting

Far Western Section

Deadline for organizers: October 15, 1986
Deadline for consideration: To be announced

Spring 1986 Meeting

Southeastern Section

Deadline for organizers: October 15, 1986
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.

The Society reserves the right of first refusal for the publication of proceedings of any special session. These proceedings appear in the book series *Contemporary Mathematics*.

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.

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
Robert M. Fossum, Associate Secretary
Department of Mathematics
University of Illinois
1409 West Green Street
Urbana, IL 61801
(Telephone 217-333-3975)

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.

Call For Topics For 1987 Conferences

Suggestions are invited from mathematicians, either singly or in groups, for topics of the various conferences that will be organized by the Society in 1987. The deadlines for receipt of these suggestions, as well as some relevant information about each of the conferences are outlined below. An application form to be used when submitting suggested topic(s) for any of these conferences (except the Short Course Series) may be obtained by writing to the Meetings Department, American Mathematical Society, P.O. Box 6248, Providence, Rhode Island 02940, or telephoning 401-272-9500, extension 296.

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 for all conferences except Summer Research Conferences, it is required that the proceedings be published by the Society, and that SRC's are frequently published. A member of the Organizing Committee must be willing to serve as editor of the proceedings.

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, timeliness of the topic, and estimated attendance; (3) a list of the recent conferences in the same or closely related areas; (4) a tentative list of 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.

Refer to the box titled **Topics of Current and Recent Conferences** in this announcement for lists of topics.

Topics of Current and Recent Conferences

AMS-SIAM Symposium in Applied Mathematics

1980–*Mathematical psychology and psychophysiology,* organized by STEPHEN GROSSBERG of Boston University.

1983–*Inverse problems,* organized by D. W. MCLAUGHLIN of the University of Arizona.

AMS Summer Institute

1983–*Nonlinear functional analysis and applications,* organized by FELIX BROWDER of the University of Chicago.

1984–*Geometric measure theory and the calculus of variations,* organized by WILLIAM K. ALLARD of Duke University and FREDERICK J. ALMGREN, JR. of Princeton University.

1985–*Algebraic geometry,* organized by DAVID EISENBUD of Brandeis University.

1986–*Representations of finite groups and related topics,* organized by JONATHAN L. ALPERIN of the University of Chicago.

AMS-SIAM Symposium on Some Mathematical Questions in Biology

1983–*Muscle physiology,* organized by ROBERT M. MIURA of the University of British Columbia.

1984–*DNA sequence analysis,* organized by ROBERT M. MIURA of the University of British Columbia.

1985–*Plant biology,* organized by ROBERT M. MIURA of the University of British Columbia.

1986–*Modeling circadian rhythms,* organized by GAIL A. CARPENTER of Northeastern University.

AMS-SIAM Summer Seminar

1983–*Large scale computations in fluid mechanics,* organized by RICHARD C. J. SOMERVILLE, Scripps Institution of Oceanography

1984–*Nonlinear systems of PDE in applied mathematics,* organized by BASIL NICOLAENKO of Los Alamos National Laboratories.

1985–*Reacting flows: Combustion and chemical reactors,* organized by G.S.S. LUDFORD of Cornell University.

1987 AMS-SIAM Symposium In Applied Mathematics

This two-day symposium in applied mathematics will henceforth take place in every odd-numbered year, alternating with a symposium in pure mathematics in even-numbered years. The next regularly scheduled symposium is scheduled to be held during the two days preceding the 1987 spring AMS sectional meeting at a site that has not yet been selected. Proceedings are published by the Society as volumes in the series *SIAM-AMS Proceedings.*

Deadline For Suggestions: August 15, 1985

1987 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 some time in August) and, there should be a period of at least one week between them. Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Pure Mathematics.*

Deadline For Suggestions: August 15, 1985

1987 AMS-SIAM Symposium Some Mathematical Questions in Biology

This one-day symposium is usually held in conjunction with the Annual Meeting of the AAAS in May. Papers from the symposia are published by the Society as volumes in the series *Lectures on Mathematics in the Life Sciences.*

Deadline For Suggestions: April 1, 1985

1987 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. Proceedings are published by the Society as volumes in the series *Lectures in Applied Mathematics.*

Deadline For Suggestions: August 15, 1985

1987 Joint AMS-IMS-SIAM 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 fourth series of one-week conferences, being held in 1985, are *Brown-Gitler spectra and applications, Applications of Lie groups in differential geometry, Numerical simulations of fluid flow, Multiparameter bifurcation theory, Harmonic analysis in* $\mathbf{R}^n$, *Function estimates, Applications of mathematical logic to finite combinatorics, Combinatorics and ordered sets, Current trends in arithmetical algebraic geometry,* and *Computational number theory.* If proceedings are published by the Society, they will appear as volumes in the series *Contemporary Mathematics.*

Deadline For Suggestions: February 1, 1986

Call for Topics for 1987 AMS Short Course Series

The AMS Short Courses consist of a series of introductory survey 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 *Fair Allocation* (January 1985), *Environmental and Natural Resource Mathematics* (August 1984), *Mathematics of Information Processing* (January 1984), *Population Biology* (August 1983), and *Computer Communications* (January 1983). Proceedings are published by the Society as volumes in the series *Proceedings of Symposia in Applied Mathematics,* with the approval of the Editorial Committee.

Deadline for Suggestions: July 1, 1985 for January 1987 course, and December 1, 1985 for August 1987 course.

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

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.

August 21, 1984–May 20, 1985. **Special Year in Logic**, University of Illinois, Urbana, Illinois. (August 1984, p. 521)

September 1, 1984–August 31, 1985. **Program on Continuum Physics and Partial Differential Equations**, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota. (August 1984, p. 521)

October 7, 1984–December 14, 1985. **Mathematisches Forschungsinstitut Oberwolfach** (Weekly Conferences), Federal Republic of Germany. (October 1984, p. 689)

1984–1985. **Academic Year Devoted to Nonlinear Differential Equations**, The Mittag-Leffler Institute, Djursholm, Sweden. (February 1984, p. 194)

1984–1985. **Special Year Devoted to Minimal Surfaces and their Applications to Low-Dimensional Topology**, Department of Mathematics, University of California, Santa Barbara, California. (October 1984, p. 690)

1984–1985. **Special Year Devoted to Reacting Flows: Combustion and Chemical Reactors**, Center for Applied Mathematics, Cornell University, Ithaca, New York. (April 1984, p. 333)

1984–1985. **Special Year in Mathematical Logic and Theoretical Computer Science**, University of Maryland, College Park, Maryland.

Support: Some financial support is available for other participants. Priority will be given to graduate students and junior faculty.

Organizing Committee: H. P. Edmundson, D. Kueker, K. Lopez-Escobar, H. Mills, J. Minker, J. Owings, D. Perlis, and C. Smith.

Information: K. Lopez-Escobar, Department of Mathematics, University of Maryland, College Park, Maryland 20742. Alternatively, contact any other member of the organizing committee.

March 1985

4–8. Automath and Natural Deduction, *Participants*: N. G. DeBruijn and J. Zucker.

11–15. Stability Theory, *Participants*: J. Baldwin, S. Buechler, A. Pillay, S. Shelah, and C. Steinhorn.

April

22–May 2. Logic and Category Theory, *Participants*: A. Blass, M. Bunge, P. Freyd, A. Joyal, F. Lawvere, I. Moerdijk, G. Reyes, A. Scedrov, D. Scott, and P. Scott.

Spring 1985. **Special Semester in the Theory of Singularities**, Banach Center, Warsaw, Poland. (August 1984, p. 521)

1985. **European Mechanics Colloquia**, Various locations. (October 1984, p. 690)

1985–1986. **Academic Year Devoted to Nonlinear Differential Equations**, Mittag-Leffler Institute, Djursholm, Sweden. (January 1985, p. 89)

MARCH 1985

4–8. **Workshop on Amorphous Polymers and Non-Newtonian Fluids**, University of Minnesota, Minneapolis, Minnesota.

Conference Committee: J. Ericksen, D. Kinderlehrer, S. Prager, and M. Tirrell.

Speakers: R. Bird, C. Dafermos, W. Graessley, D. Joseph, A. Kearsley, V. Mizel, G. Muthukumar, J. Nohel, R. Wool, and L. Zapas.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455, 612-373-0355.

11–15. **Symposium on the Occasion of the Proof of the Bieberbach Conjecture**, Purdue University, West Lafayette, Indiana. (January 1985, p. 90)

18–22. **Short Course on Numerical Methods for Partial Differential Equations**, University of Tennessee Space Institute, Tullahoma, Tennessee. (October 1984, p. 692)

18–22. **NSF-CBMS Regional Conference on Mathematical Ecology**, University of California, Davis, California. (October 1984, p. 692)

20–22. **GI-Fachtagung "Datenbanksysteme in Büro, Technik und Wissenschaft"**, Karlsruhe, Federal Republic of Germany. (October 1984, p. 692)

22–23. **Mathematical Ecology Conference**, University of Georgia, Athens, Georgia.

Program: 25-minute contributed talks and discussion sessions.

Participants: D. DeAngelis (Oak Ridge National Laboratory), T. Hallam (University of Tennessee), R. Lassiter (U.S. Environmental Protection Agency), B. Patten (University of Georgia), R. Wiegert (University of Georgia).

Information: Thomas C. Gard, Department of Mathematics, University of Georgia, Athens, Georgia 30602.

22–24. **Conference on Automorphic Forms and L-Functions**, Purdue University, West Lafayette, Indiana. (October 1984, p. 692)

25–27. **Symposium on Principles of Database Systems**, Portland, Oregon.

Information: David Maier, Department of Computer Science, Oregon Graduate Center, 19600 N.W. Walker Road, Beaverton, Oregon 97006, 503-645-1121, Ext. 241.

25–29. **Conference on Chaotic Dynamics**, Georgia Institute of Technology, Atlanta, Georgia. (October 1984, p. 692)

25–29. **Everett Pitcher Lecture Series**, Lehigh University, Bethlehem, Pennsylvania. (January 1985, p. 90)

26–28. **M. C. Escher: An Interdisciplinary Congress**, University of Rome, Rome, Italy. (August 1984, p. 524)

27–29. **Conference on Information Sciences and Systems**, The Johns Hopkins University, Baltimore, Maryland. (October 1984, p. 692)

28–31. **Sixteenth Annual Iranian Mathematics Conference**, Zahedan, Iran. (October 1984, p. 692)

29–30. **Midwest Several Complex Variables Conference**, University of Toronto, Toronto, Canada.

Support: It is expected that funds will be available to cover accomodation.

Information: Thomas Bloom or Ian Graham, Department of Mathematics, University of Toronto, Toronto, Canada M5S 1A1.

APRIL 1985

1–3. **EUROCAL '85: European Conference on Computer Algebra (Symbolic and Algebraic Computation)**, Linz, Austria. (October 1984, p. 692)

1–5. **Workshop on Oscillation Theory, Computation, and Methods of Compensated Compactness**, University of Minnesota, Minneapolis, Minnesota.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455, 612-373-0355.

2–4. **Thirty-seventh British Mathematical Colloquium**, University of Cambridge, Cambridge, England.

Principal Speakers: D. Zagier (Bonn), C. L. Feffermann (Princeton), and M. Gromov (Paris). There will be fifteen speakers from the United Kingdom as well.

Program: Addresses, a discussion of information technology presented by C.A.R. Hoare, F.R.S., and a display of computer-aided teaching of applied mathematics.

Information: R. C. Mason, Colloquium Secretary, Department of Pure Mathematics and Mathematical Statistics, 16 Mill Lane, Cambridge CB2 1SB.

4–6. **Second Chico Topology Conference**, California State University, Chico, California.

Program: Edward Tymchatyn will give two 1-hour talks. There will be 20-minute talks on recent and current research; the emphasis will be on continuum theory but there will be some talks on other aspects of general topology.

Deadline for Abstracts: Abstracts (not to exceed one double spaced typewritten page) should be submitted by March 10, 1985.

Support: A limited amount of support will be available.

Information: Eldon J. Vought, Mathematics Department, California State University, Chico, California 95929.

8–13. **Third Easter Conference on Model Theory**, Berlin, German Democratic Republic. (November 1984, p. 801)

8–19. **International Seminar on Algebraic and Topological Graph Theory**, Dubrovnik, Yugoslavia. (November 1984, p. 801)

11–12. **Conference on the Mathematical Foundations of Programming Semantics**, Kansas State University, Manhattan, Kansas.

Topics: The theory of complete partial orders and continuous lattices; topological and categorical aspects to semantics; formal and descriptive aspects of semantic notations.

Speakers: D. Scott (Carnegie-Mellon University), H. Herrlich (University of Bremem, West Germany), G. Strecker (Kansas State University), A. Tang (University of Kansas), S. Brooks (Carnegie-Mellon University), C. Gunter (Carnegie-Mellon University).

Deadline for Extended Abstracts: March 10, 1985.

Information: Austin Melton, Department of Computer Science, Kansas State University, Manhattan, Kansas 66506, 913-532-6350.

12–13. **Illinois Number Theory Conference**, Illinois State University, Normal, Illinois. (January 1985, p. 90)

12–13. **Workshop on Numerical Fluid Dynamics**, Georgia Institute of Technology, Atlanta, Georgia. (October 1984, p. 692)

17–19. **Symposium on Complexity of Approximately Solved Problems**, Columbia University, New York, New York. (August 1984, p. 524)

18–20. **Applications of Harmonic Measure: Annual Lecture Series in the Mathematical Sciences**, Fayetteville, Arkansas. (November 1984, p. 801)

22–May 2. **NATO-Advanced Study Institute: Nonlinear Functional Analysis and Fixed Point Theorems**, Maratea, Italy.

Program: The Institute will cover recent advances in nonlinear functional analysis and its applications in differential equations, partial differential equations, and other areas.

Speakers: The tentative list includes: F. Browder, R. Conti, A. Ambrosetti, J. Mawhin, I Ekeland, H. Berestycki, A. Dold, D. Edmunds, and several others.

Support: Limited support is available from NATO.

Participation: Participation is limited to eighty-five.

Information: S. P. Singh, Department of Mathematics, Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1C 5S7, 709-737-8795.

25–26. **Sixteenth Annual Pittsburgh Conference on Modeling and Simulation**, University of Pittsburgh, Pittsburgh, Pennsylvania. (October 1984, p. 692)

25–27. **Geometric Topology Conference Honoring the Sixty-fifth Birthday of Professor C. E. Burgess**, Brigham Young University, Provo, Utah. (November 1984, p. 801)

25–27. **Midwest Dynamical Systems Seminar**, University of Cincinnati, Cincinnati, Ohio.

Information: Ken Meyer, Department of Mathematics, University of Cincinnati, Cincinnati, Ohio 45221.

26–27. **Association for Symbolic Logic Spring Meeting**, Palmer House, Chicago, Illinois. (November 1984, p. 801)

29–May 2. **Second SIAM Conference on Applied Linear Algebra**, Mission Valley Inn, Raleigh, North Carolina. (January 1985 p. 90)

MAY 1985

1–3. **Alaska Statistics Conference**, Juneau, Alaska. (August 1984, p. 524)

2–4. **John H. Barrett Memorial Lectures**, University of Tennessee, Knoxville, Tennessee. (January 1985, p. 90)

3–4. **Annual Regional Meeting on Group Theory**, University of Pittsburgh, Pittsburgh, Pennsylvania. (January 1985, p. 90)

5–11. **Third International Conference on Complex Analysis and Applications**, Varna, Bulgaria. (November 1984, p. 802)

6–7. **Seventh Symposium on Mathematical Programming with Data Perturbations**, The George Washington University, Washington, D.C.

Call for Papers: Papers solicited in the following areas: sensitivity and stability analysis; solution methods for problems involving implicitly defined problem functions, and for problems involving deterministic or stochastic parameter changes; solution approximation techniques and error analysis.

Deadline for Abstracts: March 10, 1985.

Information: Anthony V. Fiacco, The George Washington University, Washington, D.C. 20052.

6–8. **Seventeenth Annual ACM Symposium on Theory of Computing**, Providence, Rhode Island. (October 1984, p. 692)

6–10. **Journées Fermat, "Mathématiques pour l'Optimisation"**, Toulouse, France.

Information: J. B. Hiriart-Urruty, Université Paul Sabatier, 118 route de Narbonne, 21062 Toulouse Cedex, France.

6–10. **Workshop on Metastability and Incompletely Posed Problems**, University of Minnesota, Minneapolis, Minnesota.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455, 612-373-0355.

13–15. **Great Plains Operator Theory Seminar**, Texas A&M University, College Station, Texas.

Principal Speakers: M. D. Choi and P. Jorgensen.

Information: R. R. Smith, J. D. Ward, or D. P. Williams, Texas A&M University, Department of Mathematics, College Station, Texas 77843-3368, 409-845-3261.

13–17. **Australian Mathematics Convention**, University of New South Wales, Kensington, Australia. (January 1985, p. 91)

13–17. **Third Franco-Southeast Asian Mathematics Conference**, University of Malaya, Kuala Lumpur, Malaysia.

Program: There will be approximately eight invited lectures as well as several sessions of contributed short papers. Prior to the conference, there will be two one-week workshops (May 6–11). The workshop topics will be computer-oriented management and algorithms.

Organizers: Department of Mathematics, University of Malaya; Centre of Quantitative Studies, National University of Malaysia; Southeast Asian Mathematical Society.

Information: K. P. Chew, Department of Mathematics, University of Malaya, Kuala Lumpur, Malaysia.

16–17. **European Conference on TEX For Scientific Documentation**, Varenna, Italy. (November 1984, p. 802)

16–18. **Multiple Stochastic Integration, Polynomial Chaos and their Applications**, Case Western Reserve University, Cleveland, Ohio.

Speakers: C. Borell (Chalmers, Goteborg and CWRU), A. Jaffe (Harvard), S. Kwapien (Warsaw University and CWRU), R. Vitale (Claremont Graduate School), and J. Zinn (Texas A&M).

Information: John Chao, Cleveland State University, Cleveland, Ohio 44115, 216-687-4698; or Wojbor A. Woyczynski, Case Western Reserve University, Cleveland, Ohio 44106, 216-368-2880.

16–21. **Workshop on Differential Geometry**, Berkeley, California. (August 1984, p. 524)

17–19. **Conference on the History and Philosophy of Modern Mathematics**, Minneapolis, Minnesota. (November 1984, p. 802)

20–23. **International Conference on Theory and Applications of Differential Equations**, Pan American University, Edinburg, Texas. (January 1985, p. 91)

20–23. **Journées de Statistique**, Pau, France.

Information: Ph. Tassi et Ensae, 3 av. Pierre Larousse, 92241 Malakoff Cedex, France.

20–24. **Fifth Annual Conference on Evolution, Games and Learning: Models for Adaptation in Machines and Nature**, Los Alamos, New Mexico. (November 1984, p. 802)

20–24. **Pacific Statistical Congress**, Auckland, New Zealand. (January 1985, p. 91)

21–25. **Symposium on Numerical Simulation of Combustion Phenomena**, Sophia-Antipolis, France.

Information: S. Gosset or M. Guilloteau, INRIA, Service des Relations Extérieures, BP 105, 78153 Le Chesnay Cedex, France. Telephone: 33 (3) 954.90.20 poste 3600. Telex: 697 033F.

23–June 1. **Workshop on Four-Manifolds and Geometry**, Berkeley, California. (August 1984, p. 524)

26–31. **American Association for the Advancement of Science (AAAS)**, Los Angeles, California.

Information: AAAS Meeting Office, 1101 Vermont Avenue, N.W., Washington, D.C. 20006.

26–June 2. **International Conference on Functional-Differential Systems and Related Topics IV**, Jachranka, Poland. (August 1984, p. 524)

28–30. **15th Annual Symposium on Multiple-Value Logic**, Queen's University, Ontario, Canada.

Information: H. T. Multah, Department of Electrical Engineering, Queen's University, Kingston, Ontario K7L 3N6, Canada.

28–June 1. **Colloque de Combinatoire Énumérative**, Montréal, Québec, Canada. (October 1984, p. 693)

JUNE 1985

3–7. **CIT-CNNAA Joint Differential Equations Seminar**, Taiwan, Republic of China. (January 1985, p. 91)

3–7. **Program Design and Pascal**, Salisbury State College, Salisbury, Maryland. (January 1985, p. 91)

3–7. **Workshop on Dynamical Problems in Continuum Physics**, University of Minnesota, Minneapolis, Minnesota.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455, 612-373-0355.

3–7. **Third Bad Honnef Conference on Stochastic Differential Systems**, Bad Honnef, Federal Republic of Germany.

Program: Most lectures will be of half-hour duration plus a short time for immediate discussion. There will be nine one-hour survey talks on the main topics. A limited number of contributed papers are welcome.

Main Topics: Optimal stochastic control, filtering, stochastic analysis, stochastic mechanics, and applications.

Deadline for Abstracts: March 1, 1985.

Deadline for Manuscripts: June 30, 1985.

Information: K. Helmes, Conference on Stochastic Differential Systems, Institut f. Angewandte Mathematik, Universität Bonn, Wegelerstr. 6, 5300 Bonn, Federal Republic of Germany.

4–6. **7th Symposium on Computer Arithmetic**, University of Illinois, Urbana, Illinois.

Information: Daniel G. Gajski, Department of Computer Science, University of Illinois, Urbana, Illinois 61801.

5–8. **International Conference on Computational Geometry and Computer Aided Design**, New Orleans, Louisiana. (January 1985, p. 91)

5–14. **Conference on Geometry and Operator Algebras**, Berkeley, California. (August 1984, p. 525)

6–8. **Canadian Mathematical Society Annual Summer Meeting**, Université Laval, Québec, Canada.

Speakers: B. Aupetit, J. Dixmier, P. A. Fillmore, S. Novikoff, J. Tits, L. Siebenmann.

Special Sessions: Algebraic and geometric topology, classical analysis, combinatorics, harmonic analysis on groups and representation theory, Lie and Jordon algebras, mathematical physics, numerical methods.

Contributed Papers: 15-minute talks are invited.

Information: N. Lacroix, Département de Mathématiques, Université Laval, Québec G1K 7P4, Canada.

10–14. **Computer Solutions to Differential Equations**, Salisbury State College, Salisbury, Maryland. (January 1985, p. 91)

10–14. **Third International Conference on Combinatorial Mathematics**, New York, New York. (November 1984, p. 802)

10–14. **Seventh International Symposium on the Mathematical Theory of Networks and Systems**, Royal Institute of Technology, Stockholm, Sweden. (October 1984, p. 693)

10–14. **Ninth International Conference on Transport Theory**, Montecatini Terme, Italy.

Program: This biennial series of conferences is devoted to mathematical and computational aspects of transport theory. Most papers will be invited but there will be a limited number of contributed papers.

Support: Travel support from the National Science Foundation is anticipated for a few United States participants.

Information: Paul Nelson, Department of Mathematics, P. O. Box 4319, Texas Tech University, Lubbock, Texas 79409, 806-742-2566; or Vinicio Boffi, Laboratorio Ingegneria Nucleare di Montecuccolino, Università degli Studi di Bologna, 40136 Bologna, Italy.

10–14. **Short Course on Numerical Grid Generation**, Mississippi State University, Mississippi State, Mississippi.

Topics: Generation and use of grids in numerical solution of partial differential equations; code development and application techniques in computational fluid dynamics, heat transfer, and other areas.

Information: Joe Thompson, Drawer A, Mississippi State, Mississippi 39762, 601-325-3623.

10–15. **Conference on Topology**, National University of Singapore. (November 1984, p. 802)

13–15. **Logic, Logic Machines, and Public Education**, University of Houston-Clear Lake, Houston, Texas.

Call for Papers: Submission of papers as well as proposals for symposia and workshops is invited. Deadline is March 15, 1985.

Information: P. A. Wagner, Director, Institute for Logic and Cognitive Studies, University of Houston-Clear Lake, Box 269, Houston, Texas 77058.

17–21. **Lecture Series on Combinatorial Aspects of Matrix Analysis**, Johns Hopkins University, Baltimore, Maryland.

Program: Ten research-level lectures by C. R. Johnson of Clemson University, additional speakers, and small group discussions.

Support: Limited travel and subsistence funds available.

Information: Alan F. Karr, Department of Mathematical Sciences, The Johns Hopkins University, Baltimore, Maryland 21218, 301-338-7214.

17–29. **Canadian Mathematical Society Seminar on Number Theory**, Concordia University, Montréal, Québec, Canada.

Speakers: D. Boyd, E. Friedman, R. Gold, D. Goldfeld, D. Goss, B. Gross, R. Gupta, D. Hayes, D. Ramakrishnan, D. Rohrlich, M. Rosen, K. Rubin, H. Stark, R. Yeager.

Information: H. Kisilevsky, Department of Mathematics, Concordia University, 1455 de Maisonneuve Boulevard W., Montréal, Québec H3G 1M8, Canada.

18–21. **Optimisation Mathématique et Applications Spatiales**, Toulouse, France.

Information: B. Trung Van, CNES/DTI/MN, 18 av. E. Belin, 31062 Toulouse Cedex, France.

19–21. **Fourth International Conference on the Numerical Analysis of Semiconductor Devices and Integrated Circuits**, Dublin, Ireland. (June 1984, p. 398)

20–July 5. **Third Workshop on Nonlinear Evolution Equations and Dynamical Systems**, Lecce, Italy. (October 1984, p. 693)

24–26. **SIAM 1985 Spring Meeting**, Pittsburgh Hyatt House, Pittsburgh, Pennsylvania. (January 1985, p. 91)

24–28. **Aspects of Positivity in Functional Analysis**, Mathematisches Institut der Universität Tübingen, Federal Republic of Germany. (August 1984, p. 525)

24–28. **Journées Arithmétiques**, Besançon, France.

Information: J. Cougnard, Université de Franche-Comté, Route de Gray, 25030 Besançon Cedex, France.

24–29. **4th International Vilnius Conference on Probablity Theory and Mathematical Statistics**, Vilnius, U.S.S.R.

Information: V. Statulevicius, Director, Institute of Mathematics and Cybernetics, 54 K Pozelos Str., Vilnius 232600, U.S.S.R.

24–July 12. **Ecole d'Eté d'Informatique**, Clamart, France.

Speakers: M. Gondran, G. Guiho, J. L. Laurière, J. A. Robinson.

Information: Secrétariat des Ecoles d'Eté, 1, avenue du Général-de-Gaulle, 92141 Clamart, France. Tél.: (1) 65.42.13; Télex: 270 400 F.

30–July 3. **Hermann-Weyl-Congress**, Kiel University, Federal Republic of Germany.

Purpose: This international congress is organized to honor Hermann Weyl on the occasion of his 100th birthday.

Program: Inaugural address by E. Agazzi; final address by J. Wheeler; address on Hermann Weyl's life by M. Weyl; lectures by H. Breger, R. A. Coleman, B. d'Espagnat, J. Ehlers, B. van Fraassen, Y. Gauthier, F. Hehl, H. Korte, B. Kanitscheider, G. Mackey, E. Mielke, D. Speiser, E. Scheibe, A. Troelstra.

Contributed Papers: 15-minute papers are to be submitted as free contributions no later than April 15, 1985.

Information: Hermann-Weyl-Congress-Office, Kiel University, Olshausenstr. Haus N 50b, Zi. 416, 2300 Kiel 1, Federal Republic of Germany. Tel.: 0431-880-2239.

30–July 6. **3rd Conference on Differential Equations and Applications**, Ruse, Bulgaria.

Information: Organizing Committee, CDE-111, Mathematics Center, Technical University, BG-7004, Ruse, Bulgaria.

JULY 1985

1–5. **International Conference on Classical and Categorical Algebra**, University of Natal, Durban, Republic of South Africa. (October 1984, p. 693)

1–6. **First International Fuzzy Systems Association Congress**, Palma de Mallorca, Balearic Islands, Spain. (October 1984, p. 693)

1–12. **Problèmes Inverses Pour l'Analyse Numérique**, Clamart Cedex, France.

Information: Secrétariat des Ecoles d'Eté, 1, avenue du Général-de-Gaulle, 92141 Clamart, France.

2–6. **Fifteenth Conference on Stochastic Processes and their Applications**, Nagoya, Japan. (October 1984, p. 693)

5–6. **International Colloquium on Applications of Mathematics**, Hamburg, Federal Republic of Germany. (October 1984, p. 693)

7–13. **Logic Colloquium 85: European Summer Meeting of the Association for Symbolic Logic**, University of Paris XI, Orsay, France. (October 1984, p. 693)

8–12. **Modern Algebraic Methods-Combinatorial Algebra**, České Budějovice, Czechoslovakia.

Information: L. Bican, Charles University, MFF, Sokolovská 83, 18600 Praha 8, Czechoslovakia.

8–20. **Conference on Logic, Language and Computation**, Stanford University, Stanford, California.

Program: The first week consists of a summer school; the second week will be an Association for Symbolic Logic meeting including invited lectures, symposia, and sessions for contributed papers.

Topics: Situational semantics, PROLOG, denotational semantics, types and ML, complexity theory, abstract data types, the theory of algorithms, generalized quantifiers, LISP, and foundations of intensional logic.

Invited Participants: P. Azcel, R. Constable, M. van Emden, Y. Gurevich, A. Gupta (tentative), H. Kamp, D. Kaplan, K. Kunen, P. Martin-Lof, J. Reynolds (tentative), L. Wos, R. Chierchia, S. Feferman, D. MacQueen, B. Partee, D. Israel, J. McCarthy, S. Rosenschein, J. Perry, and R. Stalnaker.

Information: Ingrid Deiwiks, Center for the Study of Language and Information, Ventura Hall, Stanford University, Stanford, California 94305.

9–12. **Fourth International Conference on Numerical Methods in Laminar and Turbulent Flow**, Swansea, United Kingdom. (January 1985, p. 92)

11–13. **Journées Remoises d'Analyse de Problèmes Décisionnels dans un Environnement Incertain et Imprécis**, Reims, France.

Information: Herman Akdag, Groupe Recherche, C. F. Picard, Université de Paris-6, Tour 45, 4 place Jussieu, 75230 Paris Cedex 05, France.

15–18. **SIAM Conference on Mathematics of CAD/CAM**, Rensselaer Polytechnic Institute, Troy, New York. (January 1985, p. 92)

15–18. **SIAM Conference on Geometric Modeling and Robotics**, Albany, New York.

Deadline for Abstracts: March 4, 1985.

Registration: Advance registration material will be available in May 1985.

Information: Conference Coordinator, Society for Industrial and Applied Mathematics, 117 South 17th Street, 14th floor, Philadelphia, Pennsylvania 19103, 215-564-2929.

15–18. **Numerical Methods in Thermal Problems**, Swansea, United Kingdom. (January 1985, p. 92)

15–19. **Conference on Algorithms for the Approximation of Function and Data**, Shrivenham, United Kingdom. (January 1985, p. 92)

15–26. **Ecole d'Eté d'Analyse Numérique**, Clamart, France.

Speakers: G. T. Herman, K. J. Langenberg, P. C. Sabatier.

Information: Secrétariat des Ecoles d'Eté, 1, avenue du Général-de-Gaulle, 92141 Clamart, France. Tél.: (1) 765.42.13; Télex: 270 400 F.

16–19. **Second International Conference on the Teaching of Mathematical Modelling**, University of Exeter, Exeter, England. (August 1984, p. 525)

21–26. **Workshop on Homotopical Algebra and Its Applications**, University College of North Wales, Bangor, United Kingdom.

Organizers: R. Brown, C. J. Mulvey, and T. Porter.

Topics: Talks at the workshop will be restricted to these main themes: algebraic homotopy theory, algebraic models of homotopy types, rational homotopy theory, homotopy coherence, cohomological methods, topos and sheaf theory. It is expected that discussions will take place on the extensive manuscript of Grothendieck.

Support: Partial support is expected from the London Mathematical Society.

Information: T. Porter Department of Pure Mathematics, University College of North Wales, Bangor, Gwynedd LL57 2UW, United Kingdom.

22–25. **SLU-GTE Conference on Sequence Spaces**, St. Lawrence University, Canton, New York. (January 1985, p. 92)

22–26. **Tenth British Combinatorial Conference**, Glasgow, Scotland, United Kingdom. (October 1984, p. 693)

27–August 10. **Groups–St. Andrews 1985**, St. Andrews, Scotland. (January 1985, p. 92)

28–August 10. **Conference on Banach Spaces and Classical Analysis**, Kent State University, Kent, Ohio. (November 1984, p. 802)

29–31. **5th International Conference on Mathematical Modelling**, Milano, Italy.

Information: F. Celentano, Dipartimento Biologia, 26 Via Celoria, 1-20133 Milano, Italy.

29–August 16. **NATO Advanced Study Institute: Nonlinear Dynamical Systems; Integrability and Qualitative Behavior**, Université de Montréal, Montréal, Canada. (January 1985, p. 92)

31–August 8. **Symposium on the Transmission of Mathematical Science**, Berkeley, California. (June 1984, p. 398)

AUGUST 1985

4–10. **Conference on Near-rings and Near-fields**, Tübingen, Federal Republic of Germany. (January 1985, p. 92)

5–9. **Second Seminar on Random Graphs and Probabilistic Methods in Combinatorics**, Poznań, Poland. (October 1984, p. 694)

5–9. **12th International Symposium on Mathematical Programming**, Cambridge, Massachusetts.

Information: Massachusetts Institute of Technology, Operations Research Center, Room E40-164, Cambridge, Massachusetts 02139.

5–16. **Georgia Topology Conference**, University of Georgia, Athens, Georgia. (October 1984, p. 694)

11–17. **Haar Memorial Conference**, Budapest, Hungary.

Information: K. Tandory/J. Szabados, Bolyai Janos Mathematics Society, 1-3 Anker Koz, H-1061, Budapest, Hungary.

11–20. **4th Session of International Institute of Statistics**, Maastricht, The Netherlands.

Information: ISI Permanent Office, 428 Prinses Beatrixaan, P.O. Box 950, NL-2270 AZ Voorburg, The Netherlands.

12–16. **Workshop/Conference on Hydrocodes and Other Codes on Parallel Processors**, Michigan Technological University, Houghton, Michigan. (October 1984, p. 694)

16–23. **International Conference on Radicals; Theory and Applications**, Krems/Donau, Austria. (January 1985, p. 93)

18–22. **CRYPTO '85**, Santa Barbara, California.

Topic: Cryptology.

Deadline for Papers: April 15, 1985.

Information: Ernest F. Brickell, Org. 1641, Sandia National Laboratories, Albuquerque, New Mexico 87185, 505-844-5949.

21–30. **Workshop on Stochastic Differential Equations and their Applications**, University of Minnesota, Minneapolis, Minnesota.

Information: Institute for Mathematics and its Applications, University of Minnesota, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, Minnesota 55455, 612-373-0355.

23–27. **Meeting on Mathematical Statistics and Probability**, Maastricht, The Netherlands.

Information: W. Albers, Department of Medical Information and Statistics, University Limburg, P.O. Box 616, NL-6200, MD Mastricht, The Netherlands.

25–31. **Second International Symposium on Probability and Information Theory**, Hamilton, Ontario, Canada.

Topics: Probability, stochastic processes, statistics, entropy, ergodic theory, coding theory, fuzzy sets, game theory, pattern recognition, artificial intelligence, genetics, and related areas.

Information: M. Behara or I. Z. Chorneyko, McMaster University, Department of Mathematical Sciences, Hamilton, Ontario, Canada, L8S 4K1, 416-525-9140.

26–30. **Colloquium on Ordered Sets**, Szeged, Hungary. (November 1984, p. 803)

26–30. **6th Czechoslovak Conference on Differential Equations and their Applications**, Brno, Czechoslovakia.

Information: EQUADIFF 6, J. E. Purkyně University, Department of Mathematics, 2a Janackovo CS-66295 Brno, Czechoslovakia.

26–31. **International Symposium on Operator Theory**, Athens, Greece. (January 1985, p. 93)

SEPTEMBER 1985

2–12. **NATO Advanced Study Institute: Advances in Microlocal Analysis**, Il Ciocco, Castelvecchio-Pascoli, Italy. (August 1984, p. 525)

9–12. **International Symposium on Computational Fluid Dynamics**, Tokyo, Japan. (January 1985, p. 93)

9–12. **Problèmes Spectraux, Approximation, Calculs Numériques, Applications**, Sophia-Antipolis, France.

Information: M. Bernadou, INRIA, B.P. 105, 78153 Le Chenay Cedex, France.

12–14. **Mathematics Teaching 1985**, Edinburgh, Great Britain.

Information: J. W. Searl, Department of Mathematics, The University, James Clerk Maxwell Building, The King's Building, Maryfield Road, Edinburgh EH9 3J2 Great Britain.

16–21. **Eleventh International Congress of the Österreichische Mathematische Gesellschaft**, Graz, Austria. (October 1984, p. 694)

17–19. **Conference on Mathematics and Signal Processing**, University of Bath, United Kingdom. (January 1985, p. 93)

17–19. **International Symposium on Numerical Analysis**, Madrid, Spain. (August 1984, p. 525)

30–October 5. **Fourth International Conference on Topology and its Applications**, Dubrovnik, Yogoslavia. (January 1985, p. 93)

OCTOBER 1985

19–20. **Midwest Partial Differential Equations Conference**, University of Illinois, Urbana, Illinois.

Information: Harold Benzinger or John D'Angelo, Department of Mathematics, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801.

22–24. **Seventeenth National SAMPE Technical Conference**, Kiamesha Lake, New York. (October 1984, p. 694)

28–30. **International Symposium on Advances in Nonlinear Partial Differential Equations**, Madison, Wisconsin.

Topics: Problems arising in gas and fluid dynamics, combustion, elasticity, theoretical physics, geometry, and others.

Information: Gladys Moran, Conference Secretary, Mathematics Research Center, 610 Walnut Street, WARF Building, Madison, Wisconsin 53705.

28–30. **SIAM 1985 Fall Meeting**, Arizona State University, Tempe, Arizona. (January 1985, p. 93)

31. **Fourteenth Annual Midwest Differential Equations Conference**, University of Missouri, Columbia, Missouri.

Program: Invited addresses and contributed papers.

Principal Speakers: T. Hallam (University of Tennessee), M. Hirsch (University of California), P. Waltman (Emory University).

Deadline for Abstracts: August 1, 1985.

Information: Calvin Ahlbrandt or Carmen Chicone, Department of Mathematics, University of Missouri, Columbia, Missouri 65211.

NOVEMBER 1985

18–20. **Second SIAM Conference on Parallel Processing and Scientific Computing**, Norfolk, Virginia. (January 1985, p. 93)

DECEMBER 1985

16–21. **Methods of Functional Analysis in Approximation Theory**, Indian Institute of Technology, Bombay, India.

Program Objective: To focus attention on some of the emerging areas in approximation theory and its applications; recent researches are to be highlighted.

Topics: Approximate solutions of operator equations including eigenvalue problems; approximation by positive maps; spline theory and applications; convex analysis and best approximation; optimal estimation, n-widths; interpolation and complex approximation.

Program: One-hour and half-hour talks, group discussions and problem sessions on topics related to the conference theme.

Participants: P. M. Anselone, E. W. Cheney, M. Golomb, P. J. Laurent, G. G. Lorentz, and R. S. Varga.

Information: D. V. Pai, Indian Institute of Technology, Bombay, Powai, Bombay 400 076, India; or C. M. Micchelli, IBM, Thomas J. Watson Research Center, Box 218, Yorktown Heights, New York 10598; or B. V. Limaye, L'Institut Mathématiques Appliquées de Grenoble, Tour des Mathématiques, BP 68, 38402, St. Martin d'Heres Cedex, France.

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MAY 1986

18–21. **International Symposium on Flood Frequency and Risk Analyses**, Louisiana State University, Baton Rouge, Louisiana. (October 1984, p. 694)

AUGUST 1986

3–11. **International Congress of Mathematicians**, Berkeley, California. (February 1984, p. 159)

11–16. **Second International Conference on Teaching Statistics**, University of Victoria, Victoria, British Columbia, Canada. (January 1985, p. 93)

Recursion Theory

Anil Nerode and Richard A. Shore, Editors

(Proceedings of Symposia in Pure Mathematics, Volume 42)

This Proceedings of the 1982 AMS Summer Research Institute in Recursion Theory, co-sponsored by the Association for Symbolic Logic at Cornell University, June 28 to July 17, represents the largest and broadest meeting ever devoted to recursion theory. It should be a landmark in the subject, as was the AMS Institute at Cornell in 1957.

Anyone from graduate students to active researchers with interests in any aspects of recursion theory, including its interactions with set theory, model theory, constructive mathematics, foundations of mathematics and computer science, will be interested in this book. The background required varies with the papers; some require a basic course in logic or recursion theory only, others advanced research.

The book contains major surveys with expository papers as well as important new research in the general area of recursion theory. From the survey and expository articles a reader can get a general view of recent progress in the various areas of recursion theory, an introduction to current techniques and an idea of some of the important problems still to be solved. One should also get some picture of how recursion theory has interacted with other areas of logic, mathematics and computer science.

The organizers' intention was to consider recursion theory in the broadest sense. This is reflected in the lists of participants and lectures as well as in the contents of the book. The hour talks were roughly grouped around seven short courses—two in Classical Recursion Theory and one each in Generalized Recursion Theory, Fine Structure of L, Descriptive Set Theory, Effective Mathematics, and Complexity Theory (Computer Sciences). These series correspond to the sections of this volume except that two set-theoretic subjects have been grouped into one section and the papers on the foundational topics have been combined with those on computer science. Both of these are natural alignments since the talks in Descriptive Set Theory dealt mainly with the structure of $L(\mathbf{R})$ and the papers in complexity theory are strongly related to classical undecidability and incompleteness results.

The major research articles include the following.

Carl J. Jockusch, Jr. and **Richard A. Shore** on the minimal cover problem—a key to recent results on the degrees of unsolvability.

Wolfgang Maas on automorphisms of the lattice of r.e. sets.

Gerald Sacks and **Theodore A. Slaman** on the r.e. degrees in E-recursion theory (Post Problem and density, respectively).

H. D. Donder, R. B. Jensen and **L. J. Stanley** on combinatorial principles in L.

Jean-Yves Girard and **Jean Pierre Ressayre** on Π^1_n logic—a major paper on a subject newly developed by Girard and others which while at its root is proof theoretic seems to have important implications for and applications to generalized recursion theory, descriptive set theory and other areas.

Expository and survey articles include

Robert I. Soare, the first article presenting an accessible approach to the $0'''$ priority method introduced by Lachlan and currently being extensively exploited by Harrington and others to settle many important questions about the r.e. sets and degrees.

Richard A. Shore, a survey of recent work on the structure of the degrees of unsolvability.

Anil Nerode and **J. Remmel**, an encyclopedic survey of the lattice of r.e. substructures of effectively presented mathematical systems.

Papers by **Kenneth McAloon, Stephen S. Simpson** and **Paul Young** on the connections between logic and recursion theory on the one hand and strength of axiom systems and low level complexity of computation on the other.

Sy D. Friedman, an introduction to the fine structure of L from a recursion theoretic viewpoint with some new applications.

1980 *Mathematics Subject Classifications*: 03D25, 03D30, 03D45, 03D55, and others
ISBN 0-8218-1447-8, LC 84-18525
ISSN 0082-0717
viii + 528 pages (hardcover), March 1985
List price $60, Institutional member $48, Individual member $36
Shipping and handling charges must be added
To order, please specify PSPUM/42N

Four-Manifold Theory

Cameron Gordon and Robion C. Kirby, Editors

(Contemporary Mathematics, Volume 35)

These are the proceedings of the Summer Research Conference on 4-manifolds held at Durham, New Hampshire, July 1982, under the auspices of the AMS and National Science Foundation.

The conference was highlighted by the breakthroughs of Michael Freedman and S. K. Donaldson, and Frank Quinn's completion at the conference of the proof of the annulus conjecture (We commend the AMS committee, particularly Julius Shaneson, who had the foresight in spring 1981 to choose the subject, 4-manifolds, in which such remarkable activity was imminent.) Freedman and several others spoke on his work; some of their talks are represented by papers in this volume. Donaldson and Clifford H. Taubes gave surveys of their work on gauge theory and 4-manifolds and their papers are also included herein. There were a variety of other lectures, including Quinn's surprise, and a couple of problem sessions which led to the problem list.

A background of basic differential topology is adequate for potential readers.

Contents

1980 *Mathematics Subject Classifications*: 57-06, 53-06, 57MXX
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Shipping and handling charges must be added
To order, please specify CONM/35N

Group Actions on Manifolds

Reinhard Schultz, Editor

(Contemporary Mathematics, Volume 36)

The articles in this book are mainly based upon lectures at the 1983 AMS-IMS-SIAM Joint Summer Research Conference on Group Actions on Manifolds held at the University of Colorado. A major objective was to provide an overall account of current knowledge in transformation groups; a number of survey articles describe the present state of the subject from several complementary perspectives. The book also contains some research articles, generally dealing with results presented at the conference. Finally, there is a discussion of current problems on group actions and an acknowledgment of the work and influence of D. Montgomery on the subject.

The book will be accessible to advanced graduate students who have had the equivalent of three semesters of graduate courses in topology; some previous acquaintance with the fundamentals of transformation groups is also highly desirable. Readers can obtain an overall understanding of the sorts of problems one studies in group actions and the methods used to study such problems. This book is not merely an account of new results, but also a guide to motivation behind present work and potentially future developments.

Contents

1980 *Mathematics Subject Classifications*: 55-06, 57-06
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Conference on Algebraic Topology in Honor of Peter Hilton

Renzo Piccinini and Denis Sjerve, Editors

(Contemporary Mathematics, Volume 37)

This book contains 18 papers in algebraic topology and homological algebra by collaborators and associates of Peter Hilton. It is dedicated to Peter Hilton on the occasion of his 60th birthday. The various topics covered are homotopy theory, H-spaces, group cohomology, localization, classifying spaces, and Eckmann-Hilton duality.

Students and researchers in algebraic topology will gain an appreciation for Peter Hilton's impact upon mathematics from reading this book.

Contents

Kee Yuen Lam, *On stable Hopf invariant one elements in RP^{∞}*
Charles A. McGibbon and **Joseph A. Neisendorfer**, *Various applications of Haynes Miller's theorem*
Ib Madsen and **Jan-Alve Svensson**, *Induction in unstable equivariant homotopy theory and non-invariance of Whitehead torsion*
Mark Mahowald, *Lin's theorem and the EHP sequence*
J. P. May, *Stable maps between classifying spaces*
Joseph Roitberg, *Residually finite, Hopfian and co-Hopfian spaces*
Victor Snaith, *On the classifying spaces of Galois groups*
James Stasheff, *Hilton-Eckmann duality revisited*
K. Varadarajan, *Projective and free approximations*

1980 *Mathematics Subject Classification*: 55-06
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Topics in Complex Analysis

Dorothy B. Shaffer, Editor

(Contemporary Mathematics, Volume 38)

Most of the mathematical ideas presented in this volume are based on papers given at an AMS meeting held at Fairfield University in October 1983. The unifying theme of the talks was Geometric Function Theory.

Papers in this volume generally represent extended versions of the talks presented by the authors. In addition, the proceedings contain several papers that could not be given in person. A few of the papers have been expanded to include further research results obtained in the time between the conference and submission of manuscripts. In most cases, an expository section or history of recent research has been added. The authors' new research results are incorporated into this more general framework. The collection represents a survey of research carried out in recent years in a variety of topics.

The paper by Y. J. Leung deals with the Loewner equation, classical results on coefficient bodies and modern optimal control theory. Glenn Schober writes about the class Σ, its support points and extremal configurations. Peter Duren deals with support points for the class S, Loewner chains and the process of truncation.

A very complete survey about the role of polynomials and their limits in class S is contributed by T. J. Suffridge.

A generalization of the univalence criterion due to Nehari and its relation to the hyperbolic metric is contained in the paper by David Minda. The omitted area problem for functions in class S is solved in the paper by Roger Barnard. New results on angular derivatives and domains are represented in the paper by Burton Rodin and Stefan E. Warschawski, while estimates on the radial growth of the derivative of univalent functions are given by Thom McGregor.

In the paper by B. Bshouty and W. Hengartner a conjecture of Bombieri is proved for some cases. Other interesting problems for special subclasses are solved by B. A. Case and J. R. Quine; M. O. Reade, H. Silverman and P. G. Todorov; H. Silverman and E. M. Silvia.

New univalence criteria for integral transforms are given by Edward Merkes. Potential theoretic results are represented in the paper by Jack Quine with new results on the Star Function and by David Tepper with free boundary problems in the flow around an obstacle. Approximation by functions which are the solutions of more general elliptic equations are treated by A. Dufresnoy, P. M. Gauthier and W. H. Ow.

At the time of preparation of these manuscripts, nothing was known about the proof of the Bieberbach conjecture. Many of the authors of this volume and other experts in the field were recently interviewed by the editor regarding the effect of the proof of the conjecture. Their ideas regarding future trends in research in complex analysis are presented in the epilogue by Dorothy Shaffer.

A graduate level course in complex analysis provides adequate background for the enjoyment of this book.

1980 *Mathematics Subject Classifications*: 30C50, 30C70, 30C55, 30C80, 30C10 and others
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Errett Bishop: Reflections on Him and His Research

Murray Rosenblatt, Editor

(Contemporary Mathematics, Volume 39)

This book is the proceedings of the Memorial Meeting for Errett Bishop held at the University of California, San Diego, September 24, 1983.

Errett Bishop was distinguished for his mathematical work on function algebras and

the foundations of mathematics. His research on function algebras and complex analysis was universally recognized. The research on foundations which came later was also remarkable. As is well known, many people have very strong opinions concerning foundations. The object here is to present a view of Errett Bishop as an individual, a colleague to many of us, and as a mathematician. A vita of Bishop is first given with a listing of his mathematical papers. This is followed by a paper of Bishop's titled "Schizophrenia in contemporary mathematics." This paper was distributed in conjunction with the Colloquium Lectures he delivered in 1973 at the Seventy-Eighth Summer Meeting of the American Mathematical Society.

People with an interest in function algebras, the foundations of mathematics, or Bishop himself will be pleased with this book. They will gain an understanding of the contributions of Bishop to research on function algebras and foundations, and their novelty and continuing impact on these fields.

Contents

1980 *Mathematics Subject Classifications*: 03A05, 03E25, 03F65, 03E45, 36A03, and others
ISBN 0-8218-5040-7, LC 85-152
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xviii + 91 pages (softcover), April 1985
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Prescribing the Curvature of a Riemannian Manifold

Jerry L. Kazdan

(CBMS Regional Conference Series, Number 57)

These notes were the basis for a series of ten lectures given from January 6–10, 1984 at Polytechnic Institute of New York under the sponsorship of the Conference Board of the Mathematical Sciences and the National Science Foundation. The lectures were aimed at mathematicians who knew either some differential geometry or partial differential equations, although others could hopefully understand the lectures.

Author's Summary: Given a Riemannian Manifold (M, g) one can compute the sectional, Ricci, and Scalar curvatures. In other special circumstances one also has mean curvatures, holomorphic curvatures, etc. The inverse problem is, given a candidate for some curvature, to determine if there is some metric g with that as its curvature. One may also restrict ones attention to a special class of metrics, such as Kähler or conformal metrics, or those coming from an embedding. These problems lead one to (try to) solve nonlinear partial differential equations. However, there may be topological or analytic obstructions to solving these equations. A discussion of these problems thus requires a balanced understanding between various existence and non-existence results.

The intent of this volume is to give an up-to-date survey of these questions, including enough background, so that the current research literature is accessible to mathematicians who are not necessarily experts in PDE or Differential Geometry.

The intended audience is mathematicians and graduate students who know either PDE or differential geometry at roughly the level of an intermediate graduate course.

Contents

(c) Another variational problem
IV. Boundary Value Problems
1. Surfaces with constant mean curvature
(a) Rellich's problem
2. Some other boundary value problems
(a) Graphs with prescribed mean curvature
(b) Graphs with prescribed Gauss curvature
3. The $C^{2+\alpha}$ estimate at the boundary
Some Open Problems

Kazdan received the Ph.D. in 1963 from the Courant Institute of Mathematical Sciences. After that, he was a Peirce Instructor at Harvard University. Since 1966 he has been at the University of Pennsylvania.

Visiting Professorships: Harvard, UC Berkeley, University of Paris, École Polytechnique, Bonn University, Max Planck Institute (Bonn), Australian National University, Tokyo University, RIMS (Kyoto)

Research interests: Nonlinear Partial differential equations and differential geometry.

1980 *Mathematics Subject Classifications*: 35Jxx, 53Cxx
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List price $12, all individuals $7
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To order, please specify CBMS/57N

Dual Algebras with Applications to Invariant Subspaces and Dilation Theory

Hari Bercovici, Ciprian Foiaş and Carl Pearcy

(CBMS Regional Conference Series, Number 56)

This book is a slightly expanded and revised version of the lecture notes from the NSF/CBMS Regional Conference held in Tempe, Arizona in May, 1984, at which the third author was the principal lecturer. In the book the authors have tried to summarize some of the voluminous progress that has been made in the theory of dual algebras since the appearance in 1978 of Scott Brown's pioneering paper which clearly showed the utility of this concept for studying the structure theory of bounded linear operators on Hilbert space. The aim of the book is to present an approach for studying (non-self-adjoint) dual algebras that allows one, in particular, to obtain results on invariant subspaces and dilation theory.

The book is put together as follows. Chapter I contains facts of a general nature about dual algebras. Chapters II and III describe a general method for proving structure theorems concerning the preduals of operator algebras. Several instances in which these general structure theorems for preduals can be applied are studied in Chapters VI, VII and IX. Chapter IX, for example, contains a very general reflexivity theorem for operator algebras. The remaining chapters are dedicated to the study of singly generated algebras, with special emphasis on a new dilation theory (Chapter V). Chapters VIII and X contain applications to special classes of operators, like weighted shifts and subnormal operators.

This book may serve as an introduction to this area of research for those not already familiar with it. Results in this area are scattered throughout the literature and, sometimes, unpublished. The book provides a unified approach to developments following Scott Brown's invariant subspace theorem for subnormal operators.

A background in basic functional analysis and operator theory on Hilbert space will prepare the reader. Some knowledge of canonical models for contractions will also be helpful, especially for Chapter VIII.

1980 *Mathematics Subject Classifications*: 47A, 47C, 47D; 46H, 46J
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Selected Tables in Mathematical Statistics, Volume 8

These volumes of mathematical tables have been prepared under the aegis of the Institute of Mathematical Statistics, which is a professional society for mathematically-oriented statisticians. The purpose of the Institute is to encourage the development, dissemination, and application of mathematical statistics. The Committee on Mathematical Tables of the Institute of Mathematical Statistics is responsible for preparing and editing this series of tables.

The tables included in the present volume were checked at the University of Victoria. Dr. R. F. Odeh arranged for, and directed this checking with the assistance of Mr. Bruce Wilson.

Contents

M. L. Tiku and **S. Kumra**, *Expected values and variances and covariances of order statistics for a family of symmetric distributions (student's t)*

1980 *Mathematics Subject Classifications*: 62Q05, 62C15, 62E30, 62F07, 62G30 and others
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Dirichlet Integrals of Type 2 and Their Applications

Milton Sobel, V. R. R. Uppuluri and K. Frankowski

(Selected Tables in Mathematical Statistics, Volume 9)

Abstract

This volume deals with incomplete Dirichlet integrals of type 2 and is a companion book to Volume 4 of this series (by the same authors) which deals with incomplete Dirichlet integrals of type 1. As in the previous volume

1) there are several new contributions present, some of which concern the development of new algorithms that made these tables possible,

2) there are many examples given to illustrate the use of the tables,

3) applications of these integrals are given to two types of problems: some that would be classified as being in the area of probability and also to some that are primarily statistical in nature,

4) there is already evidence that these tables and the associated write-up will serve as a catalytic agent for further research,

5) the probabilistic interpretation of the Dirichlet integral plays a major role in the direction we take and in the development of tables.

An important area of application of these integrals is to ranking and selection problems dealing with the multinomial distribution, especially when the statistic of major interest is related to the minimum or maximum frequency among the cells and the stopping rule is of the type used in inverse sampling. In the tables most attention is to the homogeneous multinomial; however much of the analysis attempts to get away from homogeneity.

1980 *Mathematics Subject Classifications*: 62Q05, 65E15, 62H10
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Seven Papers in Applied Mathematics

(American Mathematical Society Translations, Series 2, Volume 125)

The papers in this book are translated from the Russian.

Contents

1980 *Mathematics Subject Classifications*: 58, 35, 34, 76, 78, 70, 82, 83, 49, 85
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Selected Translations in Mathematical Statistics and Probability, Volume 16

These translations from the Russian papers are selected by a joint committee of the Institute for Mathematical Statistics and the American Mathematical Society.

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S. E. Kuznetsov, *Regularity criteria for Markov processes*
S. E. Kuznetsov, *Transformation of a Markov process with the help of excessive functions*
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Z. M. Landsman, *Asymptotic behavior of the Fisher information in the case of a family with location and scale parameters*
A. A. Zinger and **R. V. Januškevičius**, *On a theorem of characterization by identical distribution of statistics, and its stability*
È. A. Nadaraya, *On some tests based on "kernel" type estimators of a probability density*
Yu. M. Līn'kov, *Asymptotic normality of the logarithm of the likelihood ratio, and hypothesis testing for nonhomogeneous Poisson processes*
A. K. Kelmans, *On the analysis and synthesis of probabilistic networks*

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Attractors Representing Turbulent Flows

Peter S. Constantin, Ciprian Foiaş and Roger Temam

(Memoirs of the AMS, Number 314)

The aim of this monograph is to fill some part of the gap existing between two classical approaches to turbulence, on one hand the conventional statistical theory and the well-known results of Kolmogorov, on the other hand the more recent point of view based on the concept of attractors and chaos, following in particular the ideas of Smale and Ruelle-Takens. By using the mathematical theory of the Navier-Stokes equations, refined estimates on the Lyapunov numbers of the system are given and the connection is made between the concept of number of degrees of freedom of a turbulent flow and the dimension of the attractor associated to the flow.

1980 *Mathematics Subject Classifications*:
35Q10, 76D05, 76F99
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Chapter 16 of Ramanujan's Second Notebook: Theta-functions and q-series

Chandrashekar Adiga, Bruce C. Berndt, S. Bhargava and George N. Watson

(Memoirs of the AMS, Number 315)

Chapter 16 of Ramanujan's second notebook provides an introduction to his further work on q-series and elliptic functions found in later chapters of his second notebook and in his "lost notebook." The purpose of this Memoir is to give proofs of all of the 135 identities stated in 39 sections of Chapter 16. Some of the results on q-series are classical basic hypergeometric transformations due to Cauchy, Euler, and Heine. However, many of the identities, including certain q-continued fraction expansions, are originally due to Ramanujan and are proved for the first time in this Memoir. Ramanujan also develops in this chapter the classical theory of theta-functions from which Ramanujan derives original theorems not heretofore proved in print.

1980 *Mathematics Subject Classifications*:
33A30, 33A25
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Galvin's "Racing Pawns" Game and a Well-Ordering of Trees

Stephen B. Grantham

(Memoirs of the AMS, Number 316)

The combinatorial game considered here was formulated by Fred Galvin during the mid-seventies; though unpublished, his proof by "infinitary strategy-stealing" that the game is always a win for the first player has become known for its elegance. Galvin also was able to construct an

explicit strategy for the case in which the trees involved in the game are finite.

In this paper the author presents Galvin's results and then goes on to construct the elaborate machinery needed to give the explicit strategy in the general (infinite) case. At the same time he uses Galvin's game to define a well-ordering on the class of branch-finite trees and applies his machinery to determine the order types of many subsets of this class under that well-ordering.

1980 *Mathematics Subject Classifications*:
04A10; 03E10, 05C05, 06A05, 90D05
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Spectral Sequence Constructors in Algebra and Topology

Donald W. Barnes

(Memoirs of the AMS, Number 317)

Spectral sequence constructors are a special type of functor to filtered chain complexes. They provide a means of comparing the various constructions which have been given for certain spectral sequences, for example, the spectral sequence of a group extension. In this book, the theory of spectral sequence constructors is developed, the four main constructions of the spectral sequence of a Hopf algebra extension are discussed and compared, and a uniqueness theorem for the spectral sequence is proved. A similar study is made of the spectral sequence of a fibration, and its uniqueness is also established.

1980 *Mathematics Subject Classifications*:
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Embedding and Multiplier Theorems for $H^p(\mathbf{R}^n)$

Albert Baernstein II and Eric T. Sawyer

(Memoirs of the AMS, Number 318)

This paper is about the real variable Hardy spaces $H^p(\mathbf{R}^n), 0 < p \leq 1$. We prove two main theorems. The first is a sufficient condition involving the "size" of $f \in S'$ which implies that $f \in H^p$, and the second a sufficient condition on $m \in L^\infty(\mathbf{R}^n)$ for m to be a Fourier multiplier of H^p. These conditions are phrased in terms of certain function spaces introduced by Herz, and within these spaces the conditions are sharp. The embedding theorem sharpens results of Taibleson and Weiss involving "molecules" and implies a sharp Fourier embedding theorem of the Bernstein-Taibleson-Herz type, while the multiplier theorem sharpens results of Calderón and Torchinsky. The paper also contains three other theorems about Fourier transforms of H^p distributions.

1980 *Mathematics Subject Classifications*:
42B30, 42B15
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Some Basic Hypergeometric Orthogonal Polynomials that Generalize Jacobi Polynomials

Richard Askey and James Wilson

(Memoirs of the AMS, Number 319)

The classical orthogonal polynomials include those of Hermite, Laguerre, Jacobi and discrete analogues found by Chebychev, Charlier, Meixner and Hahn. In an earlier paper the authors found the most general set of classical orthogonal polynomials whose weight function is discrete. The same polynomials with different choices of parameters have an absolutely continuous weight function. The explicit orthogonality relation is obtained, many special cases are considered, and a few facts about these polynomials are discovered. These include quadratic transformations for some basic hypergeometric series, a solution of the connection coefficient problem which gives Watson's extension of the Rogers-Ramanujan identities, inequalities for the polynomials on the spectral interval, a divided difference equation and a Rodrigues type formula. All of the paper rests on a new extension of the beta integral which has four rather than two free parameters in addition to the q associated with basic hypergeometric series.

1979 *Mathematics Subject Classification*:
05A17
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Positive Polynomials and Product Type Actions of Compact Groups

David Handelman

(Memoirs of the AMS, Number 320)

In computing K_0 of fixed point C^*-algbebras under special actions of compact groups, one is lead to the following type of problem (in the case of the d-torus). Let f be a polynomial in d real variables. Decide if there exists a polynomial Q such that Qf has only non-negative coefficients. The answer to this decision question is given, completing results of Poincaré (1883), Meissner (1911), and Polyà (1928). Similar questions with characters of compact Lie groups replacing polynomials are considered, and the foundations are laid for further work on this sort of "eventual positivity" problem. The author also goes back to describe the maximal ideal structure of the original fixed point algebras, using the techniques from ordered K_0-theory developed above.

1980 *Mathematics Subject Classification*:
46L05
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Conditional Stability and Real Analytic Pseudo-Anosov Maps

Marlies Gerber

(Memoirs of the AMS, Number 321)

The author shows that the smooth pseudo-Anosov diffeomorphisms constructed by Gerber and Katok satisfy a "conditional structural stability" property, i.e. structural stability with respect to C^1 perturbations which preserve some finite number of jets at a given finite collection of points. As a corollary, she obtains real analytic diffeomorphisms which are Bernoulli with respect to a smooth invariant measure and which are conjugate to Thurston's pseudo-Anosov homeomorphisms. These results also hold for generalized pseudo-Anosov diffeomorphisms. In particular, this proves the existence of real-analytic Bernoulli diffeomorphisms on the two-dimensional disk which preserve Lebesgue measure.

1980 *Mathematics Subject Classifications*:
58F15, 58F30, 58F11
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Banach Spaces with a Unique Unconditional Basis, Up to Permutation

Jean Bourgain, Peter G. Casazza, Joram Lindenstrauss and Lior Tzafriri

(Memoirs of the AMS, Number 322)

This Memoir is a contribution to the study of the following question: What are the Banach spaces X which have up to equivalence and permutation a unique normalized unconditional basis? It is proved that the class of such spaces X includes some infinite direct sums of classical sequence spaces as well as spaces with more complicated structure (the 2-convexified Tsireslon space). The Memoir contains a detailed study of the structure of the important but difficult to handle space $(\sum \oplus \ell_1)_0$. In particular all the complemented subspaces of this space are classified. As far as uniqueness of bases is concerned this space exhibits a behavior which is surprising. A normalized K-unconditional basis in $(\sum \oplus \ell_1)_0$ is $e^{\alpha K}$ equivalent to a permutation of the unit vector basis for some $\alpha > 0$. In this statement $e^{\alpha K}$ cannot be replaced by a function which grows like a polynomial in K (as is usually the case in similar problems in Banach space theory).

1970 *Mathematics Subject Classifications*:
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ISBN 0-8218-2323-X, LC 84-28116
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Restricted Orbit Equivalence

Daniel J. Rudolph

(Memoirs of the AMS, Number 323)

These notes develop a theory of restricted orbit equivalence which has as particular examples

Ornstein's isomorphism theorem for Bernoulli processes, Dye's orbit equivalence theorem for ergodic processes and the theory of Kakutani equivalence developed by Feldman, Ornstein, Weiss and Katok. Other examples are also given. A number of results from the Bernoulli theory are shown to be true for any restricted orbit equivalence.

1980 *Mathematics Subject Classifications*: 28D05, 28D20
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A Dirichlet Problem for Distributions and Specifications for Random Fields

Michael Röckner

(Memoirs of the AMS, Number 324)

Consistent conditional distributions for a large class of Gaussian measures defined on the space of (tempered) distributions on a domain D in $\mathbf{R}^d$ are constructed explicitly. The conditional distributions are with respect to an (uncountable) family of σ-fields associated with the complements of the (relatively compact) open subsets of D. The construction involves solving a Dirichlet problem whose "boundary data" is given by a distribution. Furthermore, the associated set of Gibbs states is studied. The extreme Gibbs states are characterized and it is proved that they have the global Markov property. Based on the Dirichlet solution for distributions it is shown that any Gibbs state can be represented in terms of extreme Gibbs states.

1980 *Mathematics Subject Classification*: 60G60
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SOCIÉTÉ MATHÉMATIQUE DE FRANCE, ASTÉRISQUE

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Séminaire Bourbaki, 1983/1984, exposés 615–632

(Astérisque, Numbers 121–122)

Comme les précédents volumes de ce séminaire, celui-ci contient 18 exposés de synthèse sur des sujets d'actualité: six de géométrie différentielle, cinq d'arithmétique ou de géométrie algébrique, deux d'algèbre, deux de physique statistique, un d'analyse complexe, un de logique, un d'informatique.

Entre autres, on y trouve la démonstration des conjectures de Tate, de Shafarevitch et de Mordell, on y fait le point sur la construction du Monstre, l'homologie cyclique, la reconstruction des phases en cristallographie, le calcul des primitives.

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Discrete Lax Equations and Differential-difference Calculus

B. A. Kupershmidt

(Astérisque, Number 123)

This is the first detailed introduction into the theory of discrete infinite integrable systems and associated mathematical ideas. It covers constructions of the basic, modified, specialized, and deformed equations, their conservation laws and Hamiltonian structures, canonical maps between various equations, continuous limits, formal eigenfunctions of Lax operators, and a τ-function representation. The basic language of the theory is the discrete Calculus of Variations which behaves naturally under the continuous limit. An extensive exposition is given of the abstract Hamiltonian formalism and of the formalism of the dual spaces of Lie algebras over function rings.

The text is useful to mathematicians and physicists interested in "soliton" science and modern Hamiltonian formalism, and is suitable for graduate students.

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Homologie, Groupes Ext^n, Représentations de Longueur Finie des Groupes de Lie

(Astérisque, Numbers 124–125)

Le présent numéro d'Astérisque contient divers travaux récents portant sur le trois sujets d'actualité mentionnés dans le titre. En homologie des groupes de Lie on trouvera notamment des démonstrations du lemme de Shapiro et du théorème de régularisation. En ce qui concerne les espaces Ext^n et les représentations de longueur finie, un travail est consacré aux groupes semi-simples réels, dans le cadre classique des (g, K)-modules, un autre aux groupes nilpotents et aux espaces de vecteurs C^∞ des représentations unitaires irréductibles, les deux derniers portant sur certains produits semidirects, pour lesquels on étudie une théorie de réduction à la Mackey.

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PROCEEDINGS OF SYMPOSIA IN PURE MATHEMATICS

Complex Analysis of Several Variables

Yum-Tong Siu, Editor

These proceedings contain a collection of papers presented at the Symposium on Several Complex Variables held in Madison, Wisconsin from April 12 to April 15, 1982. At the Symposium there were one-hour survey talks by H. Grauert, J. J. Kohn, M. Schneider, H. Skoda, and S.T. Yau on major areas of important recent developments. In addition, there were more than forty specialized half-hour talks by other participants. Quite a number of talks are not included in these proceedings because detailed papers containing the results presented at the Symposium have already appeared elsewhere. On the other hand, included in these proceedings are some papers submitted by invited speakers who were unable to attend the Symposium.

Contents

1980 *Mathematics Subject Classifications*: 32-XX, 14C99, 14M07, 14M99, 35N15, 49F20, 51M05, 53B35, 53C55, 53C99

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Personal Items

James C. Becker of Purdue University has been appointed chairman of the Department of Mathematics and Statistics at the University of Vermont, effective September 1985.

Nicholaas H. Kuiper, retiring director of the Institut des Hautes Études Scientifiques, received an honorary degree of Doctor of Science, Honoris Causa, from Brown University on the occasion of the symposium "Visualizing Higher Dimensions" in October 1984.

Eugene H. Lehman, formerly retired, has been appointed to Professor of Mathematics at Dawson College, Montreal.

Emmanuel O. Okoronkwo, of Northern Illinois University, has been appointed Assistant Professor at that university.

Deaths

Charles C. Conley of the University of Wisconsin died on November 20, 1984, at the age of 51. He was a member of the Society for 25 years.

Max Deuring of the University of Göttingen, Federal Republic of Germany, died on December 20, 1984, at the age of 77. He was a member of the Society for 51 years.

Paul Dirac died on October 20, 1984, at the age of 82. Professor Dirac received the Nobel Prize in Physics in 1933 for his fundamental work in establishing the principles of quantum mechanics.

James Dugundji of the University of Southern California died on January 8, 1985, at the age of 65. He was a member of the Society for 38 years.

Andre Gleyzal, of Boca Raton, Florida, died on October 21, 1984, at the age of 76. He was a member of the Society for 42 years.

Palmer H. Graham of Burlingame, California, died on September 17, 1984, at the age of 96. He was a member of the Society for 57 years.

William L. Hart of La Jolla, California, died on December 16, 1984, at the age of 92. He was a member of the Society for 68 years.

Demetrios A. Kappos of Athens, Greece, died on January 8, 1985, at the age of 80. He was a member of the Society for 24 years.

Cyril A. Nelson of Pt. Haywood, Virginia, died on July 27, 1984, at the age of 90. He was a member of the Society for 65 years.

Louis E. Perrin of Reims, France, died on October 9, 1984, at the age of 74. He was a member of the Society for 21 years.

James B. Speer of Denver, Colorado, died on June 28, 1984, at the age of 61. He was a member of the Society for 7 years.

Michael J. Walsh of San Diego, California, died on October 31, 1984. He was a member of the Society for 42 years.

Visiting Mathematicians
(*Supplementary List*)

Mathematicians visiting other institutions during the 1984-1985 academic year have been listed in recent issues of the *Notices*: June 1984, pages 403–405; August 1984, pages 536-537; October 1984, pages 708-709; November 1984, page 806; and January 1985, page 97. The list below gives the name and home country, the host institution, period of visit, and field of special interest of additional visiting mathematicians.

Janos Bognar (Hungary), University of Calgary, September 1984 to April 1985, indefinite inner spaces.

Philip Laird (Australia), University of Calgary, January 1985 to April 1985, mean periodic functions, mean value properties in potential theory.

William J. Spratt (Scotland), University of Calgary, October 1984 to April 1985, integral transforms, fractional calculus, multipliers and distribution theory.

Juan L. Vázquez (Spain), Institute for Mathematics and its Applications, Minneapolis, and University of Chicago, March 1985 to July 1985, partial differential equations.

Reciprocity Agreements

The listing below updates the report published in the *Notices*, August 1984 (pages 527–532).

Europe

Société de Mathématiques Appliquées et Industrielles

Apply to: Société de Mathématiques Appliquées et Industrielles, Laboratoire de Mathématiques Appliquées, Ecole Polytechnique, 91128 Palaiseau, France.
Dues: 100 francs (US $11); payable to Société de Mathématiques Appliquées et Industrielles, Laboratoire de Mathématiques Appliquées.
Privileges: Right to receive the membership list and the newsletter; right to participate at SMAI sponsored meetings and workshops with a reduced fee.
Officers: R. Temam (President), J. P. Boujot, N. Elkaroui, J. Periaux (Vice-Presidents), J. P. Puel (Treasurer), P. Lasaux (Secretary).

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 12/15/84	Backlog of Printed Pages 5/31/84	Editor's Estimated Time for Paper Submitted Currently to be Published (In Months)	Observed Waiting Time in Latest Published Issue (In Months) Q_1	M	Q_3
Acta. Inform.	6	720	0	0	5	5	6	6
Aeqationes Math.	6	640	137	133	12	10	12	13
Amer. J. Math.	6	1500	2014	1350	16	19	23	27
Ann. of Math.	6	1200	300	300	12	9	12	15
Ann. Probab.	4	1300	NR	150	15	8	10	12
Ann. Sci. Ecole Norm. Sup.	4	600	NR	NR	NR	14	16	18
Ann. Statist.	4	1650	0	0	6	6	8	9
Appl. Math. Optim.	6	576	150	250	3	6	7*	7
Applicable Anal.	8	800	NR	NR	NR		NA	
Arch. Hist. Exact Scis.	12	1200	0	0	13	10	11	11
Arch. Rational Mech. Anal.	16	1600	0	0	11-12	9	9	10
Bull. Austral. Math. Soc.	6	960	0	**	5-6	9	9	10
Canad. J. Math.	6	1152	300	100	15	14	16	19
Canad. Math. Bull.	4	512	256	192	18	12	15	17
Comm. Algebra	12	3120	1239	1797	9	10	14	15
Comm. Math. Phys.	20	3040	0	0	5	7	7	9
Comm. Partial Diff. Equations	12	1400	350	500	9	4	5	8
Computing	8	768	0	0	7	7	9	12
Duke Math. J.	4	1100	0	0	9	10	11	15
Houston J. Math.	4	600	150	150	15	16	20	21
Illinois J. Math.	4	704	713	NR	21	31	31	32
Indiana Univ. Math. J.	4	928	100	200	15	18	19	20
Internat. J. Math. Math. Sci.	4	832	200	NR	6-7	8	14	18
Invent. Math.	12	2304	0	0	7	7	8	9
Israel J. Math.	12	1200	300	100	12	7	8	11
J. Algorithms	4	600	500	**	12	18	20	27
J. Amer. Statist. Assoc.	4	1100	150	NR	9	7	8	8
J. Assoc. Comput. Mach.	4	1000	0	NR	9-12	7	8	8
J. Austral. Math. Soc. Ser. A	6	852	800	**	21	19	22	25
J. Austral. Math. Soc. Ser. B	4	512	60	**	15	13	15	16
J. Comput. System Sci.	6	900	100	600	12	6	7	14
J. Differential Geom.	4	1200	600	900	9	8	11	12
J. Math. Biol.	7	896	0	0	7	7	7	9
J. Math. Phys.	12	3600	200	390	5-6	10	11***	16
J. Math. Sociol.	4	400	120	NA	6		NA	
J. Nigerian Math. Soc.	1	100	0	0	10-12	17	32	34
J. Operator Theory	4	800	NR	400	NR	14	17	19
J. Symbolic Logic	4	1152	100	200	16	18	20	22

Journal	Number Issues per Year	Approximate Number Pages per Year	Backlog of Printed Pages 12/15/84	Backlog of Printed Pages 5/31/84	Editor's Estimated Time for Paper Submitted Currently to be Published (In Months)	Observed Waiting Time in Latest Published Issue (In Months) Q_1	Observed Waiting Time in Latest Published Issue (In Months) M	Observed Waiting Time in Latest Published Issue (In Months) Q_3
Linear Algebra Appl.	9	2700	500	300	12-15	13	14	15
Linear and Multilinear Algebra	6	540	300	400	9	9	13	15
Manuscripta Math.	12	1200	NR	0	NR	8	9	10
Math. Ann.	12	1920	0	0	8	8	11	14
Math. Biosci.	10	1500	NR	100	NR	6	6	7
Math. Comp	4	1300	50	80	12	11	14	16
Math. Oper. Res.	4	704	350	590	18	17	19	21
Math. Programming	9	1080	120	NR	15	7	10	15
Math. Systems Theory	4	384	NR	NR	NR	8	10	12
Math. Z.	12	1820	0	0	8-9	7	8	11
Mem. Amer. Math. Soc.	6	2800	0	256	9	6	15	22
Michigan Math. J.	3	384	150	125	10-14	5	7	8
Monatsh. Math.	8	704	0	0	6	6	7	8
Numer. Funct. Anal. Optim.	6	700	150	0	9	3	4	7
Numer. Math.	8	1280	0	6	7	7	9	10
Oper. Res.	6	1300	NR	700	NR	28	30***	41
Pacific J. Math.	10	2500	NR	NR	13	19	20	21
Proc. Amer. Math. Soc.	12	2200	50	150	9	13	13	16
Quart. Appl. Math.	4	512	128	128	15	15	17	18
Resultate Math.	2	220	140	0	12	21	23	26
Rocky Mountain J. Math.	4	768	750	750	27	14	17	19
Semigroup Forum	9	1150	0	128	7	5	6	11
SIAM J. Algebraic Discrete Methods	4	700	269	509	14	15	17	17
SIAM J. Appl. Math.	6	1050	0	0	8	8	9	11
SIAM J. Comput.	4	1000	394	538	14	15	16	17
SIAM J. Control Optim.	6	975	356	106	13	13	14	16
SIAM J. Math. Anal.	6	1345	958	796	17	16	18	19
SIAM J. Numer. Anal.	6	1200	356	415	12	10	11	13
SIAM J. Sci. Statist. Comput.	4	1000	449	625	15	16	17	19
SIAM Rev.	4	560	0	0	5	4	6	10
Stochastics	Varies	Varies	NR	NA	3	6	7*	7
Topology Appl.	6	990	715	260	9	16	16	17
Trans. Amer. Math. Soc.	12	5000	0	100	9	13	14	20
Z. Wahrsch. Verw. Gebiete	12	1920	0	0	8	9	12	19

NR means no response received.
NA means not available or not applicable.
* From date of acceptance (this journal does not give the received date).
** This journal is new to the listing; backlog as of 5/31/84 not known.
*** From date of first receipt of manuscript (this journal does not give dates of revisions).

Mathematical Sciences Assistantships and Fellowships

for Graduate Study at Universities in 1985–1986, Supplementary List

The entries below supplement the December 1984 Special Issue of the *Notices*.

The number following "Faculty" is the number of faculty members in the department who are full time employees in the institution and at least half-time in the department; the number following "Published" is the number of those reported who have published a technical paper or book in the last three years.

The section on "Graduate Students" refers to the number of graduate students in the department who are full-time (including teaching assistants), full-time first year, and part-time. Information not supplied in any of these categories is indicated by a dash.

Under the DEGREES AWARDED column the following terms have been used:

Bachelor's by inst.	Number of bachelor's degrees awarded by the institution
Bachelor's by dept.	Number of bachelor's degrees awarded by the department
Master's by dept.	Number of master's degrees awarded by the department
Ph.D. (81/84)	Doctoral degrees awarded during the last three years (1981–1982, 1982–1983 and 1983–1984)

Abbreviations used

ANT . .	Algebra or Number Theory	S	Statistics
AFA . .	Analysis or Functional Analysis	CS . . .	Computer Science
GT . . .	Geometry or Topology	OR . . .	Operations Research
L	Logic	AM . .	Applied Mathematics
P	Probability	ME . . .	Mathematics Education

Under the SERVICE REQUIRED column, hours per week section, "c" denotes contact hours.

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	

Alabama

Alabama A&M University, Normal 35762

MATHEMATICS — Applications due: 4/15/85 — Bachelor's by inst. 375
Jerry R. Shipman, Chairman — Faculty 12; Published 2 — Bachelor's by dept. 2
Graduate Students: full-time –; full-time first year 2; part-time 10

Teaching Assistantship (1)	4250	9		20	Teaching	

Alaska

University of Alaska, Fairbanks 99701

MATHEMATICAL SCIENCES — Faculty 21; Published 6 — Bachelor's by inst. 338
Ronald W. Gatterdam, Chairman — Graduate Students: full-time 8; full-time first year 4; part-time 0 — Bachelor's by dept. 15
Master's by dept. 2

Teaching Assistantship (12–15)	7207–7607	9	1200	15–20	Teaching	
Research Assistantship (2)	9784–13144	12	1200		Research	

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984

California

Claremont Graduate School, Claremont 91711

MATHEMATICS — Applications due: 2/15/85* — Master's by dept. 3
Robert Williamson, Chairman — Faculty 4**; Published 3
Graduate Students: full-time 13; full-time first year 3; part-time 11

Fellowship (4)	1000–3000	9	Waived			Ph. D. (81/84) ANT 1, AM 3, Other 2. Total: 6
Scholarship Merit (3)	4000	9	Waived			
Tuition Waivers (6)		9	Waived			
Clinic Team Leader (4)	5600–9200	9	275/unit			

*Late applications invited.
**Claremont Graduate School is the graduate school of the Claremont Colleges; the total graduate faculty is 35.

San Diego State University, San Diego 92182

MATHEMATICAL SCIENCES — Applications due: 4/15/85 — Bachelor's by inst. 2136
David H. Carlson, Chair — Faculty 60; Published 3 — Bachelor's by dept. 123
Graduate Students: full-time 24; full-time first year 24; part-time 183 — Master's by dept. 12

Teaching Assistantship (20)	2600–2900	9	348.50	6[c]	

Stanford University, Stanford 94305

STATISTICS — Applications due: 1/1/85 — Bachelor's by inst. 1645
David Siegmund, Chairman — Faculty 16; Published 16 — Master's by dept. 24
Graduate Students: full-time 40; full-time first year 9; part-time 0

Teaching Assistantship (10)	5800	9		20	Teaching, research	Ph. D. (81/84) S 5. Total: 5

University of California, Santa Cruz 95064

MATHEMATICS — Faculty 17; Published 10 — Bachelor's by dept. 31
Geoffrey Mason, Chairman — Graduate Students: full-time 30; full-time first year 15; part-time – — Master's by dept. 5

Fellowship (3)	6000	9	*	20		Ph. D. (81/84) ANT 2, AFA 2, Other 1. Total: 5
Teaching Assistantship (25)	8250	9				
California Teaching Fellowship (2)	8250	9		20		

*In-state: $1448; out-of-state: $5012.

Connecticut

Central Connecticut State University, New Britain 06050

MATHEMATICS AND COMPUTER SCIENCE — Applications due: 6/15/85 — Bachelor's by inst. 1317
George B. Miller, Chairman — Faculty 32; Published 4 — Bachelor's by dept. 57
Graduate Students: full-time 6; full-time first year 2; part-time 25 — Master's by dept. 6

Teaching Assistantship (3)	2200/sem.	9	420/sem.*	6[c]	

*Connecticut resident.

Delaware

University of Delaware, Newark 19716

MATHEMATICAL SCIENCES — Applications due: 3/1/85 — Bachelor's by inst. 2822
Ivar Stakgold, Chairman — Faculty 38; Published 24 — Bachelor's by dept. 18
Graduate Students: full-time 39; full-time first year 14; part-time 9 — Master's by dept. 4

Fellowship (2)	6360–7035	9				Ph. D. (81/84) AFA 3, GT 1, S 1, OR 4, AM 1, ME 1. Total: 11
Teaching Assistantship (29)	6360–7035	9		12–15		
Scholarship (1)	6360–7035	9				
Internship (2)	14000–16000	12	4300	40		

Florida

University of Florida, Gainesville 32611

INDUSTRIAL AND SYSTEMS ENGINEERING — Applications due: 4/15/85 — Bachelor's by inst. 3680
D. J. Elzinga, Chairman — Faculty 15; Published 14 — Bachelor's by dept. 42
Graduate Students: full-time 38; full-time first year 16; part-time 9 — Master's by dept. 4

Fellowship (1)	7000	9	50.50/cr. hr.			Ph. D. (81/84) OR 3, AM 1. Total: 4
Teaching Assistantship (15)	5600–8400	9	50.50/cr. hr.	13–20		
Research Assistantship (6)	5600–8400	9	50.50/cr. hr.	13–20		

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	

Georgia

Georgia State University, Atlanta 30303

MATHEMATICS AND COMPUTER SCIENCE — Applications due: 7/1/85 — Bachelor's by inst. 2000
Fred A. Massey, Chairman — Faculty 25; Published 11 — Bachelor's by dept. 39
Graduate Students: full-time –; full-time first year –; part-time – — Master's by dept. 8

Research Assistantship (6)	4500–6000	12		10–13		

Hawaii

University of Hawaii, Honolulu 96822

MATHEMATICS — Applications due: 3/1/85 — Bachelor's by inst. 2613
William A. Lampe, Chairman — Faculty 35; Published 34 — Bachelor's by dept. 20
Graduate Students: full-time 13; full-time first year 3; part-time 0 — Master's by dept. 1

Teaching Assistantship (12)	5676–6324	9		3[c]	Teaching	Ph. D. (81/84) AFA 1, GT 1. Total: 2

Illinois

Southern Illinois University, Edwardsville 62026

MATHEMATICS, STATISTICS, AND COMPUTER SCIENCE — Faculty 21; Published 5 — Bachelor's by inst. 1179
Graduate Students: full-time 15; full-time first year 8; part-time 21 — Bachelor's by dept. 39
Robert N. Pendergrass, Chairman — Master's by dept. 6

Teaching Assistantship (15)	4050–4500	9	100	20	Teaching	

Indiana

Purdue University, West Lafayette 47907

STATISTICS — Applications due: 5/31/85 — Bachelor's by inst. 5329
Shanti S. Gupta, Head — Faculty 18; Published 17 — Master's by dept. 16
Graduate Students: full-time 44; full-time first year 10; part-time 7

Fellowship (1)	6000	12	270			Ph. D. (81/84) P 2, S 9. Total: 11
Teaching Assistantship (35)	5200–6200	10	270	6[c]	Teaching	
Research Assistantship (5)	5000–6000	10	270	20	Research	

Iowa

Iowa State University, Ames 50011

COMPUTER SCIENCE — Applications due: 3/1/85 — Bachelor's by inst. 3418
George O. Strawn, Chairman — Faculty 18; Published 6 — Bachelor's by dept. 121
Graduate Students: full-time 85; full-time first year 36; part-time – — Master's by dept. 13

Fellowship (5)	827/mo.	9	*	20	Grading, research	Ph. D. (81/84) CS 7. Total: 7
Teaching Assistantship (50)	827/mo.	9	*	20	Grading	
Research Assistantship (10)	827/mo.	9	*	20	Research	

*Resident: $736; nonresident: $1800.

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	
MATHEMATICS			Applications due: 3/1/85*			Bachelor's by inst.	3418
A. K. Steiner, Chairman			Faculty 68; Published 43			Bachelor's by dept.	17
			Graduate Students: full-time 59; full-time first year 21; part-time 3			Master's by dept.	2
Teaching Assistantship (55)	6700–8118	9	1360/yr.**	4–6[c]	Teaching	Ph. D. (81/84) ANT 1, AFA 1,	
Research Assistantship (5)	6000–7200	9	1360/yr.		Research	P 1, AM 1, Other 3. Total: 7	
PACE***	340/sem.						

*Late applications accepted.
**Graduate College fellowship of $680 per year available to those with good academic standing.
***Premium for Academic Excellence, based upon prior academic achievement and offered by the Graduate College.

Kansas

University of Kansas, Lawrence 66045

COMPUTER SCIENCE			Faculty 15; Published 15			Bachelor's by inst.	2000
William G. Bulgren, Acting Chair			Graduate Students: full-time 123; full-time first year 50; part-time 20			Bachelor's by dept.	165
Fellowship (2)	6000–9000	9					
Teaching Fellowship (35)	6800–7200	9	300	20	Teaching		
Research Assistantship (2)	7200–7500	9	575	20	Research		
Grading and Assisting (20)	5500–6000	9	575	20	Grading, assisting		

Louisiana

McNeese State University, Lake Charles 70609

MATHEMATICS, COMPUTER SCIENCE AND STATISTICS			Faculty 24; Published 17			Bachelor's by inst.	615
George F. Mead, Jr., Head			Graduate Students: full-time 10; full-time first year 3; part-time 4			Bachelor's by dept.	25
Teaching Assistantship (4)	4000	9	483	6[c]			
Special Assistantship (2)	4000	9	483	20			

Tulane University, New Orleans 70118

MATHEMATICS			Applications due: 2/1/85			Bachelor's by inst.	1164
James T. Rogers, Jr., Chairman			Faculty 29; Published 26			Bachelor's by dept.	15
			Graduate Students: full-time 23; full-time first year –; part-time 5			Master's by dept.	2
Teaching Assistantship (25)	5800–8000	9	175	3–4[c]	Teaching	Ph. D. (81/84) ANT 6, AFA 5, GT 1, AM 1. Total: 13	

Massachusetts

Boston University, Boston 02134

MATHEMATICS			Applications due: 2/1/85			Bachelor's by inst.	3167
R. Devaney, Chairman			Faculty 28; Published 23			Bachelor's by dept.	41
			Graduate Students: full-time 45; full-time first year 29; part-time 16			Master's by dept.	16
Fellowship (2)	5500–6050	9				Ph. D. (81/84) ANT 1, S 2,	
Teaching Fellowship (20)	6050–6350	9		12	Teaching, grading	CS 6, AM 1, Other 2. Total: 12	

University of Massachusetts at Boston 02125

MATHEMATICS AND COMPUTER SCIENCE			Applications due: *			Bachelor's by dept.	56
Colin Godfrey, Chair			Faculty 32; Published 17			Master's by dept.	1
			Graduate Students: full-time 30; full-time first year 12; part-time 18				
Teaching Assistantship (12)	4400–4600	9	Waived	12	Teaching		

*6/1/85 foreign students, 8/1/85.

Michigan

Wayne State University, Detroit 48202

MATHEMATICS			Applications due: 3/1/85*			Bachelor's by inst.	2700
Togo Nishiura, Chairman			Faculty 47; Published 42			Bachelor's by dept.	24
			Graduate Students: full-time 47; full-time first year 17; part-time 22			Master's by dept.	10
Fellowship (2)	4500**	9				Ph. D. (81/84) ANT 1, GT 2,	
Teaching Assistantship (22)	5000–6550**	9		6[c]	Teaching	P 1, S 1, Other 1. Total: 6	

*Late applications will be accepted.
**Stipend includes health insurance, and, in some cases, housing.

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	

Minnesota

University of Minnesota, Minneapolis 55455

STATISTICS
Seymour Geisser, Director

Applications due: 3/15/85
Faculty 17; Published 16
Graduate Students: full-time 44; full-time first year 16; part-time 18

Bachelor's by inst. 5934
Bachelor's by dept. 13
Master's by dept. 7

Fellowship (4)	6498–7200	9	*			Ph. D. (81/84) S 10. Total: 10
Teaching Assistantship (23)	7680	9	*	20	Grading	
Research Assistantship (4)	7680	9	*	20	Research	
Alumni Scholarship (1)	2560	9	*			

*7–15 credits: resident $720, nonresident $1440.

Montana

Montana State University, Bozeman 59717

MATHEMATICAL SCIENCES
K. Tiahrt, Head

Applications due: 4/15/85
Faculty 29; Published 22
Graduate Students: full-time 32; full-time first year 13; part-time 0

Bachelor's by inst. 1600
Bachelor's by dept. 20
Master's by dept. 11

Fellowship (2)	500	9	400		Ph. D. (81/84) AFA 1, S 1.
Teaching Assistantship (32)	5900–11000	9	400	5–15	Total: 2
Research Assistantship (3)	5900–11000	9	400	13	

Nebraska

University of Nebraska–Lincoln 68588

COMPUTER SCIENCE
Roy F. Keller, Chairman

Applications due: 7/15/85
Faculty 15; Published 15
Graduate Students: full-time 52; full-time first year 12; part-time 20

Bachelor's by inst. 3000
Bachelor's by dept. 63
Master's by dept. 19

Teaching Assistantship (26)	7000–10000	9	Waived	18–22	Teaching	Ph. D. (81/84) CS 3. Total: 3
Research Assistantship (2)	7000–10000	9	Waived	18–22	Research	

New Jersey

Stevens Institute of Technology, Hoboken 07030

PURE AND APPLIED MATHEMATICS
Milos Dostal, Acting Head

Applications due: 2/15/85
Faculty 10; Published 6
Graduate Students: full-time 19; full-time first year 6; part-time 10

Bachelor's by inst. 336
Bachelor's by dept. 23
Master's by dept. 95

Fellowship (1)	6000			Ph. D. (81/84) AFA 1, P 1,
Teaching Assistantship (8)	6300–6800	9	21	CS 1, AM 1, Other 1. Total: 5
Research Assistantship (1)	6000	9		

New York

Adelphi University, Garden City 11530

MATHEMATICS AND COMPUTER SCIENCE
Jonathan Hodgson, Chairman

Applications due: 3/15/85
Faculty 16; Published 8
Graduate Students: full-time 18; full-time first year 2; part-time 58

Bachelor's by inst. 1500
Bachelor's by dept. 28
Master's by dept. 9

Senior Teaching Fellowship (2)	7600	9	20	Ph. D. (81/84) Total: 3
Teaching Assistantship (9)	3000-4500	9	20	
Scholarship (5)		9		
Tuition Scholarship	50%–54 credits per year			

City University of New York, Graduate Center, New York 10036

MATHEMATICS
Martin Moskowitz, Executive Officer

Applications due: 2/1/85*
Faculty 40; Published 40
Graduate Students: full-time 60; full-time first year –; part-time 15

Fellowship (28)	6000	Ph. D. (81/84) Total: 20

*Late applications considered.

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	

State University of New York at Albany 12222

COMPUTER SCIENCE — Applications due: 3/15/85 — Bachelor's by inst. 2333
Richard E. Stearns, Chair — Faculty 13; Published 10 — Bachelor's by dept. 134
Graduate Students: full-time 30; full-time first year –; part-time 40 — Master's by dept. 18

Fellowship (1–2)	7000	9				
Teaching Assistantship (23)	5000–6000	9	*	20	Grading, teaching	
Research Assistantship (1)	5000–6000	9	*		Research	

*Ten credit waiver.

University of Rochester, Rochester 14627

MATHEMATICS — Applications due: 2/15/85 — Bachelor's by inst. 600
Sanford L. Segal, Chairman — Faculty 27; Published 22 — Bachelor's by dept. 21
Graduate Students: full-time 32; full-time first year 9; part-time 3 — Master's by dept. 2

Teaching Fellowship (8)	6500–8500	9–12		3–4[c]	Assisting	Ph. D. (81/84) AFA 2, GT 1,
Teaching Assistantship (26)	5000–7000	9–12		3–4[c]	Assisting	P 2, AM 2. Total: 7
Summer Fellowship (4)	1000–2000	3				

North Carolina

North Carolina State University, Raleigh 27695

OPERATIONS RESEARCH — Applications due: 2/15/85 — Bachelor's by inst. 2905
Salah E. Elmaghraby, Director — Faculty 5; Published 5 — Master's by dept. 5
Graduate Students: full-time 29; full-time first year 6; part-time 11

Fellowship (2)	3000–12000	9				Ph. D. (81/84) S 1, CS 2, OR 8.
Teaching Assistantship (10)	5500–7000	9	796	20		Total: 11
Research Assistantship (7)	8250–9750	12	796	20		

University of North Carolina, Chapel Hill 27514

BIOSTATISTICS — Applications due: Open — Bachelor's by inst. 3338
James E. Grizzle, Chairman — Faculty 31; Published 31 — Bachelor's by dept. 7
Graduate Students: full-time 71; full-time first year 20; part-time 5 — Master's by dept. 7

Teaching Assistantship (2)	5830–7711	9	1085	20	Teaching	Ph. D. (81/84) Other 43.
Research Assistantship (25)	7774–10281	12	1085	20	Research	Total: 43
Traineeship (10)	5292	12				

Ohio

Ohio State University, Columbus 43210

STATISTICS — Applications due: 4/1/85 — Bachelor's by inst. 2514
J. S. Rustagi, Chairman — Faculty 19; Published 19 — Bachelor's by dept. 1
Graduate Students: full-time 59; full-time first year 10; part-time 3 — Master's by dept. 16

Fellowship (2)	5670–6480	9				Ph. D. (81/84) S 4. Total: 4
Teaching Assistantship (34)	5670–6480	9		20		
Research Assistantship (3)	5670–6480	9		20		

Pennsylvania

Bryn Mawr College, Bryn Mawr 19010

MATHEMATICS — Applications due: 3/1/85 — Bachelor's by inst. 305
Frederick Cunningham, Chairman — Faculty 5; Published 4 — Bachelor's by dept. 9
Graduate Students: full-time 1; full-time first year 1; part-time 0

Teaching Assistantship (1)	3400–5000*	9	8475**		***	

*Plus tuition.
**Full time.
***12 hours per week grading or 20 hours per week teaching.

Shippensburg University, Shippensburg 17257

MATHEMATICS AND COMPUTER SCIENCE — Applications due: * — Bachelor's by inst. 1038
James L. Sieber, Chairman — Faculty 21; Published 3 — Bachelor's by dept. 92
Graduate Students: full-time 23; full-time first year 8; part-time 76 — Master's by dept. 27

Graduate Assistantship (5–7)	2705	9		20	Miscellaneous	

*As soon as possible.

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984

Temple University, Philadelphia 19122

STATISTICS			Faculty 24; Published 21			Bachelor's by inst. 2995
William Wei, Chairman			Graduate Students: full-time 22; full-time first year 7; part-time 17			Bachelor's by dept. 5
						Master's by dept. 7
Fellowship (1)	7000	9				Ph. D. (81/84) S 8. Total: 8
Teaching Assistantship (2)	8000	9		20	Teaching	
Research Assistantship (10)	5000–6000	9		20	Research	

Puerto Rico

University of Puerto Rico, Rio Piedras 00931

MATHEMATICS			Applications due: 2/15/85			Bachelor's by inst. 2612
David E. Pastor, Chairman			Faculty 37; Published 11			Bachelor's by dept. 47
			Graduate Students: full-time 41; full-time first year 7; part-time 11			Master's by dept. 7
Fellowship (3)	350	10				
Teaching Assistantship (35)	350	10		*		
Research Assistantship (5)	350	10		18		

*6 hours of teaching contact hours or 18 hours of tutoring or grading.

Tennessee

Memphis State University, Memphis 38152

MATHEMATICAL SCIENCES			Applications due: 4/1/85			
R. J. Faudree, Chairman			Faculty 28; Published 18			
			Graduate Students: full-time 43; full-time first year –; part-time 66			
Teaching Assistantship (33)	5100–6600	9	48/sem. hr.	20	Teaching	Ph. D. (81/84) ANT 1, AFA 1, GT 1, S 3. Total: 6

Tennessee Technological University, Cookeville 38505

MATHEMATICS AND COMPUTER SCIENCE			Applications due: 3/1/85			Master's by dept. 1
Leland L. Long, Acting Chairman			Faculty 23; Published 5			
			Graduate Students: full-time 5; full-time first year 1; part-time –			
Teaching Assistantship (6)	4500	9		6	Teaching	

Texas

Southern Methodist University, Dallas 75275

STATISTICS			Applications due: 4/1/85*			Bachelor's by inst. 1358
William R. Schucany, Chairman			Faculty 12; Published 12			Bachelor's by dept. 13
			Graduate Students: full-time 19; full-time first year 7; part-time 3			Master's by dept. 3
Teaching Assistantship (18)	6500	9		3[c]	Teaching	Ph. D. (81/84) S 8. Total: 8
Dean's Award (1)	11000	9		3[c]	Teaching	

*Late applications accepted.

Texas A&M University, College Station 77843

MATHEMATICS			Applications due: 3/1/85*			Bachelor's by inst. 5980
H. E. Lacey, Head			Faculty 73; Published 71			Bachelor's by dept. 27
			Graduate Students: full-time 32; full-time first year 5; part-time –			Master's by dept. 6
Teaching Assistantship (75)	6300–7075	9	500	10–12	Recitation section, related duties	

*Late applications will be accepted.

University of Texas at Arlington 76019

MATHEMATICS			Applications due: 4/15/85			Bachelor's by inst. 2500
V. Lakshmikantham, Chairman			Faculty 37; Published 24			Bachelor's by dept. 40
			Graduate Students: full-time 55; full-time first year 15; part-time 26			Master's by dept. 7
Teaching Assistantship (45)	6300	9		20	Grading, teaching, research	Ph. D. (81/84) AFA 3, S 2, Other 5. Total: 10

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	

University of Texas at El Paso 79968

MATHEMATICAL SCIENCES — Applications due: 4/15/85 — Bachelor's by inst. 1674
Eugene F. Schuster, Chairman — Faculty 27; Published 11 — Bachelor's by dept. 12
Graduate Students: full-time 16; full-time first year 7; part-time 3 — Master's by dept. 4

Teaching Assistantship (12)	5200–6000	9	170			
Instructorship (3)	6000–8000	9	170	6–9[c]		

Virginia

James Madison University, Harrisonburg 22807

MATHEMATICS AND COMPUTER SCIENCE — Applications due: 4/30/85* — Bachelor's by inst. 1841
Diane M. Spresser, Head — Faculty 28; Published 10 — Bachelor's by dept. 57
Graduate Students: full-time 5; full-time first year 3; part-time 2 — Master's by dept. 2

Teaching Assistantship (5)	4000	9	6[c]	Teaching	

*To receive priority.

Wyoming

University of Wyoming, Laramie 82071

MATHEMATICS — Applications due: Open — Bachelor's by inst. 1350
Kenneth I. Gross, Head — Faculty 27; Published 23 — Bachelor's by dept. 15
Graduate Students: full-time 28; full-time first year 11; part-time 0 — Master's by dept. 6

Teaching Assistantship (24)	5535–7380	9	18			Ph. D. (81/84) ANT 3, AFA 1,
Research Assistantship (4)	5535–7380	9	18			GT 1, AM 2, ME 1. Total: 8

Canada

Simon Fraser University, Burnaby, British Columbia V5A 1S6

MATHEMATICS AND STATISTICS — Applications due: * — Bachelor's by inst. 1374
G. A. C. Graham, Chairman — Faculty 33; Published 31 — Bachelor's by dept. 26
Graduate Students: full-time 48; full-time first year 16; part-time – — Master's by dept. 6

Fellowship**	11100	12	490/sem.			Ph. D. (81/84) ANT 1, AM 2.
Teaching Assistantship (100)	3100–3670	4		20	Teaching, grading	Total: 3
Research Assistantship (8)	3360	4		15	Research	
Open Scholarship (4)	8500	12				
Stipend (8)	2400–2900	4				

*One month prior to start of the semester.
**Number anticipated not known.

Université de Montréal, Montréal, Québec H3C 3J7

MATHEMATICS AND STATISTICS — Faculty 42; Published 42 — Bachelor's by dept. 30
Aubert Daigneault, Director — Graduate Students: full-time 67; full-time first year 26; part-time 63 — Master's by dept. 10

Teaching Fellowship (18)	1650–4900	8	*	1–4[c]	Teaching	Ph. D. (81/84) AFA 8, GT 2,
Teaching Assistantship (57)	2172	8	*	2[c]	Teaching	S 5, AM 1. Total: 16
Research Assistantship (30)	1800–6930	9	*			
Scholarship (36)	5000–11600	12	*		Research	

*$555; visa students without agreement between their country and Québec: $6525.

University of British Columbia, Vancouver, British Columbia V6T 1W5

COMPUTER SCIENCE — Applications due: 4/1/85 — Bachelor's by dept. 101
J. M. Varah, Head — Faculty 18; Published 14 — Master's by dept. 15
Graduate Students: full-time 50; full-time first year 15; part-time 10

Teaching Assistantship (15)	6400	8	1414	12	Grading, teaching	Ph. D. (81/84) CS 7. Total: 7
Research Assistantship (10)	10560	12	1414	12	Research	
Scholarship (10)	11000	12	1414			

TYPE OF ASSISTANCE (number anticipated 1985–1986)	STIPEND paid to student dollars	months	FEES paid by student ($)	SERVICE REQUIRED hours per week	type of service	DEGREES AWARDED Academic year 1983–1984	
MATHEMATICS			Applications due: 10/26/84			Bachelor's by dept.	40
Maurice Sion, Head			Faculty 62; Published 53			Master's by dept.	6
		Graduate Students: full-time 28; full-time first year 12; part-time 2					
Fellowship (7)	11600					Ph. D. (81/84) ANT 2, AFA 2,	
Teaching Assistantship (45)*	6000–6200	8	**	12		GT 4, S 1, AM 4. Total: 13	
Research Assistantship (45)	3500–5300	8					

*Package-teaching assistantship and research assistantship is usually offered providing over $12000 for 12 months.
**First $1750, second $1300, third $876.

University of Manitoba, Winnipeg, Manitoba R3T 2N2

STATISTICS			Faculty 13; Published 12			Master's by dept.	5
L. K. Chan, Head		Graduate Students: full-time 17; full-time first year 10; part-time 0					
Marking and Demonstration (20)	Varies	8	1100		Varies	Ph. D. (81/84) S 3. Total: 3	

University of Toronto, Toronto, Ontario M5S 1A1

COMPUTER SCIENCE			Applications due: 2/1/85			Bachelor's by inst.	8000
Allan B. Borodin, Chairman			Faculty 32; Published 9			Master's by dept.	23
		Graduate Students: full-time 111; full-time first year 42; part-time 40					
Connaught Fellowship (3)	8500	12	Waived			Ph. D. (81/84) CS 21. Total: 21	
Teaching Assistantship (90)	906.66–1013.58	4	*	4	Tutoring, grading		
Research Assistantship (30)	9360–10560	12	*				
NSERC Scholarship (35)	11600–17500	12	*				
Ontario Graduate Scholarship (4)	6915	12	*				
University Open Fellowship (19)	6600	12	*				

*Canadian: $1352; Visa students: $6225.

University of Windsor, Windsor, Ontario N9B 3P4

MATHEMATICS			Faculty 22; Published 19			Bachelor's by inst.	2283
D. J. Britten, Chairman		Graduate Students: full-time 14; full-time first year 4; part-time 2				Bachelor's by dept.	21
						Master's by dept.	6
Teaching Assistantship (15)	2500–5600	9		40		Ph. D. (81/84) S 3, AM 2.	
Research Assistantship (5)	10560	12			Research	Total: 5	
Scholarship (5)	3000	12					

Errata

The number of faculty members who published a technical paper or book in the last three years by the UNIVERSITY OF GEORGIA, Department of Mathematics, should have been 26 not 14.

The number of Ph.D.'s granted in the last three years at INDIANA UNIVERSITY, BLOOMINGTON, Department of Mathematics, should have been ANT 2, AFA 11, GT 1, P 1, S 4, AM 2, Other 1. Total: 22.

Critical, Historical, or Expository Theses

Supplementary List

The list below supplements the list published on page 915 of the December 1984 *Notices*.

California

Stanford Univ
Statistics — Ph.D.

Massachusetts

Boston Univ
Mathematics — Ph.D.

New York

Adelphi Univ
Mathematics and Computer Science — D.A.

North Carolina

Univ of North Carolina, Chapel Hill
Biostatistics — Ph.D., D.P.H.

Tennessee

Memphis State Univ
Mathematical Sciences — Ph.D.

Texas

Southern Methodist Univ
Statistics — Ph.D.

Univ of Texas, Arlington
Mathematics — Ph.D.

Canada

Univ of British Columbia
Computer Science — Ph.D.

Univ of Manitoba
Statistics — Ph.D.

Univ of Toronto
Computer Science — Ph.D.

Recent Appointments

Committee members' terms of office on standing committees expire on January 31 of the year given in parentheses following their names, unless otherwise specified.

Harold J. Stolberg (1987) has been reappointed to the *Committee on Opportunities in Mathematics for Disadvantaged Groups* by President Irving Kaplansky. Other members of the committee are Manuel P. Berriozabal (1985), William G. Chinn (1987), Amassa C. Fauntleroy (1987), Tepper L. Gill (1987) and Gloria F. Gilmer, chairman (1985).

R. H. Bing, Richard K. Lahsof and Shing-Tung Yau have been appointed by President Irving Kaplansky to the *Committee to Select the Winner of the Veblen Prize.* Professor Yau will serve as chairman.

Reports of Past Meetings

The November Meeting in San Diego

The eight hundred and fifteenth meeting of the American Mathematical Society was held at San Diego State University in San Diego, California on Friday and Saturday, November 9-10, 1984. The meeting was held in conjunction with a meeting of the Southern California Section of the Mathematical Association of America. There were 262 registrants of which 190 were members of the Society. F. David Lesley served as the local organizer for the Meeting.

Invited Addresses. By invitation of the Committee to Select Hour Speakers for Far Western Sectional Meetings, there were two invited one-hour addresses.

DRAGAN MILICIC of the University of Utah spoke on *Representation theory and D-modules.* He was introduced by J. L. Taylor.

JOHN GUCKENHEIMER of the University of California, Santa Cruz, spoke on *Beyond the transition to chaos.* He was introduced by J. W. Helton.

Special Sessions. By invitation of the same committee, there were five special sessions of selected papers. The topics of these special sessions, the names of the organizers and the lists of speakers are as follows:

Classical harmonic analysis, SUN-YUNG ALICE CHANG, University of California, Los Angeles. The speakers were William Beckner, Michael Christ, G. David, John Garnett, Henry Helson, J. William Helton, Steven M. Hudson, Carlos E. Kenig, Ivo Klemes, Kai-Ching Lin, Donald E. Marshall, Alan MacIntosh, Kent G. Merryfield, Margaret Murray, Stephen W. Semmes, Brent Smith, Fernando Soria, Gregory Verchota and Thomas Wolff.

Graph theory and applications, J. D. ELWIN, San Diego State University. The speakers were Edward A. Bender, John Donald, John Elwin, Richard Hager, Paul Kaschube, Aram K. Kevorkian, Daniel Marcus, Henryk Minc, Hugo S. H. Sun and S. Gill Wiliamson.

Representations of semi-simple Lie groups, TOM ENRIGHT, University of California at San Diego, La Jolla, and JOSEPH WOLF, University of California, Berkeley. The speakers were Jeffrey Adams, Susan Addington, William H. Barker, Brian D. Boe, Devra Garfinkle, Henryk Hecht, Rebecca A. Herb, John J. Millson, Robert A. Proctor, Jonathan Rosenberg, Hugo Rossi, Brad Shelton, P. C. Trombi, V. S. Varadarajan and Roger Zierau.

Complex analysis in honor of Stefan Warschawski, CARL H. FITZGERALD, University of California at San Diego, La Jolla, and F. DAVID LESLEY, San Diego State University. The speakers were Albert Baernstein II, David A. Brannan, Louis deBranges, Peter Duren, S. D. Fisher, Carl H. FitzGerald, D. Hamilton, Walter Hengartner, David A. Herron, Roger A. Horn, James A. Jemkins, Jacob Korevaar, F. David Lesley, Willwm A Luxemburg, Albert Marden, C. David Minda, Kotaro Oikawa, Bruce O'Neill, Bruce Palka, Edgar Reich, Burton Rodin, Glenn Schober, Evelyn Silvia, Nobuyuki Suita and A. M. Trembinska.

Differential geometry and mathematical physics, PETER SALAMON, San Diego State University. The speakers were Bjarne Andresen, Robert J. Blattner, Frederic Brulois, R. Peter DeLong, K. L. Duggal, Michael Freedman, Robert Hermann, Ed Ihrig, Bernard Marcus, James Nulton, George Ruppeiner, Peter Salamon, Stanislaw Sieniutycz, Franklin E. Schroek, Jr., James Serrin and A. Swimmer.

Contributed Papers. There were two sessions of contributed ten-minute papers of ten and five speakers each. They were chaired by Saul Drobnies and Betty Garrison respectively.

MAA Program. The MAA program included two hour addresses as follows: one by Everett Bull of Pomona College titled *Why don't you get a bigger computer?,* and another by Fred Dashiell of the Inference Corporation titled *Symbolic mathematics by computer: New opportunities for the mathematician.* There was also a Saturday afternoon luncheon sponsored by the MAA. The luncheon speaker was Michael Golomb of Purdue University, West Lafayette, who delivered an address titled, *Reminiscences of an immigrant mathematician.*

Hugo Rossi
Salt Lake City, Utah — Associate Secretary

The Council Meeting in Anaheim

The Council met on 8 January 1985 at 2:00 P.M. in California Room E of the Anaheim Convention Center. President Irving Kaplansky was in the chair.

The Council was informed of the results of the election of 1984. See the report in this of the *Notices*.

The Council changed the name of the *Committee on Summer Institutes* to the *Committee on Summer Institutes and Special Symposia*. The charge to the Committee is correspondingly enlarged.

The Council approved the trial of an occasional regional meeting principally devoted to a single broad topic, for example algebra or geometry. That is, all of the invited addresses and special sessions would be in the same field. The limitation would not affect contributed papers.

The Council recommended an amendment to the bylaws that reduces the size of the Council by almost half.

The terms of appointed committees have been changed so that in general they will begin on February 1 instead of January 1. An effect is that a committee that meets at the time of the January meeting will be in the hands of the old chairman rather than a new one. Another effect is that newly appointed members will attend for indoctrination rather than as members.

The Committee on Human Rights had several items to report. One is that the Morrocan mathematician Sion Assidon has been released from prison and reunited with his family. It is thought that inquiries and protests by this Society and others were a contributing factor.

Another concern is the recent arrest of three Chilean mathematicians, Ada Cam, Manuel Alarcon, and Douglas Fuentesca of the mathematics department of the University of Antofagasta. Initial inquiries about the reasons for their arrest and their whereabouts received the answer that nothing was known. The Committee on Human Rights and President Kaplansky sent cables of inquiry and there were similar communications from the National Academy and from other mathematical societies. Thus two of the three have been released and the third is in a detention center for three months. It is thought that the demonstration of concern was an important factor in the release.

The Council adjourned at 5:40 P.M.

The Business Meeting in Anaheim

The Business Meeting was held in the [room] of the Anaheim Convention Center on 10 January 1985 about 4:30 P.M., following the award of the Cole Prize. President Kaplansky was in the chair.

The Secretary reported on some actions of the Council of 8 January, as detailed above.

It was noted that the Summer Meeting of 1987, jointly with the Mathematical Association of America, was approved. The succession of summer activity then consists of the joint meeting of 1985 in Laramie, the ICM 86 in Berkeley displacing the Summer Meeting, the joint meeting of 1987 at a place to be designated, and the Centennial of the Society in 1988. The continuation of joint summer meetings in 1989 and beyond is still under study.

The Council has been concerned with the apparent anti-Semitic stance of the journal *Matematicheskiĭ Sbornik*, which the Society publishes in translation as part of a contract to translate a set of Russian journals. As an expression of their concern, the Council proposed some time ago that a loose sheet be inserted in each copy or wrapper with the following wording:

> The American Mathematical Society has been cognizant of the Mathematical distinction of the journal *Matematicheskiĭ Sbornik*. For this reason and as a service to the mathematical community, it was happy to enter into a contract with VAAP (All-Union Agency for Authors' Rights) to translate the journal and publish the translation. At the same time, the Society wishes to record the fact that it deplores the anti-Semitic bias that has appeared to become part of the editorial policy of the journal. The American Mathematical Society hopes that this aspect of policy in the management of the journal will change.

The Trustees approved and the mailing began with the January 1985 issue.

The Secretary noted that extended reports from the Treasurer, the Secretary, and the Executive Director are to appear in this issue of the *Notices*.

The President reported on distinguished mathematical accomplishments of the past year.

Three amendments to the bylaws, recommended by the Council, were passed. The first changes the name *Mathematical Surveys* to *Mathematical Surveys and Monographs*. This corresponds to a modest redirection of the nature of the series. The change occurs in two places in the bylaws, to wit, in the name of the publication committee in Article III, Section 2, and in the name of the publication in Article IX, Section 1.

The second amendment concerns the Executive Committee, which consists of four members elected from the Council by the Council and three members ex officiis. The term of office is prescribed in Article VII, Section 1 where it is stated that "[t]he term of office for elected members of the executive committee shall be two years, two of the elected members retiring annually." The amendment changes the term to four years, with one elected member retiring annually.

The third amendment is concerned with corporate membership. It alters Article IX on Dues and Privileges of Membership by deleting Section 5 (which sets the dues of corporate members), deleting words from Section 6 as noted in square brackets and relabeling Section 5, and supplying a new Section 6. Thus Sections 5 and 6 are to be as follows.

> Section 5. The privileges of [a corporate or] an institutional member shall depend on its dues

in a manner to be determined by the Council, subject to approval by the Board of Trustees. These privileges shall be in terms of Society publications to be received by the institution and of the number of persons it may nominate for ordinary membership in the Society.

Section 6. Dues and privileges of corporate members of the Society shall be established by the Council subject to approval by the Board of Trustees.

It should be noted that the Council recommended dues of $2000 for corporate members ($3000 for those who choose certain privileges with respect to copyright). The Council further recommended that corporate members be entitled to send up to five representatives to meetings with registration at members' rates and to use the Employment Register and *Employment Information in the Mathematical Sciences* (with a ceiling on the number of ads) without charge. The Trustees approved these dues and privileges.

At the close of the meeting, the President thanked the members of the Committee on Arrangements.

The meeting adjourned at 5:40 P.M.

Everett Pitcher
Bethlehem, Pennsylvania — Secretary

Election Results of 1984

The newly elected Vice-President of the Society is Linda Preiss Rothschild. The newly elected Members-at-Large of the Council are A. T. Bharucha-Reid, Daniel M. Burns, Joseph B. Keller, Audrey A. Terras, and David A. Vogan, Jr.

Ramesh A. Gangolli was elected to the position of Trustee. All candidates in noncontested elections were elected to their respective offices.

The candidates elected to the Nominating Committee of 1985-1986 are Vera S. Pless, Mary Ellen Rudin, Michael Shub, and Raymond O. Wells, Jr. The composition of the Council for 1985 follows.

COUNCIL FOR 1985

President:	Irving Kaplansky
Ex-President:	Julia B. Robinson
Vice-Presidents:	Linda Preiss Rothschild
	Jacob T. Schwartz
	Stephen Smale
Secretary:	Everett Pitcher
Associate Secretaries:	Frank T. Birtel
	W. Wistar Comfort
	Robert M. Fossum
	Hugo Rossi
Treasurer:	Franklin P. Peterson
Associate Treasurer:	Steve Armentrout

MEMBERS-AT-LARGE

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U. S. LAWS PROHIBIT discrimination in employment on the basis of color, age, sex, race, religion or national origin. "Positions Available" advertisements from institutions outside the U. S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U. S. laws. Details and specific wording may be found following the Classified Advertisements in the January and August issues of the *Notices*.

SITUATIONS WANTED ADVERTISEMENTS from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-556-7774 and speak to Wahlene Siconio for further information.

SEND AD AND CHECK TO: Advertising Department, AMS, P. O. Box 6248, Providence, Rhode Island 02940. Individuals are requested to pay in advance, institutions are not required to do so.

POSITIONS AVAILABLE

PURDUE UNIVERSITY CALUMET
Hammond, Indiana
Department of Mathematical Sciences

Applications are invited for a tenure-track position in mathematical sciences starting August 1985. Candidates must have a Ph.D. in Mathematics, Statistics, or Computer Science. Salary is competitive and there are excellent fringe benefits, including full TIAA/CREF contributions and paid sabbatical leaves.

The Department of Mathematical Sciences at Purdue Calumet has programs leading to the Bachelor of Science and Master of Science degrees. The Department currently has twenty full-time faculty members.

Members of the staff teach the full-range of undergraduate courses as well as specialized graduate courses.

Candidates should have an interest in teaching and research.

Hammond is located in northwest Indiana and is a thirty minute drive from the Chicago Loop.

Applicants are asked to submit résumés and obtain at least three letters of recommendation.

Please address correspondence to: Head, Department of Mathematical Sciences, Purdue University Calumet, Hammond, Indiana 46323 – An Affirmative Action/Equal Opportunity Employer.

ARIZONA STATE UNIVERSITY
Department of Mathematics

Applications are invited for anticipated positions at ranks of Assistant and Associate Professor. There is a possibility of appointments at Professor rank. Visiting positions are also expected. Send vita and direct three letters of recommendation to J. Bustoz, Chair, Department of Mathematics, Arizona State University, Tempe, AZ 85287. A.S.U. is an equal opportunity employer.

WILKES COLLEGE
Faculty Position

The Department of Mathematics and Computer Science invites applications for a tenure-track position beginning fall, 1985. Ph.D. or ABD in computer science or a Ph.D. in mathematics and substantial training in computer science is required. Wilkes College has 1800 undergraduates; the department has 13 faculty members and 175 majors. Send résumé and three letters of recommendation to Richard E. Sours, Chairman, Department of Mathematics and Computer Science, Wilkes College, Wilkes-Barre, PA 18766.

UNIVERSITY OF CALIFORNIA, LOS ANGELES
DEPARTMENT OF MATHEMATICS

Subject to administrative approval, a few adjunct assistant professorships; two year appointment only; strong research and teaching background; no restriction as to field. Salary $26,600 for academic year. Teaching load: Five quarter courses per year. To apply, write to Yiannis N. Moschovakis, Chair, Los Angeles, CA 90024.

UCLA is an equal opportunity affirmative action employer.

COMPUTER SCIENCE AT PROVIDENCE COLLEGE

The Department of Mathematics and Computer Science at Providence College invites applications for two positions in Computer Science. These positions become available in September 1985. Applicants should possess the Ph.D. or its equivalent in Computer Science. Candidates with a M. S. in Computer Science will also be considered for non-tenure track appointments. Providence College is a four year, coeducation, very selective liberal arts college conducted under the auspices of the Dominican Fathers. It enrolls 3500 students of which approximately 200 are mathematical science majors.

The duties of this position include 9–12 hours of teaching in Computer Science, the pursuit of research interests and participation in the growth of our rapidly expanding department. Salary and rank are commensurate with qualifications. Applications will be considered until the position is filled. Please send vita, transcripts and the names of three references to:

Search Committee
Department of Mathematics/Computer Science
Providence College
Providence, Rhode Island 02918

Providence College is an equal opportunity affirmation action employer.

SOUTHWEST TEXAS STATE UNIV., DEPT. OF MATH/CS, SAN MARCOS, TX 78666. One or more assist. or assoc. professorships expected for fall 1985. Possibility of tenure-track appointments. Ph.D. (or equiv.) and potential for excellence in research and teaching required. Prefer those in math. ed., applied math., computer science, diff. eq. (o.d.e. or p.d.e.), dynamical systems, number theory and topology. Contact Chairman, Southwest Texas State University, San Marcos, TX 78666. Application deadline: 2/1/85, late applications considered if openings exist. SWTSU is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

NEW MEXICO STATE UNIVERSITY

Visiting position(s) and possible tenure-track position(s) in mathematics, numerical analysis, statistics or computer vision. Start August 26, 1985. Salary for 1985–86 academic year: $21,000 or higher and dependent upon rank, qualifications and experience. Ph.D. (or equivalent) and strong commitment to teaching and research essential. Applications are kept on file through hiring period and positions filled as openings occur. Send vita and arrange for three reference letters to be sent to Carol L. Walker, Head, Department of Mathematical Sciences, New Mexico State University, Las Cruces, NM 88003. An Equal Opportunity/Affirmative Action Employer.

MEMORIAL UNIVERSITY OF NEWFOUNDLAND
DEPARTMENT OF MATHEMATICS & STATISTICS

Applications are invited for two tenure-track statisticians, either at Assistant Professor or Associate Professor levels for September 1985, subject to budgetary constraints. For an Associate Professor position, substantial achievement in research, teaching and consulting in statistics is required. For an Assistant Professor position, applicants should have a Ph.D. in statistics and demonstrated ability in research and teaching. In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Those interested should submit a curriculum vitae and references to:

Dr. J. H. Burry,
Head
Department of Mathematics and Statistics
Memorial University of Newfoundland
St. John's, Newfoundland
Canada
A1C 5S7

VISITING LECTURER POSITION

Pending final budgetary approval, Visiting Lecturer with annual contract renewable for 3 years, to teach large beginning statistics courses and train graduate student teaching assistants. We are looking for an outstanding individual, with a demonstrated commitment to intellectual quality in teaching. Experience required. Salary negotiable in the range $27,468 to $39,000, depending on qualifications. There is some possibility of conversion to a permanent position. Inquiries to Rudy Beran, Chairman, Personnel, Department of Statistics, University of California 94720, by May 15, 1985. The University of California is an Equal Opportunity, Affirmative Action Employer.

UNIVERSITY OF NATAL

Department of Mathematics and Applied Mathematics

DURBAN
SOUTH AFRICA

Applications are invited from suitably qualified persons regardless of sex, religion, race, color or national origin for appointment to the post of

LECTURER

The appointment carries an attractive salary package, details of which are obtainable from the Staffing Section on request (telephone 8163308). The salary offered will be determined according to the qualifications and/or experience of the successful applicant.

Application forms, further particulars of the post and information on pension, medical aid, group insurance, service bonus of 93% of one month's salary, staff bursary, housing loan and subsidy schemes, long leave conditions and travelling expenses on first appointment are obtainable from the Registrar, University of Natal, King George V Avenue, Durban, 4001, with whom applications, on the prescribed form, must be lodged not later than 30 April 1985 quoting the reference D120/84.

KEAN COLLEGE OF NEW JERSEY
UNION, NEW JERSEY

Dean of Natural Sciences, Nursing and Mathematics

SEARCH EXTENDED

Kean College of New Jersey is seeking candidates for the position of Dean of Natural Sciences, Nursing and Mathematics. The Dean reports to the Vice President of Academic Affairs and is responsible for the development and administration of plans to meet the needs of students served by the School of Natural Sciences, Nursing and Mathematics and for the fostering of excellence in programs, instruction, and research.

Kean College of New Jersey is a multi-purpose State College with graduate and undergraduate programs and an enrollment of approximately 13,000 students. It is located on a 150 acre campus in Union Township and Hillside.

The Dean is a member of the Council of Deans and working within the context of shared governance, participates in the formulation, evaluation, and administration of College policies and procedures.

Candidates must hold the minimum of a Ph.D. in an academic discipline related to the School of Natural Sciences, Nursing and Mathematics or other appropriate area. Educational administrative experience at a policy level in a public four year college or university and a commitment to participative management are highly desired. A minimum of five years' college teaching experience is required.

Salary range: $40,282–$54,373. Comparable fringe benefits. Salary is negotiable based on qualifications, experience and previous salary. Position is available July 1, 1985.

Applicants should submit resumes and statements describing their qualifications, and a written statement indicating their administrative philosophy and views on major issues in higher education. They should also have three letters of reference and graduate transcripts sent to:

Dr. A. Bryan Lees, Chairperson
Search Committee for the Dean of Natural Sciences, Nursing and Mathematics
Room T–130
Kean College of New Jersey
Union, New Jersey 07083

All materials must be received by March 22, 1985.

Minority and Women Candidates Encouraged to Apply.

An Equal Opportunity/Affirmative Action Employer

ROCHESTER INSTITUTE OF TECHNOLOGY

Department of Mathematics
Rochester, NY 14623

At least one asst/assoc prof., tenure-track position anticipated for Sept., 1985. Ph.D. in math or statistics preferred, MS with extensive applied experience considered. Preferred specialties: Applied prob/stat, or, computational math, graph theory, discrete math. Applicant must have primary interest in teaching undergrad math, as well as doing some research or consulting. Salary: Competitive, negotiable. Contact: Prof. James Glasenapp, Chairman, Faculty Recruiting Committee. RIT is affirmative action/equal opportunity employer.

UNIVERSITY OF MANCHESTER INSTITUTE OF SCIENCE AND TECHNOLOGY

CHAIR IN PURE MATHEMATICS

Applications are invited from suitably qualified persons for a new Chair in Pure Mathematics tenable in the Department of Mathematics from 1 October 1985 or as soon as possible thereafter. Candidates should have research interests in algebra or a related field such as algebraic number theory or algebraic geometry. Requests for application forms and further particulars, quoting reference MAT/23, should be sent to the Registrar, Room B9, UMIST, PO Box 88, Manchester M60 1QD, United Kingdom, to whom completed application forms should be returned by 14 April 1985.

POSITIONS AVAILABLE

Applied Mathematics
Washington State University

The Department of Pure and Applied Mathematics expects an opening for a tenure-track position starting August 1985. Applicants should have active research interests in OPERATIONS RESEARCH, preferably with emphasis on discrete or stochastic optimization. An additional position may occur; applicants with active research interests in NUMERICAL ANALYSIS and/or COMPUTATIONAL STATISTICS are invited to apply. The position(s) requires a Ph.D. with competence in teaching relevant graduate and undergraduate courses and the capability of supervising doctoral dissertations. While appointments are planned at the Assistant Professor level, more senior applicants are encouraged to apply. The University is an equal opportunity/affirmative action employer. Applications from members of minority groups, women, and handicapped persons are encouraged. Vitae and three (3) letters of reference should be sent by March 15, 1985, to:

Professor John R. Cannon
Chairman, Search Committee
Department of Pure and Applied Mathematics
Washington State University
Pullman, Washington 99164-2930

MATHEMATICS OVERSEAS: The Department of Mathematics at the American University of Beirut (AUB) invites applications for tenure-track faculty positions, available October 1, 1985 in the following fields: Preference for Statistics, Analysis and Topology, but other specialties will also be considered. Applicants should hold the Ph.D. degree and appointments are normally made for a three-year period in the rank of Assistant Professor. The Department has a faculty of 13 lines, an undergraduate B.A./B.S. program and an M.A./M.S. graduate program with thesis. Interested persons may send their curriculum vitae and inquiries to Chairman, Department of Mathematics, American University of Beirut, Beirut, Lebanon, with copy to Personnel Services, AUB, 850 Third Avenue, New York, NY 10022. AUB is an equal opportunity, affirmative action employer.

UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE
DEPARTMENT OF MATHEMATICS
CHARLOTTE, N. C. 28223

Assistant/Associate Professor (tenure track, rank depends on qualifications and experience). Ph.D. in mathematics, statistics, or operations research required. Preferred areas: applied probability/stochastic modeling/optimization, numerical analysis, differential geometry/dynamical systems, classical analysis. Exceptional candidates regardless of field will also receive serious consideration. To apply, send a résumé and transcripts to Faculty Selection Committee, Department of Mathematics, University of North Carolina at Charlotte, Charlotte, N.C. 28223; and arrange to have four letters of recommendations addressed to Prof. B. Weinstock, Chairman, sent to same address. UNCC IS AN EQUAL OPPORTUNITY EMPLOYER.

PRINCETON UNIVERSITY
FACULTY POSITIONS IN MATHEMATICS
AND MATHEMATICAL PHYSICS

Applications are invited from persons with an established record of research accomplishment in algebraic number theory, complex analysis, topology, or mathematical physics, for senior faculty positions in the mathematics department, or, for mathematical physics, jointly in the mathematics and physics departments. Inquiries, accompanied by vitae and publication record, should be addressed promptly to Wu-chung Hsiang, Chairman, Department of Mathematics, Fine Hall, Washington Road, Princeton, NJ 08544. Princeton University is an equal opportunity, affirmative action employer.

MACALESTER COLLEGE

The Department of Mathematics and Computer Science is inviting applications for a full-time position, beginning September 1985. Applicants should have a degree (preferably Ph.D.) in mathematics or computer science. Initial appointment is for one year, position may become tenure track. Salary is competitive. Applications, including resume and three references, should be addressed to John Schue, Chair, Department of Mathematics and Computer Science, St. Paul, MN, 55105, prior to March 15, 1985. Phone (612) 696-6335. Macalester is an affirmative action, equal opportunity employer.

UNIVERSITY OF SOUTHERN CALIFORNIA
DEPARTMENT OF MATHEMATICS
LOS ANGELES, CA 90089-1113

Applications are invited for several tenure track Assistant Professorships, available for September 1985, and for some senior level positions at the ranks of Professor and Associate Professor. Recent Ph.D.'s are expected to teach two courses per semester, and must show strong research promise. Applicants for senior level positions should have an outstanding record of research and scholastic achievements. Persons specializing in Statistics, Partial Differential Equations, Combinatorial Analysis and areas of Applied Mathematics such as Numerical Analysis are especially encouraged to apply. Applications should be addressed to Chairman, Search Committee, University of Southern California, Department of Mathematics, DRB 306, Los Angeles, California 90089-1113.

DEPARTMENT OF MATHEMATICS
COLLEGE OF CHARLESTON

Applications are invited for three tenure-track positions at the junior or senior level available Fall, 1985. Candidates must have a Ph.D. in one of the mathematical sciences, a commitment to undergraduate teaching, and potential for continuing research. The normal teaching load is 12 hrs/wk with course reductions for those engaged in research. The minimum salary is $25,000. Internal grants for release time or financial support for research projects are available as is travel support. Applicants should send a vita and have three letters of recommendation sent to William L. Golightly, Chairman, Department of Mathematics, College of Charleston, Charleston, SC 29424. The College of Charleston is an Affirmative Action/Equal Opportunity Employer.

HENDRIX COLLEGE

Department of Mathematics, Robert Eslinger, Chairman, Conway, Arkansas 72032

Assistant Professor, tenure track position anticipated beginning September 1985, to teach introductory through advanced undergraduate mathematics, contribute to an established undergraduate research program, and share responsibility for curriculum development especially in applied mathematics and statistics. Ph.D in math or applied math, demonstrated teaching excellence and promise for continuted professional growth essential. Evaluations of applicants will begin April 1. Send cover letter, vita, 3 letters of recommendation and transcripts for consideration. Hendrix College is an equal opportunity employer.

SOUTHWEST TEXAS STATE UNIV., DEPT. OF MATH/CS, SAN MARCOS, TX 78666. One or more non-tenure track instructorships expected for fall 1985. Master's degree in mathematics or computer science and potential for excellence in teaching required. Contact Chairman, Department of Mathematics and Computer Science, Southwest Texas State University, San Marcos, TX 78666. Application deadline: 2/1/85. Late applications considered if openings exist. Southwest Texas State University is an equal opportunity/affirmative action employer.

POSITIONS AVAILABLE

UNIVERSITY OF ARIZONA
DEPARTMENT HEAD SEARCH REOPENED

The Department of Mathematics at the University of Arizona is seeking a permanent Department Head.

The Department of Mathematics offers degree program in Mathematics, from the B. A. through the Ph.D., supports an interdisciplinary Ph.D. Program in Applied Mathematics, and provides service courses for a large undergraduate student body. Department members are involved in numerous research projects. In the last two years, faculty members have received a Sloan Fellowship, a Guggenheim Fellowship, an NSF Post-Doctoral Fellowship, a Presidential Young Investigators Award, and over a dozen research grants. Two NSF Postdoctoral Fellows are currently serving their fellowship tenure at Arizona.

The Head will be asked, first of all, to lead the Department as it continues to develop national prominence in a variety of research areas. The Head will also be involved in the implementation of new undergraduate programs and in the coordination of these programs with other Departments.

Inquiries and applications should be sent to: Head Search Committee, Department of Mathematics, University of Arizona, Tucson, AZ 85721.

Applications should contain a curriculum vita and the names of at least three references who can evaluate the candidate's background in research and administration. Applications should be received before April 1, 1985 to be guaranteed consideration.

The University of Arizona is an Affirmative Action/Equal Opportunity employer.

CHAIRPERSON
DEPARTMENT OF MATHEMATICS
WEST VIRGINIA UNIVERSITY

Applications and nominations are invited for the position of Chairperson of the Department of Mathematics at West Virginia University. The Chair is the chief administrative officer of the department. The search is for a person who has a strong research record, a commitment to excellence in instruction, and the ability to provide scientific and administrative leadership of the 35-member department, which offers B.S. and M.S. degrees.

West Virginia University is the state's sole comprehensive, land-grant, doctoral institution with an enrollment of 20,000 students. The Department of Mathematics is part of the College of Arts and Sciences.

A complete application consists of a vita and the names and addresses of at least four references. Applications will be received until the position is filled but should arrive by February 1, 1985, to insure consideration.

Applications and nominations should be addressed to Dr. Emory Kemp, Chair, Mathematics Department Chair Search Committee, 201 Woodburn Hall, West Virginia University, Morgantown, West Virginia 26506.

West Virginia University is an Affirmative Action/Equal Opportunity Employer.

UNIVERSITY OF BRIDGEPORT
CHAIRPERSON, DEPARTMENT OF MATHEMATICS

Tenure-track appointment beginning Fall 1985. Candidates must have a Ph.D. in Mathematics/Mathematical Sciences. Applicants should have evidence of leadership ability and excellence in teaching. Research interests in Applied Mathematics/Statistics preferred, but outstanding candidates in any field will be considered. Some expertise in Computer Science is desirable. The Department offers degree programs in Mathematics and Computer Science, and graduate programs are under development. Send résumé and names of four references to Dr. Grace Ho, Mathematics Department, University of Bridgeport, Bridgeport, CT 06601. UB is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA
RIVERSIDE

Faculty Position in Computer Science

Applications are invited for a tenure-track position in Computer Science beginning with the 1985-86 academic year. Applicants must have a Ph.D. in Computer Science and a demonstrated commitment to teaching and research. Candidates from all areas of specialization in Computer Science will be considered.

Rank and salary are open; candidates for senior rank must have leadership ability and a proven research record.

The Computer Science program at Riverside is housed in the well-established Department of Mathematics, which offers bachelor's, master's, and doctoral degrees in Mathematics as well as the B.S. and M.S. in Computer Science. The Department owns four VAX 11/750s and various microcomputers. General campus facilities include an IBM 4341-2, a PRIME 750, and two VAXs.

To apply, send résumé with names of three references to:

Professor Theodore J. Barth, Chair
Computer Science Search Committee
Department of Mathematics and Computer Science
University of California
Riverside, CA 92521

The University of California is an Equal Opportunity/Affirmative Action Employer.

DEPARTMENT OF MATHEMATICS
UNIVERSITY OF CALIFORNIA
RIVERSIDE, CALIFORNIA

Applications are invited for one or more temporary positions beginning in September 1985. These positions are funded at the Assistant Professor level, but there is some slight flexibility in salary. They are open to applicants from all research areas within mathematics and computer science with significant accomplishments or high potential in both research and teaching. Candidates should send vita and arrange for at least three letters of recommendation to be sent to: Professor J. K. Oddson, Chair, Search Committee, Department of Mathematics, University of California, Riverside, California 92521.

The University of California, is an Equal Opportunity/Affirmative Action Employer.

DEPARTMENT OF MATHEMATICS
AND COMPUTER SCIENCE
CALIFORNIA STATE UNIVERSITY
LOS ANGELES, CALIFORNIA 90032

Assistant or Associate Professor, tenure-track position. Ph.D. in Mathematics or Ph.D. in Computer Science with a background in Mathematics required. Strong computer science background desirable. Starting date: September 1985. Salary: $24200 – $35200 with additional summer employment possibilities. Evaluation of applicants will begin February 1, 1985. Send inquiries to Wayne Bishop, Chair, at the above address.

An Equal Opportunity, Affirmative-Action, Handicapped Title IX Employer.

ST. JOHN'S UNIVERSITY, NEW YORK
STATEN ISLAND CAMPUS

The Division of Mathematics and Science invites applications for a tenure-track position at the assistant professor level beginning September 1985. Ph.D. in mathematics or computer science is required; some experience with computers is desirable. Duties include undergraduate teaching in mathematics and computer science; research potential is expected. Send résumé and three letters of recommendation to: Dr. David Patterson, Chairman of the Division of Mathematics and Science, St. John's University, 300 Howard Ave., New York, N.Y. 10301.

An Equal Opportunity Employer–M/F

POSITIONS AVAILABLE

Mathematics: Plymouth State College, tenure track, Inst./ Asst. Professor position (Sept. 85). Doctorate preferred (doctoral candidate considered) with strong background in statistics or applied mathematics. Responsibilities include teaching 12 hours per semester of undergraduate non-major and major courses, student advising and other college faculty activities. The college is located in a rural, central NH town 125 miles north of Boston. Competitive salary commensurate with background and experience. Deadline: 4/1/85 or extended if necessary. Send vita, graduate transcripts, and three letters of recommendation to: Dr. Wm. J. Roberts, Chm., Search Committee, Dept. of Mathematics, Plymouth State College, Box F, Plymouth, NH 03264.

AA/EOE

Tenure-track positions anticipated. Particularly sought are applicants who can participate in both computer science programs and mathematics programs. Doctorate and strong commitment to teaching and research required. Rank and salary commensurate with qualifications. Send résumé to:

Professor Robert Feinerman, Chairman
Department of Mathematics and Computer Science
Herbert H. Lehman College
The City University of New York
Bronx, New York 10468

AN EQUAL OPPORTUNITY/
AFFIRMATIVE ACTION EMPLOYER

Applications are invited for a mathematician at the Assistant Professor level. The anticipated position is tenure track and will be available in Fall, 1985. While candidates in all fields will be considered, preference will be given to applicants with proficiency in applied mathematics, especially theoretical computer science. The successful candidate will be a recent Ph.D. who demonstrates considerable potential in research as well as teaching. Salary will be commensurate with qualifications.

Applications, including a résumé and at least three letters of recommendation, should be sent to:

Professor L. Raymon
Department of Mathematics
Temple University
Philadelphia, Pa. 19122

To be insured of consideration, applications should be received by March 22, 1985.

Temple University is an Affirmative Action/Equal Opportunity Employer.

University of Wyoming
Department of Mathematics

Tenure-track assistant professorship for Fall 1985. The person in this position will direct the freshman mathematics courses, which include over 60% of the department's enrollments and which heavily impact the overall quality of the University's undergraduate educational function. Roughly two-thirds time will be devoted to instruction and the directorship, with the remaining one-third time devoted to research. Applicants should possess a Ph.D. in mathematics or mathematics education, have excellent credentials in teaching throughout the undergraduate program including remedial instruction, should show evidence of being effective in the department's interface with public education in the State, and should have accomplishments or strong potential in research. Applications should include a detailed résumé, three letters of reference, and any other supporting information. Inquiries and applications should be addressed to

Professor Richard E. Ewing
Chairman, Personnel Committee
Mathematics Department
University of Wyoming
Laramie, Wyoming 82071

University of Wyoming is an equal opportunity employer.

Department of Mathematics
Department of Secondary Education
UNIVERSITY OF ILLINOIS

The Department of Mathematics and the Department of Secondary Education at the University of Illinois at Urbana-Champaign are inviting applications for one or two faculty positions that would involve major liaison responsibilities with the secondary schools in Illinois as well as teaching and scholarly activity.

Position Description and Duties: The individual assigned to this full-time faculty position will hold a joint appointment with the Department of Mathematics (3/4-time) and the Department of Secondary Education (1/4-time). The primary duties for the position are:

1) to assume primary responsibility for the development of articulation and assistance programs in mathematics for secondary schools in Illinois;
2) to teach mathematics education courses;
3) to engage in scholarly activity in mathematics education.

Required Qualifications:

1) Earned doctorate in Mathematics or Mathematics Education or the equivalent.
2) Experience in secondary school teacher training program development and/or secondary school curriculum development in mathematics.
3) Current background and scholarly interest in research in mathematics education.

Desirable Qualifications:

1) Teaching experience at the secondary school level and/or experience with university programs for secondary school teachers and students in mathematics.
2) Experience in curricular research and design in mathematics.
3) Experience in dealing with secondary school systems at the statewide level.

This tenure track position will carry the title of Assistant Professor or Associate Professor of Mathematics Education.

Salary: Negotiable with a $20,000 minimum.

Starting Date: August 26, 1985 or June 10, 1985.

In order to ensure full consideration applications must be received by March 1, 1985. Interviews may be conducted prior to the closing date for applications.

Contact: Professors Anthony Peressini or Kenneth Travers, Search Committee Co-Chairs, Department of Mathematics, 273 Altgeld Hall, University of Illinois, 1409 W. Green St., Urbana, Illinois 61801 (tel. 217-333-6336).

To apply, forward a letter of application and a resume, along with a list of three individuals who can be contacted for letters of recommendation.

The University of Illinois is an Affirmative Action/Equal Opportunity Employer.

University of Wyoming, Computer Science/Mathematics. Visiting Professorships available in fall of 85. Persons with partial sabatical support especially encouraged to apply. Professor Henry Bauer, Computer Science Department, Box 3682, University of Wyoming, Laramie, WY 82071. University of Wyoming is an equal opportunity employer.

UNIVERSITY OF CALIFORNIA, LOS ANGELES
DEPARTMENT OF MATHEMATICS

Three or four E. R. Hedrick Assistant Professors. Applicants must show strong promise in research and must have received the Ph.D. after 1 January 1984 (but may be of any age); no restrictions as to field; salary $30,800. Three year appointment; research supplement of $3,400 first summer. Teaching load: Four quarter courses per year, including one advanced course in candidates field. Deadline for applications is January 15, 1985. To apply, write to Yiannis N. Moschovakis, Chair, Los Angeles, CA 90024.

UCLA is an equal opportunity affirmative action employer.

POSITIONS AVAILABLE

Director
New Master's Program in Computer Science
Boston College

Boston College invites applications and nominations for the position of Director of its new Master's Program in Computer Science.

The Job could be very rewarding. The director will have the opportunity to influence the direction of the curriculum, the composition of the faculty, the directions of the research program and even the structure of the director's position itself. The Administration strongly supports our program and has offered considerable financial support. We expect to have the Director in place by September of 1985 and the first students entering the Program in September of 1986.

Boston College is a congenial and exciting place. It is neither in Boston nor is it a college. It is in the Boston suburb of Newton, with its excellent public schools. It is a university with five professional schools and many doctoral programs. With fourteen thousand students, it is among the most selective universities in the country. It had one of the largest applicant pools of a private university in the US last year and applications are up 30% this year. We have four VAX–11/780's and over two hundred Macintoshes, all fully dedicated to academic use.

Please write to:

Prof. Peter Kugel, Chairman
Computer Science Department
Boston College, Chestnut Hill, MA 02167

An equal opportunity, affirmative action employer.

AUSTIN PEAY STATE UNIVERSITY, DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE, CLARKSVILLE, TENNESSEE 37044. Applications are invited for two tenure track positions for fall 1985 in computer science and in mathematics. All specialties will be considered. Ph.D. or a substantial training beyond M.S. desired. Teaching primarily at undergraduate level. Send letter of application, résumé, transcripts and three letters of recommendation by April 1 to Dr. William Stokes, Chairman. APSU is an Equal Opportunity, Affirmative Action Employer.

NORTHEASTERN UNIVERSITY
Department of Mathematics

Applications are invited for position of Assistant or Associate Professor and one Post-Doctoral Lectureship. A Ph.D. is required, and priority will be given to candidates with strong records of scholarship and excellence in teaching. Particular needs of the department are in Applied Mathematics and Statistics.

All positions start Fall 1985. Please send résumé and three letters of references to: Hiring Committee Chairman, Department of Mathematics, Northeastern University, Boston, MA 02115. Northeastern University is an Equal Opportunity/Affirmative Action Employer.

DEPARTMENT OF MATHEMATICS
UNIVERSITY OF CALIFORNIA
RIVERSIDE, CALIFORNIA

Applications are invited for a faculty position in Mathematics beginning September 1985. This position is unrestricted as to level of appointment and area of specialization. Candidates must have demonstrated research ability and a commitment to excellence in teaching at the undergraduate and graduate levels. Candidates should send a vita and arrange for at least three letters of recommendation to be sent to: Professor James D. Stafney, Chair, Search Committee, Department of Mathematics, University of California, Riverside, California 92521.

The University of California is an Equal Opportunity/Affirmative Action Employer.

UNIVERSITY OF CALIFORNIA, LOS ANGELES
DEPARTMENT OF MATHEMATICS

Subject to administrative approval, a few assistant professorships, with special attention given to candidates in applied mathematics, algebraic number theory/modular forms, several complex variables and topology. Strong research and teaching background required. Sufficiently outstanding candidates in other fields and/or at higher levels will also be considered. Salary $26,600 for academic year. Teaching load: Five quarter courses per year. Also several positions for visitors and lecturers. To apply, write to Yiannis N. Moschovakis, Chair, Los Angeles, CA 90024.

UCLA is an equal opportunity affirmative action employer.

THE UNIVERSITY OF ALABAMA
DEPARTMENT OF MATHEMATICS

The mathematics department has received funding for a new senior position in applied mathematics. We expect to hire at the rank of associate professor. We also anticipate approval of another, similar, position next year. We invite applications from experienced mathematicians in applied mathematics with excellent records in research and teaching. We are looking for someone who will help us develop our research group and our graduate programs in applied mathematics. Applications or inquiries should be sent to: Martyn Dixon, Chairman, Mathematics Search Committee, P.O. Box 1416, University, AL 35486. THE UNIVERSITY IS AN EQUAL OPPORTUNITY/AFFIRMATIVE ACTION EMPLOYER.

HOBART AND WILLIAM SMITH COLLEGES
Department of Mathematics and Computer Science

Applications are invited for two tenure-track positions, beginning September 1985.

Position 1: Assistant or Associate Professor; Ph.D. in Mathematics with strong background (preferably a Master's) in Computer Science required; teach all levels of undergraduate mathematics and computer science and participate in the General Curriculum.

Position 2: Assistant Professor; Ph.D. in Mathematics with some background and strong interest in Computer Science required; teach all levels of undergraduate mathematics and some computer science, and participate in the General Curriculum.

For both positions, candidates should have strong commitment to excellence in teaching and promise of continued scholarly activity. Teaching load two courses per trimester. Salary negotiable and competitive.

Applicants should send detailed résumé, three letters of recommendation (at least one including comments on teaching ability), and undergraduate and graduate transcripts (photocopies) to:

Professor Irving Bentsen, Chairman
Department of Mathematics and Computer Science
Hobart and William Smith Colleges
Geneva, New York 14456

An Equal Opportunity Employer.

UNIVERSITY OF LOWELL, Lowell, Mass. MATHEMATICS. Several tenure-track positions at all levels anticipated for academic year 1985-86. All areas considered but statistics and applied mathematics preferred. Requirements are: Ph.D., strong research credentials, evidence of active interest in quality teaching and U.S. Citizenship or permanent resident status. Rank and salary commensurate with experience. Applicants should send vita, statement of current research activities and three letters of recommendation to: Professor Alan Doerr, Personnel Committee, Department of Mathematics, University of Lowell, Lowell, Mass. 01854. Positions contigent upon funding. The University of Lowell is an equal opportunity/affirmative action, Title IX, 504 employer.

POSITIONS AVAILABLE

UNIVERSITY OF CINCINNATI
Department of Computer Science

Applications are invited for several tenure-track positions in Computer Science beginning September 1, 1985. Candidates should have a Ph.D. in Computer Science or closely related field. Emphasis is on teaching advanced undergraduate courses in the mainstream of computer science and implementing a multidisciplinary graduate program. Joint appointments with other departments are possible. Rank and salary are open. Candidates for a senior endowed position must be capable of leadership in research in theoretical or experimental computer science and curriculum development.

The maximum teaching load is two courses per quarter. Salary is competitive and fringe benefits are excellent.

Résumés should be sent to the Faculty Search Committee for Computer Science, Mail Location 8, University of Cincinnati, Cincinnati, OH 45221. Applications will be considered as received and the positions are open until filled. The University of Cincinnati is an AA/EO employer, and encourages applications from women and minority candidates.

Southern Tech. Inst., 1112 Clay St., Marietta, Ga. MATHEMATICS: Southern Technical Inst. anticipates one or more tenure-track positions beginning Sept. 1985. Ph.D. in Mathematics and a background in technology preferred. M.S. in Mathematics required. Southern Technical Institute offers four-year degree in Engineering Technology and is located in Marietta, Ga. a suburb of Atlanta. Most teaching is in the lower division. Research not required. A complete application consists of an application letter, a complete résumé, three letters of reference, and transcripts of all college work. Applications completed by 21 March 1985 will be considered first. Inquiries and applications should be addressed to Dr. H. R. Andrews, Chrm. Mathematics Search Committee, Southern Technical Institute, Marietta, Ga. 30060.

HARVEY MUDD COLLEGE; DISCRETE MATHEMATICS/COMPUTER SCIENCE: A tenure-track position in the mathematics department is available at the Assistant Professor level. Qualifications include a Ph.D. in mathematics or computer science with a strong emphasis in discrete mathematics and the theoretical aspects of computer science. Responsibilities include teaching, research, curriculum development, and the supervision of industrially-sponsored projects in these areas. Harvey Mudd College, one of the nation's most selective undergraduate colleges, offers degrees in mathematics, engineering, chemistry, and physics. The person appointed to this position will work with mathematicians and computer scientists now on the faculty in the further development of the existing mathematics major option in computer science. The five Claremont Colleges and the Claremont Graduate School [with about forty mathematicians and computer scientists in all] and the site in Southern California provide an attractive professional setting. Reply to: Professor Courtney S. Coleman, Mathematics Department, Harvey Mudd College, Claremont, CA 91711, 714-621-8023. An equal opportunity/affirmative action employer.

SAINT LOUIS UNIVERSITY
Department of Mathematics and Computer Science
St. Louis, MO 63103

Two tenure-track positions are available at the Assistant Professor level to begin fall 1985. The department offers undergraduate majors in Mathematics and Computer Science and a doctorate in Mathematics. Persons holding a Ph.D. in Mathematics or Computer Science who are committed to teaching and research and are willing to participate in the undergraduate Computer Science program are invited to apply. Send a vita and arrange for three letters of recommendation to be sent to Professor Charles Ford at the above address.

An equal opportunity, affirmative action employer.

Department of Mathematics
University of Bristol

Applications are invited for two lectureships, i.e. tenure-track positions, anticipated in nonlinear mathematics or fluid dynamics and mathematical logic or the theory of computation. Applicants should have a good research record and be likely to interact with present members of the Department. Other things being equal, preference will be given to young candidates with rights to work in the United Kingdom. The salary scale is 7,520—14,952 pounds p.a. (to be reviewed) and initial salary will be determined according to qualifications, experience and age. The posts are tenable from October 1985. The selection process may begin at once.

In the first instance, please obtain further particulars from Head, Department of Mathematics, University Walk, Bristol BS8 1TW, England.

UNIVERSITY OF HONG KONG
LECTURESHIP IN MATHEMATICS

Applications are invited for a Lectureship in the Department of Mathematics, tenable from September 1985. Applicants specialising in any main branch of mathematics will be considered.

Annual salary (superannuable) is on an 11-point scale: HK$148,080—247,560 (US$1 = HK$7.80 on 3.1.85). Starting salary will depend on qualifications and experience. At current rates, salaries tax will not exceed 17% of gross income. Housing benefits at a rental of 7½% of salary, children's education allowances, leave and medical benefits are provided.

Further particulars and applications forms may be obtained from the Secretary General, Association of Commonwealth Universities (Appts), 36 Gordon Square, London WC1H 0PF, or from the Appointments Unit, Secretary's office, University of Hong Kong, Hong Kong. Closing date: 15 April 1985.

Mathematics: Tenure-track, assistant professor beginning August 20, 1985. Ph.D. in mathematics preferred, with strong commitment to teaching undergraduates. Application deadline: March 15, 1985. Send letter of application, résumé, and three letters of recommendation to: Director of Personnel, Northwest Missouri State University, Maryville, Missouri 64468. Affirmative Action Equal Opportunity Employer.

CARNEGIE-MELLON UNIVERSITY
Department of Mathematics
Discrete Mathematics Position

The Department of Mathematics at Carnegie-Mellon University has a faculty opening in Discrete Mathematics. Applicants are expected to show exceptional research promise as well as clear evidence of achievement in the fields of Category Theory, Universal Algebra, Fix Point and Algebraic Semantics of Programming Languages, Partial Algebra, Ordered Structures, Category Theoretical version of Abstract Model Theory and Nonstandard Dynamic Logic. The applicant should be able to teach Logic, Logics of Programs and Universal Algebra. Salary will be based on the qualifications of the candidate. Interested candidates should send a résumé, a copy of their transcript, and three reference letters to Professor George J. Fix, Head, Department of Mathematics, Carnegie-Mellon University, Pittsburgh, PA 15213. To ensure consideration, the above materials must be received on or before 1 April 1985. Carnegie-Mellon University is an Affirmative Action/Equal Opportunity Employer.

BROWN UNIVERSITY

Professorship at the Associate level or above, with tenure, beginning July 1, 1986. Salary to be negotiated. Applicants should have outstanding records of research and strong commitment to teaching. Curriculum vitae and 3 letters of recommendation should be received by October 15, 1985. Equal Opportunity/Affirmative Action Employer. Address inquiries to John Wermer, Providence, RI 02912, Executive Officer.

POSITIONS AVAILABLE

Skidmore College
Department of Mathematics and Computer Science
Saratoga Springs, NY 12866-0851

Associate/Assistant Professor of Computer Science to develop curriculum to enhance computer science minor. Candidates should be able to develop and teach data strucutres, database management, graphics and systems design courses. Applicants should possess a Ph.D. in computer science or related discipline.

Assistant Professor of Mathematics to teach undergraduate mathematics courses and introductory computer science courses. Candidates should have a Ph.D. in mathematics with some background in computing.

Skidmore College operates two DEC VAX 11/750's with 40 micro computers to support academic computing. Please send a letter of application, résumé and at least three references by March 21 to Robert P. DeSieno, Chair, Department of Mathematics and Computer Science, Skidmore College, Saratoga Springs, NY, 12866-0851. An affirmative Action/Equal Opportunity Employer.

DEPARTMENT OF MATHEMATICS
KANSAS STATE UNIVERSITY

Applications are invited for several anticipated temporary (9-month) positions at the Assistant Professor level, or above, beginning August, 1985. Salary commensurate with qualifications. Candidates in all fields of mathematics are encouraged to apply. Strong interest in both teaching and research is expected. Ph.D. in mathematics or equivalent required. Starting date: August 15, 1985; Application deadline: April 1, 1985. Contact: R. Richard Summerhill, Department Head, Department of Mathematics, Kansas State University, Manhattan, Kansas 66506. (913)532-6750. KSU is an AA/EOE.

The Department of Mathematics at Brock University seeks a sabbatical replacement, at the Assistant Professor level, for the period September 1, 1985 to June 30, 1986. Candidates should have a Ph.D., and will be expected to teach two undergraduate courses in the area of real and complex analysis and differential equations, and to conduct research. Candidates should send a curriculum vitae and arrange for three letters of reference to be sent to the Chairman, Department of Mathematics, Brock University, St. Catharines, Ontario, L2S 3A1, Canada. In accordance with Canadian Immigration requirements, this advertisement is directed to Canadian citizens and permanent residents. Applications should be submitted no later than April 15, 1985.

INSTITUTE FOR DEFENSE ANALYSES
COMMUNICATIONS RESEARCH DIVISION

Applications are invited from Ph.D. level mathematicians for research positions on our technical staff. Initial appointment would be for one or two years, possibly leading to a permanent position.

Additionally, we also organize each year a summer program (SCAMP) for which places are available. Wide mathematical interests, and the ability to motivate one's own work are more important than knowledge of specific areas of mathematics. Facility in computer programming and some knowledge of statistics would be definite assets.

Salaries will be competitive and commensurate with experience and qualifications.

IDA/CRD is an equal opportunity/affirmative action employer, and encourages applications from women and members of minority groups. Send résumé and publication list to:

Dr. N. J. Patterson
Deputy Director
IDA/CRD
Thanet Road
Princeton, NJ 08540

U.S. citizenship required.

Applications are invited for a senior-level mathematician. The anticipated position is tenure-track and will be available in Fall, 1985. The successful candidate will be one with a distinguished research record who has had significant impact on the development of mathematics in recent years. The department's greatest strengths currently are in the fields of number theory, classical analysis and approximation theory, algebra, and probability and statistics. Temple University is conveniently located in urban Philadelphia, with easy access to the mathematical communities in New York, Princeton, Maryland and Washington, D.C., as well as Philadelphia. Salary will be commensurate with qualifications.

Applications, including a résumé and at least three letters of recommendation, should be sent to:

Professor L. Raymon, Chairman
Department of Mathematics
Temple University
Philadelphia, Pa. 19122

To be insured of consideration, applications should be received by March 15, 1985.

Temple University is an Affirmative Action/Equal Opportunity Employer.

MOORHEAD STATE UNIVERSITY
Moorhead, Minnesota

The Mathematics Department invites applications for a tenure-track position at the Assistant Professor level. The position involves teaching undergraduate mathematics courses, advising students, and university and departmental committee work. The teaching load is 12 hours per quarter. A Ph.D. in mathematics education is required. Some background in statistics, applied mathematics or mathematics education and evidence of successful college teaching experience are desirable. Application materials and a job description can be obtained from Dr. Milton Legg, Chairman, Mathematics Department, Moorhead, State University, Moorhead, Minnesota 56560. An equal opportunity/affirmative action employer.

ASSISTANT PROFESSOR OF MATHEMATICS
ST. MARY'S COLLEGE OF MARYLAND

Applications are invited for a permanent position in mathematics. We are looking for a person with a Ph.D. in mathematics who is interested in undergraduate teaching and able to contribute to the continuing development of a strong mathematics major program.

St. Mary's College is a public liberal arts college with 1300 students, 68 miles south of Washington, D.C. in the Chesapeake region. The mathematics program has five faculty members and approximately 50 majors. Normal teaching load is 12 credit hours (three courses) per semester.

Please submit your application including a résumé and three letters of reference by March 22, 1985 to Richard Stark, Chairman, Mathematics Search Committee, St. Mary's College of Maryland, St. Mary's City, Maryland 20686. EEO/AA Employer.

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

Department of Mathematics, Greensboro, North Carolina 27412. Senior faculty member with initial appointment as Department Head. The Department is responsible for offering general undergraduate instruction in mathematics, computer science, and statistics, and offers the M.A. and M.Ed. in mathematics. Candidates should have an outstanding research record and a commitment to excellence in teaching. The appointment will be at the rank of Professor with tenure. The Head administers the Department, made up of 25 faculty members and over 200 majors, and is responsible for providing leadership in the areas of teaching, research, and service. Salary will be commensurate with experience and qualifications. Applicants should send credentials and three letters of recommendation to Karl Ray Gentry, Chair, D. H. Search Committee. UNC-G is an Equal Opportunity/Affirmative Action Employer.

POSITIONS AVAILABLE

CHAIRPERSON
Department of Mathematics

The University of Southern California invites applications and recommendations for the faculty position of Chairperson of the Department of Mathematics. The department has a faculty of about 40 members, representing many areas in pure and applied mathematics. In addition to the Ph.D. in mathematics, it offers graduate programs in statistics, and in applied mathematics with special options including bio-mathematics and numerical analysis. It also has a large computer assisted learning center for undergraduate and a statistics laboratory. Candidates for the position must have an outstanding record of research and scholarship and must be ready to assume academic leadership and administrative direction of a broadly based university department. If interested, send a vita and names of references to:

Theodore E. Harris, Chair-Search Committee
Department of Mathematics, DRB 306
University Park
Los Angeles, CA 90089-1113

INDIANA STATE UNIVERSITY
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

The Mathematics and Computer Science Department anticipates three tenure-track positions at the Assistant Professor level beginning in September of 1985. The Department has 22 full-time faculty members and offers BA and BS degrees in Mathematics and in Computer Science, and MA and MS degrees in Mathematics. Applicants should possess an earned Ph.D. and potential for teaching and research excellence.

Indiana State University has extensive computing facilities, including a CYBER, an IBM 4361, two PRIME 750's and several microcomputer laboratories. The Department operates its own microcomputer laboratory and a VAX-11/750 with both Bell and Berkeley UNIX available.

Send vita and three letters of recommendation to:

Dr. Donald F. Reynolds, Chairman
Department of Mathematics and Computer Science
Indiana State University
Terre Haute, IN 47809

Applicants should be U.S. citizens or hold a resident visa. Applications received after March 31, 1985 cannot be guaranteed consideration. Indiana State University is an EO/AA employer.

HOLY CROSS COLLEGE
WORCESTER, MASSACHUSETTS
COMPUTER SCIENCE IN THE LIBERAL ARTS MILIEU

Applications are invited for a tenure-track position in a department of mathematics which is developing a concentration in computing. The Ph.D. in computer science or in mathematics with a strong interest and background in computer science is required. Rank and salary are open. Special funds are available to assist the computer scientist in forming research ties with an appropriate private corporation. Three courses per semester is the normal teaching assignment at Holy Cross. However, for at least the first few years, the successful candidate could teach only two courses and serve as a computing resource person for staff in the department or teach three courses. Guidance in developing the concentration will be expected. Facilities include two DEC VAX 11/780's operating under VMS with over 100 terminals available. Application consists of undergraduate and graduate transcripts, résumé, and three letters of recommendation, at least two of which address the candidate's teaching and at least two of which address research.

Holy Cross is a Jesuit, liberal arts college with 2500 students and an affirmative action-equal opportunity employer. Send applications to P. Perkins, Chairman, Department of Mathematics, Holy Cross College, Worcester, MA 01610.

The Department of Mathematics and Statistics invites applications for a tenure-track position at the assistant professor level in discrete mathematics effective September 1, 1985. PhD or equivalent is required. Experience in teaching would be an asset. Duties include pursuing research in the appointee's area of expertise, and teaching three courses at the undergraduate level. Salary is commensurate with rank and experience. A curriculum vitae should be forwarded to Dr. L. M. Batten, Chair, Department of Mathematics and Statistics, University of Winnipeg, 515 Portage Avenue, Winnipeg, Manitoba, Canada R3B 2E9. In addition, three referees should be requested to forward letters directly to the above address. Closing date for applications is March 15, 1985. The position is subject to budgetary constraints. In accordance with Canadian immigration requirements, this advertisement is directed to Canadian citizens and permanent residents.

COMPUTER SCIENCE

Tenure-track faculty position beginning Fall, 1985. Responsibilities – undergraduate teaching (12 semester hours per semester) in a program leading to a B.A. or a B.S. in Computer Science. Required: M.S. in Computer Science. Rank and salary dependent on qualifications and experience. Send résumé, three letters of reference and graduate transcripts prior to March 15, 1985, to Director of Personnel, St. Ambrose College, 518 West Locust Street, Davenport, Iowa 52803.

EQUAL EMPLOYMENT OPPORTUNITY

Send a tear sheet and billing to:

Director of Personnel
St. Ambrose College
518 West Locust Street
Davenport, Iowa 52803.

UNIVERSITY OF WATERLOO

Applications are invited for a tenure-track position at the Assistant or Associate Professor level in the Department of Applied Mathematics, for a term beginning September 1, 1985. The successful candidate must have demonstrated research ability and should have a broad mathematical background. Preference will be given to applicants whose research interests are in the general area of partial differential equations, including both theoretical and applied aspects. However, outstanding applicants in other areas will also be considered. Résumé and three letters of recommendation should be sent to B. Forte, Chairman, Department of Applied Mathematics, University of Waterloo, Waterloo, Ontario, N2L 3G1. Deadline for applications: April 30, 1985 or until position is filled.

RUTGERS, The State University Camden, New Jersey – Anticipated position at the Assistant or Associate Professor level. Candidates must have a Ph.D. in mathematics and a strong commitment to research and teaching. All fields considered. Send a résumé and three letters of recommendation (and for new Ph.D.s, a summary of the thesis and a statement of research plans) to: Howard Jacobowitz, Department of Mathematical Sciences, Rutgers University, Camden, New Jersey 08102.

VISITING LECTURER POSITION

Pending final budgetary approval, Visiting Lecturer with annual contract renewable for three years, to teach large beginning statistics courses and train graduate student teaching assistants. We are looking for an outstanding individual, with a demonstrated commitment to intellectual quality in teaching. Experience required. Salary negotiable in the range $27,468 to $39,000, depending on qualifications. There is some possibility of conversion to a permanent position. Inquiries to Rudy Beran, Chairman, Personnel, Department of Statistics, University of California 94720, by May 15, 1985. The University of California is an Equal Opportunity, Affirmative Action Employer.

POSITIONS AVAILABLE

DEAN
FACULTY OF NATURAL SCIENCES AND MATHEMATICS
STATE UNIVERSITY OF NEW YORK AT BUFFALO

SUNY/Buffalo, the largest most comprehensive unit of the State University system, seeks a Dean for its Faculty of Natural Sciences and Mathematics. The Faculty comprises 269 full-time persons in the departments of Biological Sciences, Chemistry, Computer Science, Geological Sciences, Mathematics, Physics, and Statistics which offer degree programs from baccalaureate through doctoral levels. The Dean will be expected to provide effective academic leadership, stimulate the strengthening and development of research, teaching, and service activities, and be responsible for effective management of personnel and budget resources. Candidates should have demonstrated a commitment to scholarly excellence and qualify for a tenured full professor appointment in one of the above disciplines. Women and minority candidates are encouraged to apply.

Forward nominations and applications by March 15, 1985 to: Dr. Donald W. Rennie, Search Committee Chair, SUNY/Buffalo, 521 Capen Hall, Buffalo, New York 14260.

SUNY/Buffalo is an Equal Opportunity/Affirmative Action Employer.

BELOIT COLLEGE
Department of Mathematics and Computer Science

Applications are invited for a tenure-track position at the assistant professor level, beginning fall 1985. We seek a Ph.D. in mathematics or computer science with a strong interest in undergraduate teaching in a liberal arts environment. Preference to candidates who can teach some computer science courses as well as mathematics. Send letter and résumé to Philip Straffin, Chair, Mathematics and Computer Science, Beloit College, Beloit, Wis. 53511 by March 31. Arrange to have three letters of reference and appropriate transcripts forwarded. Beloit College is an Equal Opportunity, Affirmative Action Employer.

POSITIONS IN COMPUTER SCIENCE
DEPAUL UNIVERSITY
CHICAGO, ILLINOIS

DePaul University invites applications for tenure-track positions in Computer Science at all levels. The starting date is September 1985. Any area of specialization will be considered. An applicant should hold a Ph.D. in Computer Science or be a candidate for such a degree; consideration will also be given to holders of Ph.D. degrees in Mathematics or related fields who express an interest in Computer Science. Duties include a six-hour teaching load and research. Tenure details and salary are negotiable. Benefits include TIAA and standard health insurance. U.S. citizenship is not required.

The Department of Computer Science and Information Systems at DePaul has over 1200 majors which are nearly equally divided between undergraduate and graduate students. Facilities include two VAX 11/780's, a VAX 11/750, an IBM 4341, a PDP 11/60, a PDP 11/44, a PDP 11/23, a Harris 800, ten LSI-11's and numerous microcomputers. Individual faculty offices are equipped with high speed terminals. The Department is in the process of equipping an Artificial Intelligence Laboratory, a Robotics Laboratory and has a Vision Laboratory. There are also two PC laboratories. Faculty interests include artificial intelligence, computer vision, applied statistics, applied graph theory, information systems, compiler design, semantics of programming languages, and computer architecture.

Applications will be received until positions are filled. Send résumé and at least three letters of reference to: Helmut P. Epp, Chairman, Department of Computer Science and Information Systems, DePaul University, 243 S. Wabash, Chicago, IL 60604.

DePaul University is an equal opportunity employer.

Department of Mathematics
John Jay College of Criminal Justice
The City University of New York

Assistant Professor, tenure-track position, 9/1/85. Requirements: Ph.D.; demonstrated potential for research; strong commitment to teaching. Computer science, numerical analysis or operations research background preferred. John Jay College of Criminal Justice, located in Manhattan, is a senior college in CUNY. Send résumé, graduate transcript, relevant reprints, dissertation abstract and three letters of reference to Samuel Graff, Chairperson, Department of Mathematics, John Jay College of Criminal Justice, 445 West 59th Street, N.Y., N.Y. 10019 by May 1, 1985. AA/EOE Employer.

UNIVERSITY OF CALIFORNIA, IRVINE
DEPARTMENT OF MATHEMATICS
IRVINE, CALIFORNIA 92717

Two faculty positions at the level of Assistant Professor in Applied Mathematics, available beginning academic year 1985–86. A Ph.D. degree, publications, and evidence of active interest in quality teaching are required. Examples of preferred research areas: partial differential equations, nonlinear phenomena, applied functional analysis, and numerical analysis. Send applications, a curriculum vitae, and the names of three or more references to Professor Martin Schechter, Department of Mathematics, University of California, Irvine, CA 92717. An Affirmative Action/Equal Opportunity Employer.

ILLINOIS WESLEYAN UNIVERSITY
Chair of Mathematics

Illinois Wesleyan University seeks a Department Head in Mathematics. The department is composed of four full-time faculty and offers BA's both in Mathematics and Mathematics–Computer Science. The department currently has 42 majors and delivers 600 course units per year, the majority to students in the natural sciences and in business; thus, the department seeks to offer a strong program for its majors as well as serve the broader interests of the University. Candidates must have the Ph.D. in Mathematics, and a proven record of teaching and research. Preference will be given to candidates with strong credentials in analysis or some area of applied mathematics. Rank and salary are negotiable. Interested candidates should send a current CV along with names and addresses of three references to: Roger Schnaitter, Director, Division of Natural Science, Illinois Wesleyan University, Bloomington, IL 61701. IWU is an equal opportunity employer.

The College at New Paltz
State University of New York

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Michel Talagrand

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André Joyal and Myles Tierney

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Secondly, they show that the difference between an arbitrary Grothendieck topos and their new notion of space lies in the possibility of action by a *spatial groupoid*. That is, if $G_1 \rightrightarrows G_0$ is a groupoid in the category of (extended) spaces, then the general notion of Grothendieck topos is captured by considering sheaves on G_0 with a *continuous action* by G_1. This is an extension of Grothendieck's interpretation of classical *Galois theory*.

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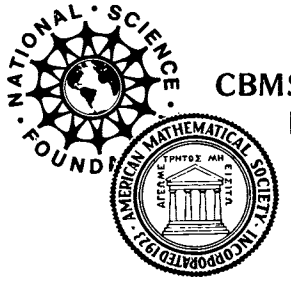

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Orderings, Valuations and Quadratic Forms

Tsit-Yuen Lam

These notes were developed from the ten lectures the author gave at the CBMS Regional Conference held at Carleton College, Northfield, Minnesota in August, 1981. Much new material not covered in the lectures has been added to make this into a full-length book.

The main topics treated in this book are orderings, valuations and quadratic forms. Orderings and valuations are related through the notion of compatibility; valuations and quadratic forms are related through the notion of residue forms, while quadratic forms and orderings are related through the notion of signatures. In the recent literature, this triumvirate of topics and their remarkable relationships and interplay has been the object of an intensive and fruitful study. This book provides an authoritative account of these recent developments, covering, in particular, many results from original research papers published in the last fifteen years.

After a beginning chapter on the reduced theory of quadratic forms, the author lays the foundation for the study of the compatibility notion between orderings (resp. preorderings) and valuations. This is followed by an introduction to the techniques of residue forms and the relevant Springer theory. The author then presents the solution of the Representation Problem due to Becker and Bröcker, with simplifications due to Marshall. The notice of fans plays an all-important role in this approach. The text goes on to treat the theory of real places and the real holomorphy ring, and proves Bröcker's theorem on the trivialization of fans. (The material on the holomorphy ring should be of interest and reference value for workers in commutative algebra.) Two important invariants of a preordering, the chain length and the stability index, are studied in detail. Other topics treated include the notion of semiorderings, its applications to SAP fields and SAP preorderings, and the valuation-theoretic Local-Global Principle for reduced quadratic forms.

The presentation in these notes is largely self-contained, and does not presuppose any advanced knowledge of orderings or quadratic forms. The only prerequisite is perhaps a good working knowledge of general valuation theory, and some familiarity with the basic notions and terminology of quadratic form theory as contained, for instance, in the first two chapters of the author's previous book published by W. A. Benjamin. The present notes may therefore be read either as a sequel to the author's Benjamin book, or as an independent introduction to ordered fields and reduced quadratic forms using valuation-theoretic techniques.

1980 *Mathematics Subject Classifications*: 10C04, 12J10, 12J15; 10C01, 12D15, 12J25.

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[ ]	[ ]	$25	#1 - Geometry for college teachers (Branko Grünbaum, U of Washington)
[ ]	[ ]	$25	#2 - Applied mathematics via classroom experiments (Herbert R. Bailey, Rose-Hulman Institute of Technology)
[ ]	[ ]	$25	#3 - Teaching experiential applied mathematics, (TEAM) (James R. Choike, Oklahoma State U)
[ ]	[ ]	$35	#4 - Computing in undergraduate linear algebra (Eugene A. Herman, Grinnell College)
[ ]	[ ]	$35	#5 - Microcomputer software in mathematics instruction (Roy E. Myers, Pennsylvania State U, Kensington)

Summer List of Applicants

Instructions for Applicant Form on facing page

The form. Forms submitted by job applicants who attend the August meetings in Laramie will be posted. The first impression a prospective employer has of an applicant may be based on the appearance of this form.

The forms should be carefully typed using a fresh black ribbon. The best results are obtained with a carbon-coated polyethylene film ribbon, but satisfactory results may be obtained using a ribbon made of nylon or other woven fabric if suitable care is exercised. It is important that the keys be clean and make a sharp, clear impression. Use a correcting typewriter or correction tape or fluid if necessary. Submit the original typed version only. Hand lettered forms are acceptable if prepared carefully.

The summary strip. Information provided here will be used to prepare a printed list of applicants for distribution to employers. Please supply all information requested, and confine your characters to the boxes provided. Use the codes below. Circled letters identify corresponding items on the form and the strip.

Address forms to the Mathematics Meetings Housing Bureau, P. O. Box 6887, Providence, RI 02940. The deadline for receipt is **June 14, 1985**. See pages 240 and 244 for more information.

Ⓐ Specialties

AL = Algebra	AN = Analysis
BI = Biomathematics	BS = Biostatistics
CB = Combinatorics	CM = Communication
CN = Control	CS = Computer Science
CT = Circuits	DE = Differential Equations
EC = Economics	ED = Mathematical Education
FA = Functional Analysis	FI = Financial Mathematics
FL = Fluid Mechanics	GE = Geometry
HM = History of Math	LO = Logic
MB = Mathematical Biology	ME = Mechanics
MO = Modelling	MP = Mathematical Physics
MS = Management Science	NA = Numerical Analysis
NT = Number Theory	OR = Operations Research
PR = Probability	SA = Systems Analysis
ST = Statistics	TO = Topology

Ⓑ Career Objectives

AR = Academic Research	AT = Academic Teaching
NR = Nonacademic R&D	NC = Nonacad. Consulting
NS = Nonacademic Supervision	

Ⓗ Ⓘ Duties

T = Teaching	U = Undergraduate
G = Graduate	R = Research
C = Consulting	A = Administration
S = Supervision	IND = Industry
GOV = Government	DP = Data Processing

Location

E = East		S = South
C = Central		M = Mountain
W = West	O = Outside U.S.	I = Indifferent

Ⓛ U.S. Citizenship Status

C = U.S. Citizen	P = Permanent Resident
T = Temporarily in U.S.	N = Non-U.S. Citizen

Summer List of Applicants

Mathematical Sciences Employment Register

August 1985 Laramie, Wyoming

(Please see instructions on facing page)

APPLICANT: Name_____

Mailing address (include zip code) _____

_____

Ⓐ Specialties_____

Ⓑ Career objectives and accomplishments

ACADEMIC: ☐ Research, ☐ Teaching

NON-ACADEMIC: ☐ Research and Development, ☐ Consulting, ☐ Supervision

Near-term career goals_____

_____

Significant achievements or projects, including role_____

_____

Honors and offices_____

Other (e.g., paper to be presented at THIS meeting)_____

_____

Selected titles of papers, reports, books, patents_____

_____

Ⓒ Degree Year Institution

____ ____ _____ Ⓓ No. of abstracts, internal reports____

____ ____ _____ Ⓔ No. of papers accepted____

____ ____ _____ Ⓕ No. of books and patents____

EMPLOYMENT HISTORY:

	Present	Previous	Previous
Ⓖ Employer			
Position			
Ⓗ Duties			
Years	____ to ____	____ to ____	____ to ____

DESIRED POSITION:_____

Ⓘ Duties_____

Ⓙ Available mo.____ /yr.____ Location_____ Salary____

Ⓚ References (Name and Institution)

_____

_____

_____

Ⓛ Citizenship _____

Ⓜ **I plan to attend the Summer Meeting** yes ☐ no ☐

Conference on Modern Analysis and Probability (1982, Yale University)

Richard Beals, Anatole Beck, Alexandra Bellow and Arshag Hajian, Editors

The Conference in Modern Analysis and Probability in honor of Professor Shizuo Kakutani was held on June 8–11, 1982, at Yale University on the occasion of his retirement. In these Proceedings the papers that were submitted for this Conference are presented. Initial funding was provided by the National Science Foundation.

The three major areas of mathematics on which the Conference focused were functional analysis, probability theory, and ergodic theory. Most of the articles presented were works by the respective authors on problems that were pioneered by Professor Kakutani in the past. Questions in Brownian motion, induced transformations, representation of M-spaces, and fixed point theorems were discussed.

Contents

1980 *Mathematics Subject Classifications*: 46Bxx, 60Gxx, 28Dxx

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PREREGISTRATION AND HOUSING FORM, LARAMIE, WYOMING

AMS Short Course
August 10-11, 1985

Joint Mathematics Meetings
August 12-15, 1985

MUST BE RECEIVED IN PROVIDENCE NO LATER THAN JUNE 14, 1985
Please complete this form and return it with your payment to
Mathematics Meetings Housing Bureau
P.O. Box 6887, Providence, Rhode Island 02940 - Telephone 401-272-9500, Ext. 239

DEADLINES: Preregistration: June 14, 1985 for preregistration fee(s)
Residence Hall Room Payments: June 14, 1985
Cancellations: Preregistration may be cancelled until August 9 by writing or calling the Mathematics Meetings Housing Bureau; see above. 50% of the preregistration fee(s) will be refunded if notification is received by this date. Confirmed residence hall reservations may be cancelled until July 25 and full payment will be refunded; however, after that date, only partial refunds will be allowed. Full refunds will be made of MAA 25-year Banquet tickets if notification is received prior to July 25; after that date, 50% refund applies.
Changes: Changes in arrival and departure dates must be made with the Mathematics Meetings Housing Bureau by August 9. After that date, please call message center number at Laramie.

NOTE: All dues and meeting registration fees paid to AMS or MAA by professional mathematicians are tax deductible.

	REGISTRATION FEES	
	Preregistration (by mail prior to 6/14)	At Meeting
JOINT MATHEMATICS MEETINGS		
Member of AMS, MAA, IIME	$55	$72
* Student, Unemployed or Emeritus	$14	$18
Nonmember	$84	$109
AMS SHORT COURSE		
Member/Nonmember	$25	$30
* Student or Unemployed	$5	$10

* 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 persons who have voluntarily resigned from their latest position. 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.

PREREGISTRATION SECTION: Please check the function(s) for which you are preregistering:
Joint Meetings [ ] AMS Short Course [ ]

1) _____ Nickname for badge:_____
(Please print) Surname First Middle (optional)

2) _____
ADDRESS: Number and street City State Zipcode

3) _____
Address for confirmation of room reservation, if other than above

4) Employing institution_____ Emeritus member [ ] Unemployed [ ]

5) I am a student at_____ 6) Name of spouse_____ 7) Number of children_____
(List only if accompanying to meeting)

8) Member of AMS [ ] MAA [ ] IIME [ ] Nonmember [ ] (Member discount applies only to members of AMS, MAA, or IIME.) Member of other organizations: AWM [ ] NAM [ ]

9) Joint Meetings fee $_____ 10) AMS Short Course fee $_____

11) MAA 25-year Banquet ticket(s) _____@ $17.25_____(for those not on 3-meal plan)

12) MAA 25-year Banquet ticket(s) _____@ $12.75_____(for those on 3-meal plan)

13) FULL PAYMENT for residence hall accommodations enclosed $_____(Partial refund applies after July 25.)

14) TOTAL AMOUNT ENCLOSED FOR 9 through 13 $_____ (Make checks payable to AMS; Canadian checks must be marked "In U.S. Funds".) VISA or MasterCard credit cards may be submitted for payment.

Credit card type: VISA [ ] or MasterCard [ ] Card number_____Expiration date_____

_____
Signature (name as it appears on credit card)

[ ] PLEASE CHECK HERE IF YOU WILL NOT REQUIRE A ROOM.

Please be sure to complete the section on next page if you will require housing.

For office use only:

Codes:	Options:	Dates:	Residence Hall:	Rm. Type
				[ ]
Special:			Amt. pd:	CC[ ] Check

PREREGISTRATION AND HOUSING REQUEST FORM (continued)

(Please read sections on housing and room rates in meeting announcements.)

UNIVERSITY HOUSING SECTION: (Please complete Sections I through IV below.)

NOTE: Full prepayment for room and board is required as noted in Item 13 on the reverse. Please make checks payable to AMS. Canadian checks must be marked "In U.S. Funds". VISA and MasterCard credit cards will also be accepted.

I. Please reserve the following residence hall accommodations and send confirmation to me at address below:

ADULTS AND CHILDREN (other than those occupying a portacrib)

Rates include breakfast, lunch, and dinner.

	Singles - one person	Doubles - two persons
One day	$ 25.00 _____	$ 40.00 _____
Two days	$ 50.00 _____	$ 80.00 _____
Three days	$ 75.00 _____	$120.00 _____
Four days	$ 90.00 _____	$145.00 _____
Five days	$104.00 _____	$171.00 _____
Six days	$117.00 _____	$195.00 _____
Seven days	$130.00 _____	$219.00 _____

II. I will arrive on_____at_____a.m./p.m., and depart on_____at_____a.m./p.m.

I will share a double room with_____who will arrive on_____

at_____a.m./p.m., and depart on_____at_____a.m./p.m.

PLEASE LIST AGES OF ACCOMPANYING CHILDREN:_____

III. ADDRESS FOR CONFIRMATION OF ROOM RESERVATION:

_____

Telephone number:_____
(area code)

IV. TRAVEL INFORMATION:

[ ] I plan to arrive by plane on_____scheduled to arrive at_____
(airline flight and number)

airport on_____at_____a.m./p.m.
(date) (time)

[ ] I plan to drive to the meeting.

Note: This additional information is being requested in order to assist the university's housing office in planning for heavy arrival times.

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(Use your peel-off label from the *Notices*)

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